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У збірнику подано іноземними мовами результати наукових досліджень студентів, аспірантів та молодих науковців у різних галузях економіки, що можуть зацікавити світову наукову спільноту. Регулярні публікації робіт допоможуть виявити талановиту студентську молодь, здатну брати участь у міжнародному професійному, науковому та освітньому обміні та втілювати одержаний досвід у розвиток передових технологій.

Усі матеріали публікуються в авторській редакції.

ЗМІСТ

MACHINE BUILDING

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IMPROVEMENT OF TESTING LABORATORIES METROLOGICAL ASSURANCE

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The establishment and application of scientific and organizational foundations, technical tools, rules and regulations, necessary to achieve the unity and the required accuracy of measurements refer to the metrological assurance.

The transition to an advanced organizational level of testing requires the development of subsequent indicators and criteria for assessing the product quality, accordingly, and the development of up-to-date test methods, including their metrological assurance. The accuracy of measurement results in the state and their comparability is achieved by the state metrological assurance system. The basis of this system is the state reference base. The profile-testing laboratory contains sufficient information on the technological processes of testing, the laws of the technical development of products tested. Therefore, the laboratory can offer its approaches to each customer for evaluating the product quality, namely: what indicators should be measured, with what accuracy, what the accuracy and adequacy of the results obtained would be. All measurement methods used in testing laboratories involve three, and in some cases, five observations.

All test methods used by laboratories conducting automotive tests are standardized and their effectiveness is confirmed by the long period of time they are applied. In this regard, the test methods themselves contribute to the reasonable identification of all sources of uncertainty, and the calculation of such measurements uncertainty isn’t accompanied by complex mathematical operations.

In the context of metrological assurance of testing, the subject is the organizational and scientific basis of their conduct. Namely, depending on those norms, requirements and principles that will be laid at the organizational level, the object of metrological assurance of tests will be formed.

The main component of the object of metrological assurance of testing is the method, which presents a set of elements and specifically described operations, the performance of which will ensure the obtaining of results with established indicators of accuracy and uncertainty. Accordingly, the test method is also formed, taking into account both the achievements of science and the organization of testing.

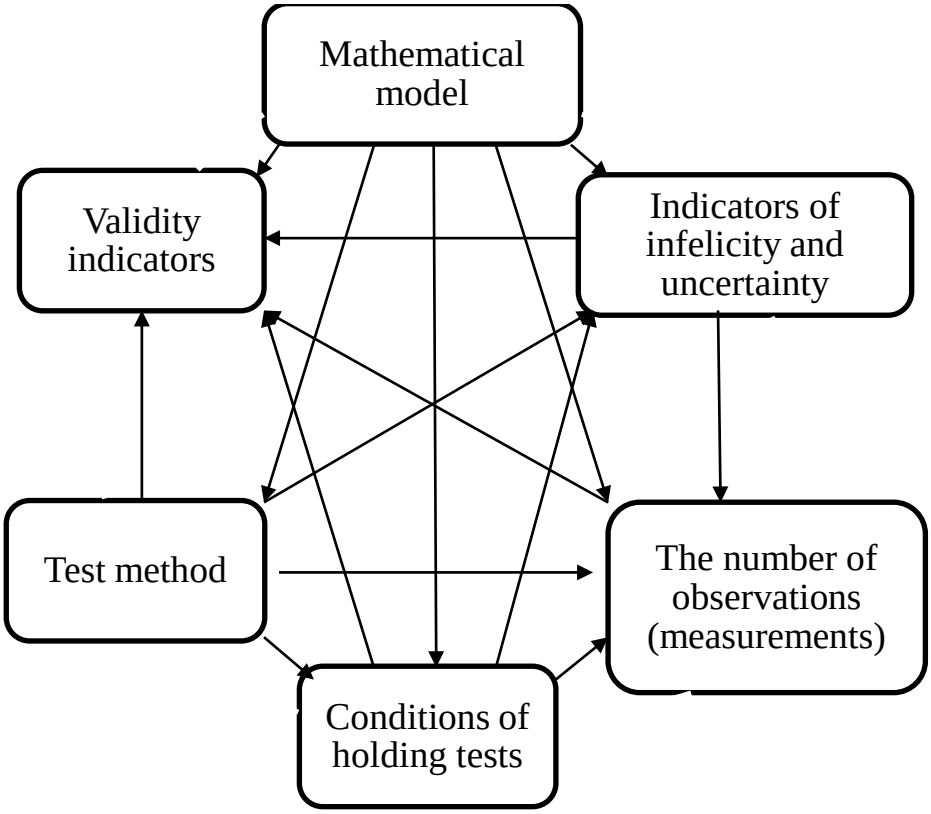
When developing new test methods, a comprehensive solution of a set of different tasks is required, including, in a general form, the operative analysis of information as well as the development and generation of control signals ensuring the formation of appropriate solutions [1]. The solution of these problems is possible only in the case of a systematic approach with the use of adaptive

management, which will allow solving problems, taking into account specific conditions.

The basis of the methodology required for the development of new test methods are the individual elements of the system and process approaches that contribute to the devising of an effective strategy needed for researching an object, as well as studying various interconnections and synthesizing an adequate test method model. The effectiveness of the developed test method is determined by the correctness of the choice of a set of concepts and their interconnections and mutual influence, which makes it possible to meet the objectives and attain the goal.

At almost every stage of the new test method development, the person carrying out this activity faces the problem of decision-making. An effective way of making a decision is the use of fuzzy cognitive models, which allow taking into account the fact that the interaction between the factors caused by different causal relationships may have a different intensity, and this intensity may change with time [2, 3]. The concept of a fuzzy cognitive card is introduced. The use of fuzzy cognitive models makes it possible to automate the solution of a number of complex formalizable tasks arising at various stages of the decision-making process.

A fuzzy cognitive map is conveniently represented in the form of a weighted oriented graph, the vertices of which (concepts) correspond to the objects of the set of model objects (concepts), and the arcs correspond to the causal relationships (Fig. 1).



Picture 1– Weighted and oriented Graph of controlling the process of the test method development

The end result (decision taken) is the value of the suitability method indicators and their compliance with the established requirements. Two factors will affect the validity indicators: a test method with appropriate conditions, error values and measurement uncertainties, as well as a mathematical test model characterizing the adequacy of the method to real conditions. The test method will affect the number of observations and, accordingly, the error and uncertainty of measurements conducted.

The classical approach to the systems management is based on the assumption that it is possible to obtain a complex, but precise analytically given form of the input and output signal functional dependence with subsequent coefficient refinement [4]. However, the scope of application of such control methods are relatively simple control objects. With a non-classical approach to control [5] and an insufficient number of known parameters, control is exercised according to the state of the system, which fully reflects its future behavior.

According to the above, the following conclusions can be drawn:

Metrological assurance of testing is a complex system with many inputs and outputs. A comprehensive solution of the metrological support problems is possible only with the application of a systematic approach, which will make it possible to solve the set tasks, taking into account specific conditions.

The transition from mandatory certification to the confirmation of compliance with the requirements of technical regulations necessitates a rethinking of approaches to the organization of tests, and entails the need to revise their metrological support. It is necessary to implement tests according to the indicators agreed with the customer. The metrological assurance of such tests should fully ensure their suitability.

To confirm the quality of new test methods, it is necessary to synthesize the industry quality assurance systems for conducting tests. Such systems will enable to carry out inter-laboratory comparative tests to contribute to the test methods improvement as well as their metrological support.

References

1. Деменков Н. П. Нечеткое управление в технических системах. Учебное пособие. – М. : Изд-во. МГТУ им. Н. Э. Баумана, 2005. – 200 с.

2. Авдеева З. К., Коврига С. В., Макаренко Д.И. Когнитивное моделирование для решения задач управления слабоструктурированными системами (ситуациями) // Когнитивный анализ и управление развитием ситуаций : Труды 6-й Международной конференции / под ред. З. К. Авдеевой, С. В. Ковриги. М. : Институт проблем управления РАН, 2006. С. 41-54.

3. Максимов В. И., Корноушенко Е. К. Аналитические основы применения когнитивного подхода при решении слабоструктурированных задач // Труды ИПУ РАН : Сб. науч. тр. – М. : ИПУ РАН, 1999. – Т.2. – С. 95-109.

4. Кузнецов Е. С. Управление техническими системами. Учебное пособие / Е. С. Кузнецов. − М. : Изд-во. МАДИ (ГТУ), 2003. − 345 с.

5. Варжапетян А. Г. Квалиметрия : учеб. Пособие / А. Г. Варжапетян. – СПб. : СПбГУАП, 2005. – 176 с.

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DIAGNOSTICS AND BASIC FAULTS OF STEERING CONTROL

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Malfunctions of the steering system create a serious threat to traffic safety and complicate driving. The main signs of steering control failures are as follows: increased free wheel steering, tight rotation or jamming in the steering mechanism, knock and impermeability, insufficient or uneven tightening, and so on.

Increased free running of the steering wheel appears when wearing the hinges of the steering legs, violation of the regulation of the worm with the roller, worn worm bearings, the weakening of the crankcase of the steering mechanism, the increase in clearance in the bearings of the mats of the front wheels and shaft. These malfunctions are eliminated by the execution of adjusting works, replacement or repair of worn parts.

Toughening of rotation or jamming in the steering mechanism is due to incorrect adjustment of the clutch in the gearbox of the steering mechanism, the bending of the rods, the lack of lubrication in the gearbox crankcase. These malfunctions can be eliminated by adjusting, repairing the traction, filling the oil in the gearbox of the steering mechanism to the required level. Violations of tightness in the steering mechanism are eliminated by replacing the gaskets and tightening fasteners and joints.

Inadequate or uneven gain in the steering mechanism with the hydraulic booster can be due to the weak tension of the belt drive pump, reducing the oil level in the tank, the air entrapment in the system, plugging the spool or the flow valve when contaminated. After detecting the causes of malfunctions, they are eliminated by adjusting the tension of the drive belt, adding oil to a predetermined level, washing the system and replacing the oil, repairing the pump, the hydraulic booster or control valve. All work on determining the causes of malfunctions of steering control is performed during diagnostics and maintenance, and troubleshooting is done at TP.

Steering control diagnostics allows evaluating the state of the steering mechanism and steering drive without disassembling its units. It includes work on determining the free play of the steering wheel, the total frictional force, backlash in the hinges of the steering legs. The free running of the steering wheel and the friction force are determined by the universal device model NIIAT DRO-402. The device consists of a fluorescent lamp and a two-axis dynamometer. Endfloatmeter consists of a scale fixed on the dynamometer, and an arrow pointing rigidly fixed to the steering column by clamps. The dynamometer clamps to the steering wheel. The dynamometer scales are located on the handle and provide a countdown of force applied to the steering wheel in the ranges up to 20 N and 20 to 120 N.

When measuring the steering wheel's rear wheel through the handle, you should apply an effort of 10 N, which initially acts to the right, and then to the left. Moving the arrow from the zero position to the left and right extreme positions will indicate the amount of wheel clearance. For vehicles with transverse non-splitting traction, the left front wheel must be hanged at the time of measurement. In cars with a power amplifier the lethal is determined at the engine running (at low revolutions).

The overall force of friction in the steering control is checked with fully hung front wheels applying force to the handle of the dynamometer. The measurements are performed at the straight-line position of the wheels and in positions of maximum turning them to the right and to the left. In a properly adjusted steering mechanism, the steering wheel must be freely rotated from the average position for straight line travel at an effort (8-16) N.

An assessment of the condition of the joints of the steering legs is conducted visually or by touch at the moment of a sharp application of the force to the steering wheel. At the same time, the clearance in the hinges will be manifested by the relative displacement of the connected parts.

Checking of the steering amplifier is reduced to the measurement of pressure in the system of the hydraulic booster. To do this, a pressure gauge with a tap shall be installed in the discharge line. The oil is poured into the tank to the required level, the engine is let in small turns, and, having opened the crane completely, the wheels are turned to the extreme positions. At the same time, the pressure developing by the pump should not be less than 6 MPa. If the pressure is less than the specified value, slowly close the valve, observing the pressure gauge at an increase in pressure, which must rise to 6.5 MPa. If the pressure does not increase, this indicates a pump malfunction. The defective pump is removed from the car and repaired.

References

1. Біліченко В.В. Основи технічної діагностики колісних транспортних засобів : Навчальний посібник. – Вінниця: ВНТУ, 2012р. 120 с.

2. Загальні принципи діагностування електронних систем керування автомобіля**.** За ред. Копитчука М.Б.О.: Наука і Техніка, 2012. 392с.

3. Кузнецов Е.С. Управление технической эксплуатацией автомобилей. М.: Транспорт, 1990. - 272 с.

4. Лудченко О.А. Технічне обслуговування і ремонт автомобілів. К: "Знання-Прес", 2003 р.

5. Основи технічного обслуговування і ремонту автомобілів. У 3 кн. Кн.1. Теоретичні основи. Технологія.- К.:Вища шк., 1994. - 342с.

6. Техническая эксплуатация автомобилей (под ред. Крамаренко Н.В.). – М.: Транспорт, 1985.– 488 с.

7. Техническое обслуживание, ремонт и хранение автотранспортных средств/ Кн. 1 – Канарчук В.Е., Лудченко А.А., Курников И.П., Луйк И.А., - К. : Вища школа , 1991. 311с..

8. Технічна експлуатація та надійність автомобілів: Навчальний посібник / [Форнальчик Є.Ю., Оліскевич і ін.]. Л., Афіша, 2004. 492с.

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RISE AND DEVELOPMENT OF MECHANICAL ENGINEERING

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This work is devoted to mechanical engineering, its inception and evolving.

Mechanical engineering arose during the industrial revolution in Europe in the 18th century. It is one of the oldest and broadest of engineering disciplines.

Machine-building is associated with the construction of aviation and space technology, metallurgy, construction machinery, process equipment and machine tools, equipment for oil, petrochemical, chemical industries and other industries.

The industrial revolution of the 18th century led to the invention of a spinning machine, a loom, a steam engine, a universal engine, and other machines. This led to the need to "create machines for the production of machines" and initiated the emergence of machine tools as a separate branch of mechanical engineering, providing the production of machines and engines needed to bring them into action.

The application of mechanical engineering can be seen in the archives of various ancient and medieval societies. In ancient Greece, the works of Archimedes influenced mechanics in the Western tradition and Heron of Alexandria created the first steam engine (Aeolipile).

In China, Zhang Heng improved a water clock and invented a seismometer, and Ma Jun invented a chariot with differential gears. The medieval Chinese horologist and engineer Su Song incorporated an escapement mechanism into his astronomical clock tower. Two centuries before escapement devices were found in medieval European clocks. He also invented the world's first known endless power-transmitting chain drive. During the Islamic Golden Age, Muslim inventors made remarkable contributions in the field of mechanical technology. Al-Jazari, who was one of them, wrote his famous Book of Knowledge of Ingenious Mechanical Devices in 1206 and presented many mechanical designs. He is also considered to be the inventor of such mechanical devices which now form the very basic of mechanisms, such as the crankshaft and camshaft. An invaluable contribution to the development of mechanical engineering, as the field of knowledge, the type of engineering activities and designing machines was made by the most outstanding scholar, thinker, writer, artist, anatomist, architect, inventor and engineer of the Renaissance Revolution – Leonardo da Vinci. His inventions and brilliant constructive predictions have far ahead of the era. These include sketches of foundry furnace projects, rolling mill, weaving, woodworking, and printing machines, submarines, a tank, a series of gliders, a parachute, and others.

A machine is a mechanism or a combination of mechanisms that carry out controlled movements in order to eliminate work or energy. All machines can be divided into two groups: machine -engines and machine -tools. Depending on the function the machines are divided into means of production, consumer goods, defense. Engines transform one kind of energy into another. Machine tools (working machines) affect the subject, make a change in the shape, properties and quality of the subject. In turn, working machines are divided into technological, used in technological processes (foundry, welding, metal cutting, woodworking, agriculture, etc.), transport (diesel locomotives, tractors, cars, airplanes, etc.), transportation (cranes, conveyors, escalators, etc.).

Each working machine has three main mechanisms: motor, transmitting and executive. Machine-building provides all branches of economy by means of labor and is the main consumer of metal, plastics, and also uses products of wood-working, light, glass and other industries. In machine building, the widely developed specialization and cooperation of enterprises, which significantly affect its placement.

For all machine-building enterprises there is a presence of procurement industries (receipt of castings, stamps, separate parts and other components), harvesting, where from the obtained parts the finished product of auxiliary productions is collected, which includes instrumental, repair-mechanical, model, power, containers, transport and other shops. Auxiliary workshops ensure the proper operation of the main workshops, providing them with tools, containers, energy, timely repair of equipment. Separate workshops within the company may be absent if the plant, cooperating with other enterprises, receives containers.

Depending on the quantity of manufactured products, all production is divided into three types: unitary, serial and mass. In single production, the product is manufactured in one single copy. Serial production deals with the manufacture of products in batches or series, which are the same in size and design. Mass production is called the one in which, with a large number of identical products, their production is continuous.

Machines and mechanisms consist of interconnected simple parts – components (the plane consists of more than 100 thousand parts). The details differ in shape, size, material and purpose. Each item is subject to reliability and durability. By its purpose, the parts of the machines are divided into cases, parts for the transfer of motion and fastening. The first ones are frames, racks, stands, boxes, etc., details of the second group are shafts, axles, gears, rods, etc., and fastening parts are bolts, nuts, screws, etc.

Nowadays mechanical engineering is one of the most important engineering disciplines. It’s a very difficult, important and responsible discipline. A lot of people cannot imagine their lives without car. A lot of people lose their jobs without this discipline.

References

1. Руденко П. О. Проектування технологічних процесів у машинобудуванні. Київ, 1993. 414 с.

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THE PECULIARITIES OF WINTER TIRES

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Evolution of winter tires. The first winter tires used for road cars were applied during the mid-1930's. The difference between such tires and summer tires was the enlargement of the grooves. Deeper lateral groves gave better traction as it allowed the tread blocks to dig deeper into the snow-covered roads. In 1961 the first tires with metal studs were introduced. The studs help the tire gaining grip on hard packed snow and ice as the studs' claws into the ice and increases friction. The focus of the last 50 years has been on improving traction by optimizing rubber compositions and treading. This can be done by changing such parameters like elasticity, hardness; adding of studs as well as modifying treads pattern design. In summary, there have been only three major innovations to improve the winter tires since their introduction 80 years ago; changing the treading, adding metal studs and optimizing rubber composition. In recent years the government and manufacturers have been looking towards stud-free winter tires due to environmental benefits. By now removing one of the three breakthroughs in the evolution of winter tires, there is a limit on how much you can improve today's pneumatic winter tires without thinking in new directions.

Common definition of grip. Before looking in depth at the tire, we explain how the common perception of grip is. To explain what grip is we look at what situations, and how the term is being used in everyday situations. The general perception of having good grip, is when two objects with forces parallel to their contact area, don't move relative to each other. In other words, grip is the force or contact that gives us the ability to stay in contact with surfaces without slipping, referred to as frictional force. We differentiate grip in three categories; no grip, sliding, and sticking. No grip means no resistance against movement through zero frictional force. In real life, it is impossible to achieve as there will always be some energy transfer between moving objects, often in form of heat accumulation. Sliding friction is having a sliding motion but with friction working against the direction of travel. This friction force will limit the velocity by transferring the kinetic energy into potential energy, in form of heating generation on the contact surface and the object. Sticking grip is where you have enough frictional force to prevent any movement between the two objects. This means, from a stationary position that the frictional force is greater than the force trying to move the object.

We can use an example with pushing a box, to illustrate grip and its physics better. The box has sticking grip when it can't be pushed, and has limited or loss of grip when it can be moved by pushing or pulling. We can now have a closer look at what causes the box to be able to move. The reason for this to happen is that the pushing force exceeds friction force between the box and the ground. This friction force is the two surfaces resistance for relative motion, which can be in form of rolling or in this case sliding. By having high friction, high resistance against sliding, we have good grip. In figure 1 the friction force (R) exceeds the pulling force (F) and hence, the box would not move.

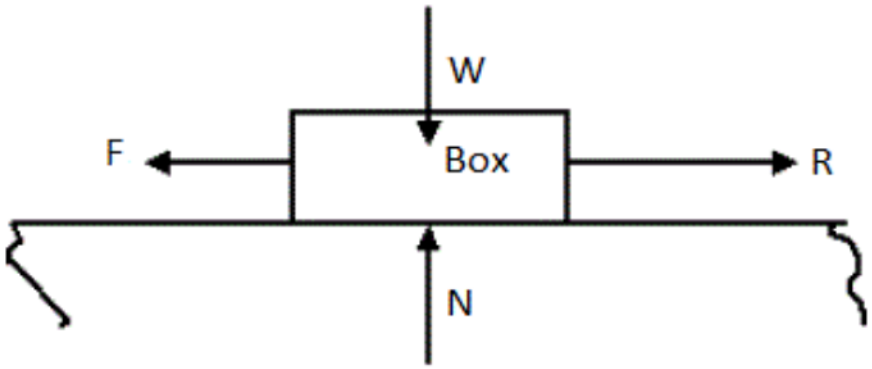

Figure 1. – Friction force on a box with applied force

There are two factors that change the level of friction; surface friction coefficient and normal force (N).

This is seen in the friction formula (1) $f\ Friction{=}\mu\ Friction\ coefficient{\cdot}NNormal\ force$

The surface friction coefficient is the surfaces gripping ability against each other. For example, a soft rubber piece has a higher friction coefficient against a metal plate than a metal on metal contact has. To implement this in the example with the box, we would have a higher friction coefficient if the contact surface is dry, compared to a lower friction coefficient if it was covered in grease or another slippery fluid. The other parameter for increasing grip is increasing the normal force (N). the normal force is counteracting the weight of the box. If the object sits on a level surface, the normal force would be equal to the weight working perpendicular to the objects contact area. If a force applied on the side of the box is making it move, you can apply a higher normal force by adding more weight to the box. By doing this you increase the friction force between the box and the ground, and again, by increasing the friction force we increase the boxes' resistance for relative motion. In this thesis however, the objective is not to improve grip by increasing the weight of the car or change the materials. As $\mu\ Friction\ coefficient$ is a function of pressure, having a pressure concentration will lead to a higher $\mu\ Friction\ coefficient$. The aim of the work is thus to increase the value of $\mu\ Friction\ coefficient$, by having a more concentrated pressure on the pressure profile between the two objects. In this case the pneumatic model pressing on the ground compared to the airless model pressing on the ground with equal force.

Winter's effect on driving physics. Winter conditions make the challenges of driving significantly harder and more unpredictable. Although there are less fatalities from traffic accidents during the winter compared to the summer months, there are a higher total number of accidents during winter, like low velocity collisions. The loss of friction between the road surface and tire reduces the grip of the car. This weakens the car's ability to accelerate, meaning a change of velocity in any direction such as turning, braking and accelerating forward. There are other characters of winter effects that causes loss of friction, like the added danger of hydroplaning or the temperature's effect on the rubber behaviour.

Studs damaging the roads. Implementation of studs in the winter tires helps improve traction. This is true as the metal studs have a high-pressure concentration due to its small surface area, making it able to penetrate the ice surface. While the implementation of studs is a great way to improve the friction between the tire and the icy road surface, it has its drawbacks. The government and environmentalists advise us to choose stud-free winter tires as the negative effects of studs are more known and gaining more attention today.

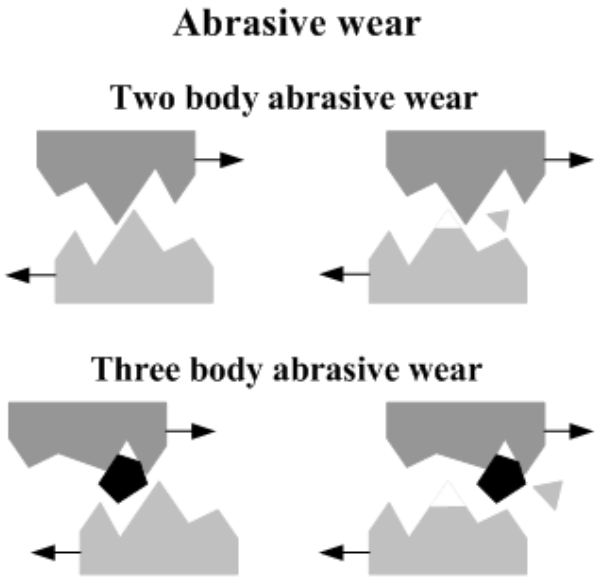

Figure 2.– Illustration of abrasive wear

Environmentalists worries about the increase of particulate matter, polluting the air we are breathing in, which is especially bothersome for asthmatics. The reason for increased pollution with studs is due to the increase the abrasive wear on the roads (figure 2). The studs are carving of small particles of the asphalt, which are mixed in with the air we breathe in. This will of course happen without the studs as well, but the amount of particulate matter pollution increases as the studs provides more abrasive wear than stud-less tires. The government is, in addition to people's health, interested in the way studded tires impose a threat to the condition of the road. As the season changes and temperatures vary, the ice is being melted or scraped off the road surface by the many vehicles driving. This in addition to the increasing use of road salt, which reduces the ice accumulation on the roads, leaves the asphalt exposed to the studded tires which erode the asphalt. This has brought an increase on the expenses of road maintenance as it is forcing shorter maintenance intervals due to the increased wear. These are some of the motivators for going away from studded tires, and a part of this thesis's motivation for improving the non-studded tires effectiveness.

Carcass: The carcass is made with strong textile fiber cords implemented in a rubber housing which objective is to maintain the tire's shape under internal pressure. This ensures that the tire won't bulge out when inflating it.

Beads: The beads are steel wires included in the part of the tire sidewall in contact with the rim. The purpose of the wires is to ensure an airtight contact so the tire pressure won't drop due to an air leakage between the tire and the rim. These wires are strong. A set of wires included in the tire can in some tires withstand ten times the weight of the car.

Sidewalls: The sidewall is where the logo of the manufacturer and the details about the tire and its production is printed. The details are preferably; dimensions of the tire, speed rating, preferred rolling direction and the month and year of when it was produced.

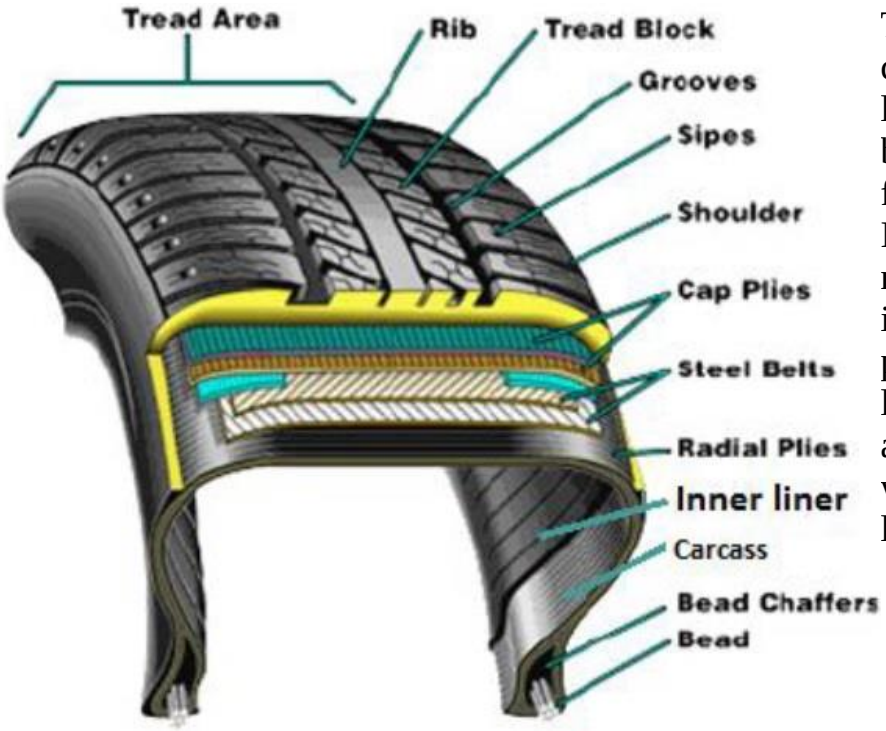

Figure 3.– A tire's anatomy

Tire components The components of the tire listed below can be also be seen graphically in figure 3.

Inner liner: The first material from the inside is a synthetic rubber providing an air tight layer. This is to prevent any leakage of air which would lead to a pressure loss inside the tire.

Steel belts: Steel belts are bounded into the rubber providing strength. This makes the tire's ability to handle the strain from turning and preventing the tire to expand from the centrifugal force caused by fast rotation.

Cap plies: The cap plies are rubber layers with integrated nylon that stretches around the circumference of the tire, located between the steel belts and the treading. This layer both adds resistance against expansion and reduce heating induced by friction.

Tread: The tread is the part of the tire in contact with the road and is the visible part of the tire. This is the part of the tire that in the highest degree determines quality and characteristics of the tire performance. The objective of the tread is to provide grip against the road surface while providing a low level of abrasion and heat generation. Each manufactory uses their own material composition and tread pattern that based on what their calculations and testing says is the best solution for given conditions. More on the treading and material in chapter 2.1.3 – "Winter tire VS summer tire". Grooves are the cuts in the tread making the tread patterns. The treading is responsible for road noise mitigation, water diverting, and to provide a large contact area with a correct frictional coefficient to provide sufficient grip in given temperatures and conditions.

References

1. BPEARSON, "Cenco Physics," 2010. [Online]. Available: http://blog.cencophysics.com/2010/02/coefficient-of-friction/. [Accessed 15 December 2016].

2. Noikan Tyres, "Noikan Tyres," 2016. [Online]. Available: https://www.nokiantyres.com/company/about-us/history/. [Accessed 2 December 2016].

3. The engineering toolbox, "The engineering toolbox," [Online]. Available: http://www.engineeringtoolbox.com/friction-coefficients-d_778.html. [Accessed 10 December 2016].

4. Statens Vegvesen, "Vegvesen.no," 2015. [Online]. Available: http://www.vegvesen.no/_attachment/1159148/binary/1086284?fast_title=Drepte+i+vegtrafikken+-+%C3%85rsrapport+2015.pdf. [Accessed 20 November 2016].

5. P. B. B. B. A.-C. O. a. B. F. Hanne Krage Carlsen, "PMC - US national library of medicine, national institute of health," 2016. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4924078/. [Accessed 1 Desember 2016].

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DEVELOPMENT OF REMOTE CONTROL OF THE CAR

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This article is devoted to the study of the car navigation process in Autonomous mode.

Currently, various Autonomous vehicles and mobile robots are widely used in almost all areas of human activity. They are able to function in difficult and extreme conditions, to perform work in dangerous places, as well as monotonous and routine operations, to work successfully in industries where the price of a human error is high.

Robots are classified according to different indicators:

- by application: transport, industrial, military, experienced, medical, etc.;
- operating conditions: ground, underground, surface, underwater, air, space;
- the degree of mobility: mobile or stationary.

In this research we developed the principles of construction of mobile transport robots on the example of a car moving without a driver with the help of the operator's commands which is at some distance from the controlled automobile. This is necessary to achieve the main goal of the study – to improve the quality and safety of road traffic by creating a remote control system of a passenger car. The conducted research can be extended to other types of mobile ground robots.

Mobile ground robots are designer to perform actions in natural environments in the zone: reconnaissance, patrolling and demining, military operations (including cases of radioactive, chemical and bacteriological contamination of the terrain), performing tasks on the surface of other planets. With the destruction of man-made environments mobile ground robots are able to carry out rescue operations in the destroyed structures, to clear debris, exploration and fighting in urban environments.

A modern intelligent car can be equipped with the following electrical and electronic equipment: an on-Board computer, various sensors, an actuator, a radar, a lidar, GPS system, satellite antennas, various systems of active and passive safety.

A built-in on-Board computer is responsible for processing data received from sensors and various vehicle systems designed for wireless communication with cloud services and road infrastructure. The interaction between the vehicles is due to the establishment of contact through communication with the cloud, or through the use of channels and communication protocols at close range. In a case of theft of the car the owner gets a unique opportunity of full remote monitoring of the location of the car, using GPS, built-in on-Board cameras and cameras of external inspection of the car, as well as by receiving on a mobile phone or other device SMS, e-mail or other type of messages with data on the last recorded in the system of the location of a car with special services of road control, the police will be sent a signal of unauthorized access to a car, the transmitted coordinates and parameters of a car.

The British automobile company Jaguar Cars Ltd, specializing in the production of luxury limousines, sports coupes and racing cars for the competition series GT-2 and Le Mans Jaguar Cars Ltd has developed a system of remote control of the car using a smartphone, which is implemented on cars Jaguar Land Rover.

Car company Jaguar Cars Ltd has demonstrated two new promising technologies that can be implemented in the future in cars Jaguar Land Rover with autopilot:

- Remote Control Range Rover Sport system;
- Multi-Point Turn system.

System Remote Control Range Rover Sport is implemented on the crossover premium Range Rover Sport. This system allows remote control of a car using a special mobile application for a smartphone or PC. It is reported that by means of a portable gadget the owner of a car, being outside, is free to control the accelerator, brakes and steering wheel. The maximum speed in this care is limited to 6 km/h. Moreover, a crossover will automatically stop if a motorist has moved away from the vehicle for a distance of more than 10 meters or it is not possible to identify the smart ignition key.

Remote control system will come in handy when riding in rough terrain, when overcoming obstacles need oversight of a vehicle from the side. In addition, the complex will help with Parking in a limited space. The second developed system remote control car has a Multi-Point Turn. It allows a car to turn on 180 degrees, to move in the opposite direction.

Among the manufacturers that has developed technologies for Autonomous control of cars: BMW, Ford, General Motors, Honda, Hyundai, Mercedes, Nissan, Toyota, Volkswagen, Volvo and others. So, there included 22 unmanned electric vehicles that deliver passengers from the terminal to the Parking lot at London Heathrow airport. Run these electric vehicles move along specially designated lanes, which virtually eliminate the possibility of an accident.

The development of automatic motion control of a mobile robot is a complex and important theoretical and practical task, which requires the simultaneous solution of several essential aspects: the possibility of observing the environment

with the help of a machine vision system; the need to determine spatial orientation; assessment of instability of frequency of the onboard time standard for the possibility of greater coherence of all actions of the controlled object; the formation of its trajectory in space. The electric, electronic and computer equipment of the modern car makes it an increasingly highly intelligent robot, intelligently interacting with the environment with sensors and actuators in its precise positioning in space through positioning and navigation channels.

As a result of this research the analysis of existing methods and means of remote control systems of the car is done various machine vision systems that can be used on Autonomous vehicles are analyzed, methods of control Autonomous robotic vehicle are considered.

References

1. Бесекерский В. А. Теория систем автоматического управления / Спб.: Профессия, 2003. 752 с.
2. Современные системы управления / Р. Дорф, Р. Бишоп. Пер. с англ. Б. И. Копылова. – М.: Лаборатория базовых знаний, 2002. 832 с.
3. Организация группового управления мобильными роботами для задач специальной робототехники. “Научно-технические ведомости СПбГПУ / Информатика, телекоммуникации, управление / Робототехника и мехатроника”, И. А. Васильев, С. А. Половко, Е. Ю. Смирнова 2013, №1, с. 119-123.

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PECULIARITIES OF MAINTENANCE OF CARS WITH HYBRID ENGINES

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Electric and hybrid cars have been under some hard scrutiny since their introduction to the market several years ago. Some of the claims critics have made against hybrids and electrics deal with parts and maintenance. It is true that these cars require some special care, but for the most part, naysayers have met their match with reliable vehicles that can go many years without needing any serious maintenance.

Since hybrids have the components of a regular gas engine along with their electric aspects, they do require the same routine maintenance as any other gas vehicle. This includes the changing of air filters and oil. However, the oil does not need to be changed in a hybrid at the same interval as its pure gas counterpart. This is because the electric side of the car takes some of the load off of the engine. Therefore, the car can go between 5,000 and 10,000 miles between oil changes. The air filter for hybrid cars typically needs to be changed approximately every 40,000 miles. Like the oil, brake pads of a hybrid car need to be changed less

frequently. This is because of the regenerative braking properties of these cars. All other engine maintenance is much like that for any other car.

One of the biggest attacks made on hybrids has to do with battery life. It is said that the battery life is very short, and if something were to happen to it, it is very expensive to replace. Contrary to popular belief, hybrid car makers usually guarantee their batteries for at least eight years or 80,000 miles, and in the states that adhere to California's Partial Zero Emissions Vehicles Act, those statistics are 10 years or 150,000 miles. One of the keys to keeping a battery in good repair is to keep the battery charged between 40 to 60 percent. This way, the battery is never completely drained or charged, increasing its life.

The battery and other elements of the hybrid car engine that allow the transfer of power between the gas engine and the electric battery can be expensive to fix or replace in cases where damage or a defect arises. In these cases, owners should check for any service bulletins released by the carmaker to determine if a particular repair is covered by a general recall or service issue identified by a lot of owners. Owners should also take the time to report any regular concerns or repairs (aside from routine ones, such as oil changes) in order for the carmaker to document any patterns or trends.

The hybrid design combines a high-efficiency gas motor with an electric motor on the same drive train. Independently, electric drive and gasoline drive vehicles have a range of advantages and disadvantages. By combining both of these in one package, a hybrid vehicle is able to garner the benefits of each option. The gasoline motor is just as functional as in a normal vehicle and runs like the engine in any comparable conventional car. Hybrid cars are often able to use motors with a smaller displacement (engine size) than a conventional car, because of the addition of the electric drive system. The electric motor can function as a "helper" to the gas motor; when the vehicle needs extra power the electric motor activates and helps drive the car.

A gasoline car actually wastes a good deal of energy when operating under normal conditions. What the hybrid system does is harvest the power that is usually lost and stored it in the form of electricity. The batteries in a hybrid act like an extra gas tank that is able to fill and refill itself while the car is operating. Every car generates electricity to work, but most of that energy is wasted. The hybrid car stores that energy to be used later. The hybrid's electric motor not only assists the gas motor with acceleration and power, but it can also function independently.

The hybrid can operate on gas alone, which means the car has two “gas tanks”, the batteries that power the electric drive system, and the conventional gas that fuels the gasoline engine. Hybrids are also able to save power other ways by using systems like regenerative braking. This is one of the reasons that hybrids are able to achieve such excellent gas mileage in city driving conditions. Regenerative braking systems harvest the energy that it takes to stop the car once it is moving. In a normal car all this energy is wasted as heat, but in a hybrid it is stored in the battery as power for the electric drive system.

Diagnosing problems with a hybrid car is no different than diagnosing problems with a traditional internal combustion vehicle.

The best way to diagnose any potential problems with your hybrid car is to listen to it. When starting it up, is there coughing or sputtering or weird noises? These could be signs of issues with the ignition or combustion or some other engine problem that needs to be addressed by a mechanic.

Without fail, you should take your hybrid car to a mechanic for regular, routine check-ups. This will allow your mechanic to maintain a schedule of what repairs have been done as well as note any changes or situations that arise.

If you need to have preventative maintenance of a hybrid specific kind performed on your vehicle, you should consider taking your vehicle to the dealership where you purchased it. Although the dealership may be a bit more expensive than other service centres, you'll be assured that the mechanic or technician has adequate experience working on hybrid cars. Taking it to a less experienced mechanic may wind up costing you more in the long run.

References

1. Alliance Bernstein. The Emergence of Hybrid Vehicles: Ending Oil's Stranglehold on Transportation and the Economy, June 2006. Calcars.org
2. Hybrid Cars. (2006). Retrieved December 9, 2009 from Hybrid Battery Toxicity, Hybridcars.com
3. Lewis Tim (2013-03-23). Peugeot's Hybrid Air: the car of the future that runs on air. *The Observer*.

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THE USE OF BRIDGE CRANES IN DIFFERENT INDUSTRIES AND THEIR CALCULATIONS FOR CONSTRUCTION

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In Ukraine, the bridge cranes are used in almost every industry sector. The simplicity of operation, ease of installation and maintenance, affordable price make the double-girder bridge crane an invariably demanded attribute of complex mechanization: in logistics centers, in warehouses, in machine-building workshops, at enterprises of military-industrial complexes, in mining complexes, in the shops of metallurgical complexes, on heat and hydroelectric power stations, at the enterprises of automobile and aircraft construction, at concrete product plants, etc [2].

Bridge crane is designed to perform loading and unloading works. It moves along railways, located at a considerable height from the floor. The bridge crane consists of a lifting trolley, which includes a lifting mechanism, a load-carrying device, a movement mechanism, and a bridge, which is a two solid (or lattice) truss, attached to the end girders, into which the drive and non-drive wheels are mounted. The movement mechanism of the bridge is driven from one or two engines.

The bridge cranes with electric drive came into common use in industry. These cranes are called bridge ones because their load-bearing structures are made in the form of a bridge over the span of a shop [3]. A bridge crane is a lifting crane, which is moved by rails on fixed supports. The bridge crane has a wide scope of application. It is intended for lifting and moving the load indoors or under the roof (Fig. 1).

Fig. 1. Bridge crane

According to DSTU 2986: bridge crane is a crane, the load-bearing structural elements of which bear directly on the under-crane track; bridge is a load-bearing structure of the cranes of bridge type, designed for the movement of the load trolley along it; top-running crane is a bridge crane, which bears on the above-ground crane track; under-running crane is a bridge crane, suspended to the lower flanges of the under-crane track.

There are also models of bridge cranes, which are used in the open areas, in the open sites of factories, storage terminals, etc. The bridge crane can be of one-girder type (the so-called “crane-beam”) and of double-girder type. The double-girder bridge crane is used in the most difficult operation conditions. The double-girder bridge crane has higher movement speed with less lifting capacity.

The bridge crane is also divided into an under-running crane (an under-running crane girder) and a top-running crane (a top-running crane girder). According to the type of drive, there are the electric bridge crane (with electric drive) and the manually operated bridge crane with a mechanical drive, i.e. lifting the load and moving the crane are carried out with the help of physical effort of a person.

The bridge cranes on stationary legs (trestles) are used only at the base deports for unloading and loading. They are sometimes also used for mounting heavy machines or other equipment [4]. The one-girder (Fig. 2) and double-girder bridge cranes (Fig. 3) are divided by the number of girders used in their design. The base of the one-girder bridge cranes is a girder, both ends of which lie on the wheels. Accordingly, the double-girder cranes have two parallel girders in their design.

Fig. 2. One-girder bridge crane

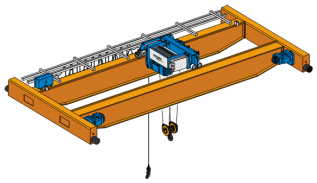

Fig. 3. Double-girder bridge crane

The electric (Fig. 4) and manually operated (Fig. 5) bridge cranes are divided by the type of equipment for mechanization and the way of operation. The use of electric bridge cranes is not allowed in factories and workshops with an aggressive environment that can damage the insulation.

Fig. 4. Electric bridge crane

Fig. 5. Manually operated bridge crane

Grab cranes are used for moving bulky goods (Fig. 6). Magnetic cranes are used for transportation of products made of ferrous metals (Fig. 7). Hook cranes are widely used in construction work (Fig. 8).

Fig. 6. Grab crane

Fig. 7. Magnetic crane

Fig. 8. Hook crane

1. CALCULATION OF THE LIFTING MECHANISM

Calculation of the rope

$$d = C\sqrt{S} = 0{,}101 \cdot \sqrt{43148{,}5} = 21 мм$$

$$C = \sqrt{\frac{Z_p}{K`} \cdot \frac{1}{R_0}} = \sqrt{\frac{5{,}6}{0{,}33 \cdot 1666}} = 0{,}101$$

2. CALCULATION OF THE MECHANISM OF TROLLEY MOVEMENT

Selection and calculation of running wheels

$$F_C = \frac{G_T + Q}{4} = \frac{120000 + 330000}{4} = 112500 H$$

3. CALCULATION OF THE MECHANISM OF CRANE MOVEMENT

The resistance of movement of the crane with the nominal load due the frictional forces of the tilt of the track is determined by the formula [1].

$$W = (Q + G_K) \cdot \left(\frac{fd_Ц + 2\mu}{D_{X.K}} k_p + \alpha \right)$$

4. CALCULATION OF THE MAIN GIRDER

Loads and their combination

$$G_Б + G_T + \psi Q.$$
$$K\left(G_Б + G_T + Q\right) + 2\left(q' + P'\right).$$

References

1. Петренко Н. О., Григоров О. В. Розрахунок мостового електричного крана : методичні вказівки. Харків, 2005. 63 с.

2. Мостовой кран (тип). URL: https://ru.wikipedia.org/wiki/Мостовой_кран_(тип).

3. Расчет металлоконструкции крана. URL: http://refleader.ru/jgepolbewbewmer.html.

4. Расчет механизмов мостового крана. URL: https://knowledge.allbest.ru/manufacture/3c0a65625b3ad78a4d43a88521306c26_0.html.

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INCREASING THE POWER AND TORQUE OF AN ENGINE

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The task of increasing the power and torque of the engine was always relevant. The easiest solution is to increase the working volume: the more burning the fuel, the higher the power. However, in this case, the dimensions and weight of the structure are significantly increased.

An alternative approach is to leave the engine's previous working volume, but to supply more fuel per unit time. Increasing gasoline supply is not easy, especially in injection systems. But in order to maintain the composition of the fuel mixture must be proportionally increased and the amount fed into the engine air. The ability of the engine to self-absorb air is limited, so you can not do without a special device that increases the pressure and, consequently, the amount of air on the inlet. These devices are commonly referred to as superchargers or compressors.

There are several supercharging systems. In the first place, they should include the most common form - turbocharged - supercharged by the use of energy from exhaust gases. This type of boost is discussed in more detail below.

The modern implementation of the design of the cam supercharger looks such that the supercharger has several rotors. These rotors can have three or four cams and turn towards each other.

Cams are arranged so that they are in a spiral and placed along the entire length of the rotor. The twist angle of these cams is chosen precisely to ensure the best efficiency of air injection while taking into account the resulting losses. In its general design, as well as on the principle of action, such a cam supercharger resembles a gear oil pump, which is installed in the system of lubrication of internal combustion engines.

The air in the compressor is carried away by the cams on the rotor, moves in the intercooler space and the space between the walls of the body of the device, compresses, and then the injection is applied to the inlet. This principle of work is called external pressure.

Superchargers of the type Roots are characterized by the fact that they quickly create the required pressure boost pressure. It is also noted the growth of the specified pressure in parallel with the increase in the rotational speed of the crankshaft of the power plant of the car. In some cases, the compressor can create a pressure that exceeds the required pressure. The result will be air cork in the discharge channel and the drop in effective pressure of the supercharger, which leads to a general decrease in the final power of the power unit in different modes of its operation.

In order to avoid such negative consequences, using mechanical compressors of different types necessarily implemented additional control and regulation of pressure of the boost. Pressure boost is regulated in two ways:

1) The first method can be to adjust the pressure by shutting down the supercharger. Most often such a trip occurs with the help of an electromagnetic coupling;

2) The second method is the transfer of air in the process of continuous operation of the compressor. The air is passed through the bypass valve;

Today, the mechanical supercharging systems are equipped with electronic circuits for such a boost control. An integrated solution consists of input sensors for pressure boost, sensor on the inlet, electronic control units, etc. In parallel, numerous actuators are used, which include electromechanical modules of the drive of the bypass valve, the coupling electromagnet and other devices.

Superchargers like Roots are quite expensive. This is due to extremely small tolerances in the process of their production. Such compressors demonstrate increased demands for clean air. Any contamination or foreign objects in the inlet system can easily disable a sensitive supercharger.

To the minuses of screw superchargers unambiguously refers to their high price, which far exceeds the cost and without that not the most affordable cam analogues. For this reason, screw superchargers are used rarely. They are often installed on massive expensive sports cars or models of limited series.

With regard to the centrifugal supercharger, the process of injection of air in it is implemented on a principle that resembles a turbocharger. In its basis, it has impeller impeller. The wheel rotates at a very high speed, and the number of revolutions can reach the mark of 50000-60000 rpm.

The disadvantages of centrifugal superchargers include a strongly expressed dependence of their productivity on the speed of the crankshaft of the engine. Developers today especially take into account this feature. For centrifugal superchargers, a drive with a variable transmission ratio is widely used. The specified transmission ratio of the drive at the maximum mark is required when the engine is running at low revs, the minimum ratio is used when operating at high revs.

Thanks to a number of design features, the Roots and Lysholm type superchargers are installed on the car to provide high dynamics dynamics when dispersing, and the centrifugal superchargers are most effective at engine operation in peak loads and at high speeds.

Since the centrifugal supercharger is distinguished by such basic advantages as compact dimensions, low weight, efficiency, reasonable cost and excellent ability of various variations of mounting on the engine in comparison with other superchargers, a centrifugal supercharger will be used to upgrade the engine.

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ANALYSIS OF THE SCHEMES OF COUNTERWEIGHT PLACEMENT ON THE CRANKSHAFT

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The rigid six-cylinder engine is the configuration of the internal combustion engine with the inline arrangement of the six cylinders, the order of the cylinders 1-5-3-6-2-4, and the pistons that rotate one common crankshaft.

Often denoted by R6 or I6. In the theory of I6 in a four-stroke version is a fully balanced configuration of the forces of inertia of different orders of pistons and upper parts of the rods (the forces of inertia of the 1st order of different cylinders are mutually compensated for each other, as well as in a row four-cylinder engine, but, unlike the latter, Inertia forces of the 2nd order are also mutually compensated), combining the relatively low complexity and cost of manufacturing with good smoothness of work.

Advantages of inline six-cylinder engines. In the first place, like any inline engine, they are quite simple and reliable. The simplicity of such motors is important during repair, since on the inline engine it is easy to get to any spark plug, wires and other elements during scheduled maintenance, but the most advantage is the balancing of the engine. With the usual scheme of such engines, the cylinders move in pairs with their "reflection in the mirror" on the other side of the motor.

Disadvantages of inline six-cylinder engines. The placement of such a motor has always raised the question, since through such additional cylinders, such a motor is installed along and under each hood. In addition, the long engine and its components suffer stiffness compared to more compact models.

To ensure torque uniformity, engine cylinders must operate at intervals

$$\Delta_{4T} = \frac{180° \cdot \tau}{i},$$

$$\Delta_{4T} = \frac{180° \cdot 4}{6} = 120°.$$

The best balance has a mirror-symmetrical shape of the crankshaft. The cranked shaft of the prototype engine has exactly that shape. The order of cylinders 1-5-3-6-2-4.

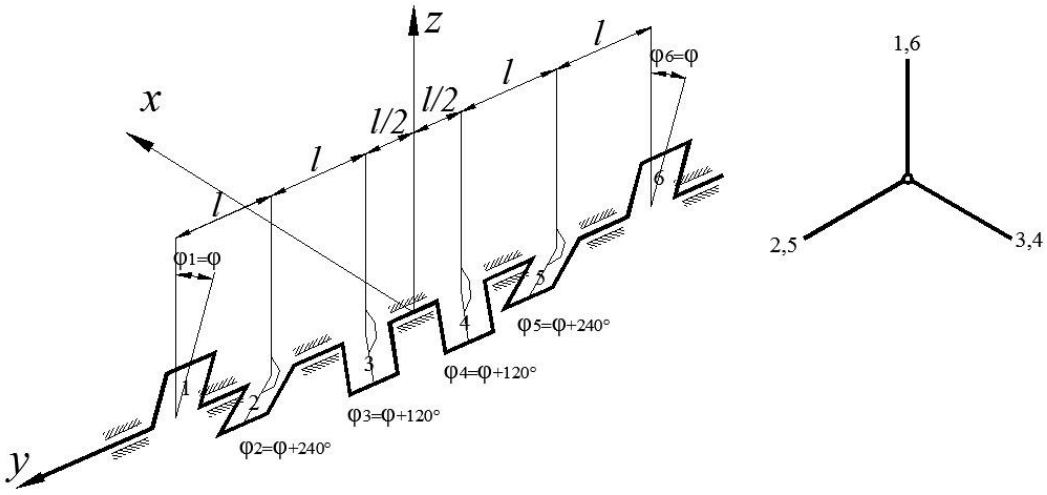

Figure 1 – Scheme of the crankshaft

The disadvantage of the mirror-symmetrical shaft is the internal imbalance. Since the inline six-cylinder four-stroke engine is externally completely balanced, when designing it, the task is to reduce internal imbalance due to unloading counterweights.

To improve the internal equilibrium apply unloading counterweights. They are chosen from the condition of unloading the average rootstock.

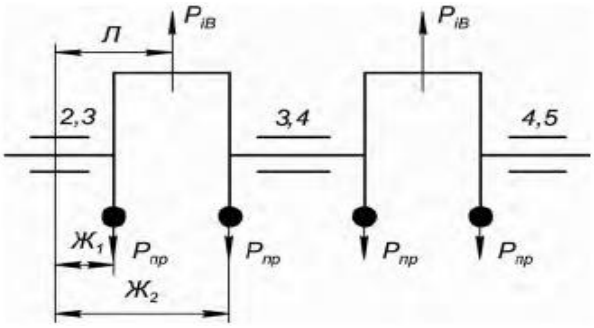

Figure 2 - Scheme for determining the forces of inertia unloading counterbalances Pnp

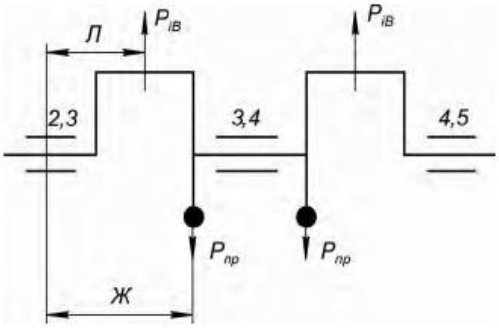

Figure 3 - Scheme for determining inertia forces unloading counterbalances Pnp

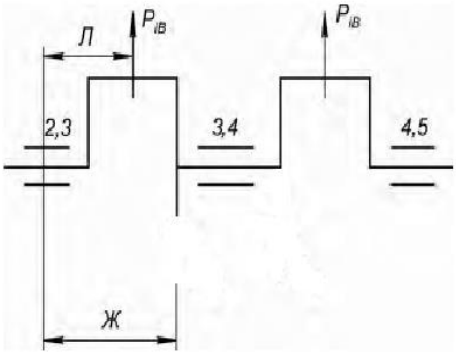

Figure 4 - Scheme for determining inertia forces unloading counterbalances Pnp

The analysis of literature has shown that in six-cylinder inline engines all three schemes of internal equilibrium are used.

References

1. Двигуни внутрішнього згоряння. Теорія поршневых и комбінованих двигунів / Під ред. А. С. Орлина, М. Г. Круглова. – Машинобудування, 1983. 376 с.

2. Перспективи розвитку двигунів внутрішнього згоряння. Ф. І. Абрамчук, С. С. Жилін, А. М. Лєвтєров. Харків, видавництво ХНАДУ, 2009. 55 с.

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ELECTRIC AND MECHANICAL DRIVE OF A GEAR SHIFT MECHANISM IN A 5th CLASS TRUCK

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Drivers' reliability largely depends on their ability to work. When it is reduced, this can lead to inattentiveness and, consequently, to traffic accidents. Increased energy leads to the growth of fatigue and, as a result, there comes time

when, despite increasing efforts, there appears a decrease in concentration on the road. Fatigue is usually preceded by a feeling of tiredness. Tiredness is a fatigue subjectively experienced by a person. It signals the body about the need to stop or lower the intensity of activity to avoid disorders of the nervous system [2]. When driving a truck on long distances, especially at night and in urban areas, the driver makes great efforts, both mental and physical. One of the most important solutions to reduce energy consumption is the use of an electric and mechanical drive of a gear shift because when the gear is engaged, the driver does not apply any force.

Modern cargo transport vehicles of the 5th class are equipped with manual transmissions which do not always meet ergonomic requirements during their operation. Improving ergonomic indicators of a gear shift is not an easy task. It can

be solved only on the basis of studies of work processes occurring in gearbox actuators [3]. The analysis of existing gearbox actuators showed that taking into account all the advantages and disadvantages of actuators, it is advisable for trucks to use an electric and mechanical drive, since it is convenient to arrange it in the car. It is economically efficient, has a high level of reliability and allows to change gears smoothly, quickly and noiselessly. The electric and mechanical gear box actuator consists of the mechanism of gear engagement, electric lines of the actuating mechanism, a gear shift mechanism (Fig. 1).

The mechanism of gear engagement is based on the use of two sensors of the gear shift lever displacement [1]. It allows the electronic control unit to give commands to electric engines that move the sliders in the corresponding direction.

Using sensor 1 (Fig. 2) the electronic control unit gives a command to the electric motor 1 (Fig. 3) which moves the “left-right” slider. Accordingly, by using sensor 2 (Fig. 2) the electronic control unit gives a command to the motor 2 (Fig.3) which moves “forward and backward” sliders [5].

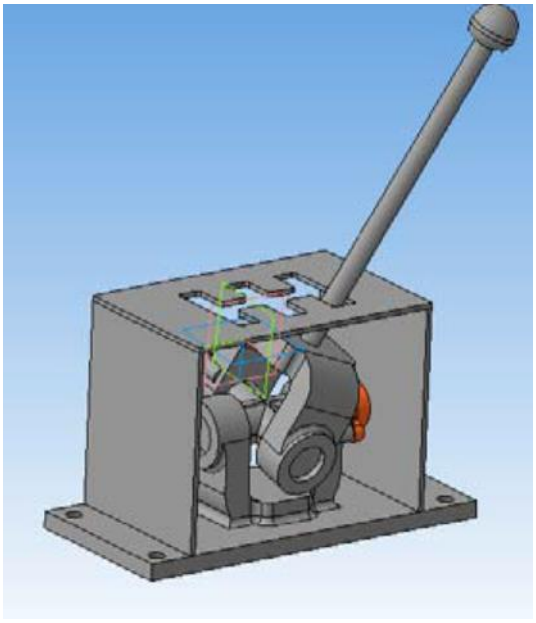

Fig. 1. Actuating mechanism of gear engagement (type A)

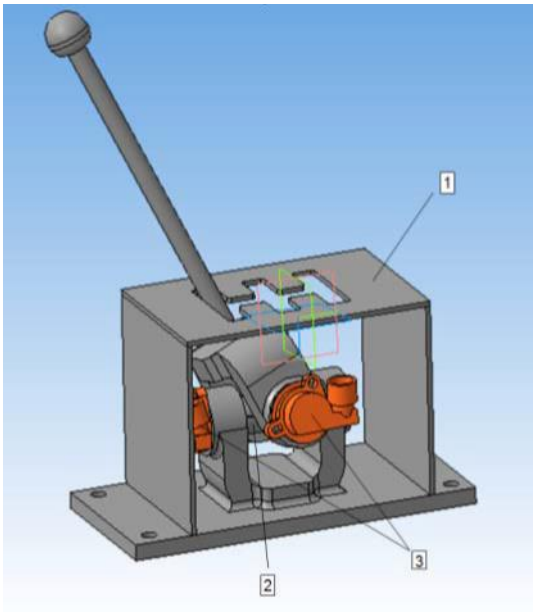

Fig. 2. Actuating mechanism of gear engagement (type B)
1.Body. 2. Cross arm. 3. Sensors of gear shift lever position

The sensor of the gearshift lever displacement is a potentiometer, on one end of which electricity is supplied and the other end is connected with the mass. The output signal goes to the controller from the third socket of a potentiometer. When the shift lever is moved, the voltage at the sensor output changes. At the initial position it is below 0.7 V. When the lever is moved, the voltage at the sensor output increases and when transmission is fully on, the voltage must be more than 4V [3].

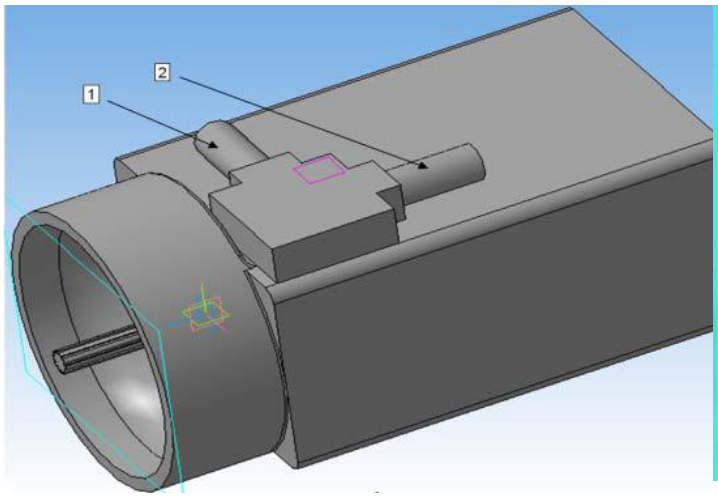

Fig. 3. The scheme of the motors on the gearbox
1. Cross movement motor. 2. Motor for the longitudinal displacement

Fig. 4. The sensor of gearshift lever (model 36.3855)
displacement (position)

The sensor of the shift lever displacement requires no regulation. A general view of this sensor is shown in Fig. 4.

When operating a vehicle it is necessary to use the gear box properly to avoid damage and premature wear. Maintenance and repair are carried out depending on the vehicle mileage [4]. When making repairs it is necessary to comply with the OHS to ensure safe working conditions and preservation of health.

References

1. Осепчугов В.В., Фрумкин А.К. Автомобиль: анализ конструкций, элементы расчета: Учебник для студентов вузов по специальности «Автомобили и автомобильное хозяйство». М.: Машиностроение, 1989. 304 с.

2. Руководство по эксплуатации Электропневматический привод коробки передач Модель ЭПП.12. 38 с.

3. Руководство по монтажу и эксплуатации тросового привода управления коробкой передач РЭ 37.1703008. URL: http://www.remkam.ru/kamazt13.

4. Ремонт топливной аппаратуры. Дизель Гранд Сервис. URL: http://kamaz.interdalnoboy.com/rukovodstvo-kamaz-korobka-peredach.htm.

5. Механизм переключения КПП Камаз. URL: http://autoruk.ru/o-kamaze/transmissiia/mekhanizm-perekliucheniia

Gerashchenko O. I.

IMPROVEMENT OF TECHNICAL-ECONOMICAL INDICATORS INCORPORATION OF IMMEDIATE FUEL INFUSION IN CYLINDER OF AN ENGINE

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The main requirements that always come up when designing engines internal combustion is to increase fuel efficiency and efficiency. One of the ways of development, the engineers have chosen directly injection of fuel into engine cylinder. For engine that work on the heavy fuel, that is diesel, it is a necessity. So what about gasoline engines, for the first time, a kind of fuel supply, was applied in aviation.

In the 30's of the 20th century, German company Bosch together with Daimler-Benz set new fuel system, the former carburetor engine, which significantly improves its performance.

The design engine is V-shaped, 12 cylinder, with liquid cooling The DB601 becomes the best engine of the Second World War, and installed on the German fighter Messerschmitt Bf 110, Messerschmitt ME 210.The advantages of the engine are: increased power by 6-7%, more qualitative mixture formation. But to a more significant achievement include the fact that the engine is stably operating independently of the position of the airplane in the air. Also, direct injection, reduced risk, fire from damage fuel system, and when jumped it was not necessary to increase the compression ratio But in addition to the advantages, there were also disadvantages: increased mass, and high requirements for fuel quality.

In 1951, the German company Goliath, establishes a system of direct fuel for a passenger car. It was equipped with a two-stroke two-cylinder engine and was named Goliath 700 Sport. In 1954, Mercedes-Benz, together with Bosch, already produces a more powerful and reliable M198 engine, and is installed on a Mercedes-Benz 300 SL sport car.

The next step was made during the oil crisis in the 1970's by Ford, but he did not succeed. In 1995, the first massive GDI engine (Gasoline Direct Injection) was developed by Mitsubishi with direct injection of gasoline. Technology "GDI" is recognized as the technology of the year in Japan, Germany, England. In the future, in one form or another, their systems were presented by all the major world producers Direct injection remains extremely relevant a topic in connection with interest in saving and rigid environmental standards in modern engine construction**.**

The system of direct injection as a result of work provides several types of mixing, depending on the mode of operation of the engine: 1. Polar 2. Homogeneous 3. Homogeneous stoichiometric.

Polar mixture formation. Polar mixing is used when the engine is running on small and medium loads. Due to the layered distribution of fuel in the combustion chamber, the engine operates at a general coefficient of excess air 1.6-3

After entering the fuel-air mixture to the spark plug, it is ignited by a spark. At the same time, only the cloud of the mixture is ignited, while other gases create its shell. Thanks to the insulating action of the shell, heat losses are reduced in the

walls of the combustion chamber and respectively increase the thermal efficiency. When using layered mixing, the torque of the engine depends on the amount of injectable fuel.

Homogeneous mixture. This mixture is used in modes that are in the field of multiparameter characteristics between the modes of the engine in the layered mixing and modes of operation on a homogeneous mixture. The coefficient of excess air of this mixture is equal 1.55.

Fuel injection occurs directly in the intake stroke. In this case, the engine control unit regulates the fuel supply in such a way that the excess air ratio remains approximately 1.55 Thanks to the early injection of fuel, enough time is provided before the ignition time to create a homogeneous mixture in the entire volume of the combustion chamber.

Homogeneous stoichiometric mixture. The work of the engine on a homogeneous mixture of stoichiometric composition can be compared with the work of the engine, when the fuel is injected into the collector. Significant difference is the only place where the fuel is injected, in this case directly into the cylinder. The torque of the engine can be changed by changing the angle of ignition (short-term), or by changing the mass of air entering the cylinder (for a long time). The coefficient of excess air in this case is 1.

The process of combustion on a homogeneous stoichiometric mixture is completely analogous to the combustion process on a homogeneous mixture.

After completing the review of the system of direct injection of fuel into the engine cylinder, the following conclusions can be drawn. The advantages of this method of fuel supply include.

1. Reduce fuel consumption up to 20%;
2. Reducing harmful emissions to EURO-6 standards;
3. Increase engine power up to 15%.

Disadvantages: 1. High cost system 2. Complexity of repair 3. High requirements to fuel quality.

The main issues that will have to be encountered when designing a system for direct fuel injection into a microlight motor include the following items:

1. Injection system selection 2. System location on the engine.

The geometric dimensions of the engine do not allow for a large selection of systems that are presented on the market. The main component that determines the possibility of using the system as a whole is the injector, because it is most difficult to place on the engine. Consequently, this system will theoretically enable us to save fuel up to 20% and increase the torque to 15%.

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FEATURES OF ELECTRIC VEHICLES OPERATION

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Modern trends in the automotive industry in the world are aimed at ensuring environmental friendliness, efficiency and ease of road transport using. So, we can

see the widespread use of electric vehicles in the European Union today. This mode of transport appeared not long ago, but it showed to good advantage. It allows car owners to save on fuel and the state to save on reimbursing the effects of environmental pollution. In Ukraine, electric cars are only beginning to gain popularity. Drivers are naturally attracted by lower costs for the cars operation. But the main problems preventing the proliferation of electric vehicles still remain. There are the cost of purchasing an electric vehicle, the lack of recharging stations network and a sufficient number of specialists for their service among them.

We tried to answer the question "What car is more economical: electric car or a car with gasoline or diesel engine?" and considered the car Tesla Model S and counted the amount of electricity consumed by it on 100 km, taking into account the costs for charging the battery. The average energy consumption of Tesla Model S is 23.8 kWh per 100 km that is 100 km on this electric car cost about 43 UAH. Let's compare to a diesel car with about 100 UAH for 100 km.

The energy consumption of the car with an electric motor and an internal combustion engine, depending on the constant speed, shows that the minimum power consumption of an electric vehicle is 30 km per hour, and a car with an internal combustion engine consumes the least at 60 km/h. So, economical driving is slower for electric car.

Electric vehicles have traction batteries, which are influenced by natural and climatic conditions. Let's analyze the capacity that the battery can give at different discharge temperatures. Lithium-iron-phosphate accumulators have the highest discharge efficiency, and in the normal conditions of operation its efficiency is not less than 97%. For electric vehicles, rather high capacity is required, since you need to save a lot of energy in the battery for a large reserve of storage.

Consequently, the peculiarities of the operation of electric vehicles in real conditions are reduced to confronting advantages and disadvantages. Advantages of electric cars are as follows:

• The electric drive (electric motor generator) works much quieter than the internal combustion engine. Thus, the noise level in electric vehicles is very small.

• When driving, the electric car does not emit any harmful substances or gases into the atmosphere. If the high-voltage battery is recharged from renewable energy sources, the electric car can be operated without CO2 emissions.

• If, in the near future, city centers that are particularly vulnerable to traffic accidents are declared as harm free zones, entry will only be allowed for vehicles with high voltage power plants.

• The electric motor generator is very reliable and does not require costly maintenance. It is only susceptible to slight mechanical wear.

• The electric motor has a high, up to 96%, efficiency compared to an internal combustion engine, which produces 35-40% efficiency.

• The electric motor generates more optimal torque and power characteristics. Right from the start it develops the maximum torque. Due to this electric vehicle in comparison with the car with an internal combustion engine at the same power can accelerate much faster.

• Transmission device is simpler, therefore there are no such units and details of the car, such as a gearbox, clutch, muffler, fuel tank, starter, sparking plugs etc.

• When braking, the electric motor can perform generator functions, generate electricity and charge battery (energy recovery).

• Energy is only provided when it is needed by the consumer. Unlike conventional cars, an electric motor generator never works at a stop before a traffic light. Especially effective electric motor generator is when moving in a dense traffic flow, as well as when driving with frequent stops. With the exception of a gear unit on an electric motor, the electric motor does not require oil for lubrication.

Disadvantages of electric vehicles are the following. 1) Electromobiles have limited cruising range. The electric energy should be accumulated by a modern high-voltage automotive battery to sufficient degree. This amount of accumulated energy is a decisive factor for any electric vehicle cruising range. 2) If the high-voltage battery needs to be charged from a fully discharged state to a fully charged one, and only minimal charging capabilities are available, the charging time can be up to 8 hours. 3) The possibilities of charging electric cars during the journey are still under development. Charging network is poorly developed. 4) If the purpose of the journey is beyond maximum cruising range, the driver must plan the trip route, taking into account the availability of charging stations.

Despite all its drawbacks, electric cars are now real competitors for traditional cars with ICE and they are becoming better and more affordable every day. All leading car makers, taking care of their image and following the trends, present some hybrid and pure electric cars. But the locomotive and impact force of the electric lobby is now the Tesla Company, which has made the most impressive success in this field.

References

1. Бажинов О.В. Науково-практичний комплекс підготовки фахівців з розроблення та ремонту гібридних автомобілів. *Новий колегіум*. - 2014.- №4 (78).- С. 27-29.
2. Говорущенко Н.Я. Экономическая кибернетика транспорта. Х.:РИО ХГАДТУ, 2000.- 218с.
3. Смирнов О.П. Теоретические основы повышения топливной экономичности автомобиля за счет использования гибридной энергетической установки. *Транспорт, экология- устойчиво развитие:* XII научно-техническая конференция с международным участием, 18-20 мая 2006г.: - Варна, Болгария, 2006.- С. 80-85.

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BESONDERHEITEN VON TSI-MOTOREN

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TSI (Abkürzung für Twincharged Stratified Injection oder Turbocharged Stratified Injection) ist die Markenbezeichnung für eine Motorentechnik des Automobilkonzerns Volkswagen bei Ottomotoren (Benzinmotor). Das Ziel dieser

Technik ist, Motoren mit kleinerem Hubraum, welche gegenüber Motoren mit größerem Hubraum einen Verbrauchsvorteil haben, mit mehr Leistung und höherem Drehmoment zu versehen. Ein direkteinspritzender Ottomotor wird dabei mit einem Abgasturbolader oder zwei verschiedenen Ladern aufgeladen. Der erste TSI-Motor war im Jahr 2005 ein doppelt aufgeladener 1,4-Liter-Motor. Diese Motorentechnik wird bei Audi ausschließlich als TFSI (Abkürzung für Turbo Fuel Stratified Injection) bezeichnet. Das technische Äquivalent zum TSI beim Dieselmotor wird als TDI bezeichnet.

Bei der Twincharged Stratified Injection kommen zwei Lader zum Einsatz. Der Erste ist ein mechanischer Drehkolbenlader (Kompressor) im Roots-Prinzip, der im unteren Drehzahlbereich (bereits ab Leerlaufdrehzahl) die angesaugte Luft verdichtet. Ab einer Drehzahl von etwa 2000/min steuert dann eine Regelklappe die Beteiligung des Kompressors an der Aufladung. Zusätzlich beginnt hier die Verdichtung durch den zweiten Lader, einen Abgasturbolader, der ab etwa 3500/min alleine die Aufladung des Motors übernimmt. Der Kompressor wird dann über eine Magnetkupplung abgetrennt.

Mit dieser Technik entfallen die größten Nachteile der beiden Lader:

- Das „Turboloch“ des Abgasturboladers in den unteren Drehzahlen wird durch den Einsatz des Kompressors überbrückt.
- Der Kompressor wird bei höheren Drehzahlen von der Kurbelwelle getrennt und entzieht dem Motor somit keine Leistung mehr.

In ähnlicher Form wurde die kombinierte Aufladung eines Benzinmotors durch Kompressor und Turbolader bereits in den 1980er-Jahren in den 200 Serienfahrzeugen des Gruppe-B-Rallyefahrzeuges Lancia Delta S4 eingesetzt.

Während VW unter der Motorenbezeichnung TSI ursprünglich nur die oben genannten doppelt aufgeladenen Motoren verkaufte (Twincharged Stratified Injection), werden seit Modelljahr 2008 kontinuierlich auch die bisherigen nur turbogeladenen Motoren mit Benzindirekteinspritzung als Turbocharged Stratified Injection (TSI) weitergeführt. Ebenso basieren neuere Motoren auf einer neuen Grundmotorkonstruktion, die unter anderem über eine Steuerkette anstatt eines Zahnriemens sowie eine volumenstromgeregelte Ölpumpe verfügen.

Da VW nicht mehr am Schichtladeprinzip festhält, sind die Kürzel TSI bzw. TFSI nur noch Markennamen. So wurden zuvor bereits die Saugmotoren 1.6 FSI und 2.0 FSI Ende 2005 von Schichtladung im Teillastbetrieb auf konventionellen Homogenbetrieb ungestellt. Damit entfiel auch der zuvor nötige Stickoxidespeicherkatalysator.

Seit 2007 wird als Einstiegsmotor ebenfalls ein 1,4-l-Motor mit dieser TSI-Technik angeboten. Durch die Leistung von 90/92 kW (122/125 PS) und maximal 200 Nm Drehmoment konnte auf eine zusätzliche Aufladung mittels Kompressor verzichtet werden. Eine zusätzliche Besonderheit dieses Motors ist der in das Saugrohr integrierte Ladeluftkühler. Ebenso wurde der Motorblock den Leistungsverhältnissen angepasst und im Gewicht optimiert sowie ein kleinerer Turbolader verbaut. Ein weiterer Downsizing-Schritt folgte Ende 2009 mit dem 1,2-l-TSI-Motor (77 kW/105 PS), der seit 2010 auch mit 63 kW (86 PS) erhältlich ist.

Ab 2012 werden im Rahmen der Strategie des modularen Querbaukastens die bisherigen TSI-Motoren bis hin zum 1,4-l-TSI-Motor grundlegend modifiziert. Die Motoren der neuen Baureihe EA211 sind leichter (beim 1,4-Liter-TSI um 22 kg) und durchgängiger modularisiert. Im Vergleich zur Vorgängerbaureihe EA111 wird anstatt der Steuerkette ein Zahnriemen verwendet. Das Kurbelgehäuse besteht aus Aluminiumdruckguss und nicht mehr aus Grauguss. Eine besondere Neuerung ist die Möglichkeit der Zylinderabschaltung der beiden mittleren Zylinder beim 1,4-l-Motor. Weitere Merkmale des modular aufgebauten Motors sind ein im Zylinderkopfdeckel integriertes Ventiltriebsmodul (iVM) mit variabler Ventilsteuerung der Einlassventile (beim 1,4-l-TSI mit 103 kW auch die Auslassventile), ein im Zylinderkopf integrierter wassergekühlter Abgaskrümmer, sowie eine Zweikreiskühlung.

Von außen sind die Motoren an der VW-typischen Farbgebung zu erkennen. Grundsätzlich gilt: Gibt es in einem Modell TSI-Motoren mit unterschiedlicher Leistung bei gleichem Hubraum, so ist bei dem Fahrzeug mit geringerer Leistung keiner der Buchstaben rot gefärbt. Das Modell mit dem leistungsstärkeren Motor hat den Buchstaben „I“ in roter Farbe am Heck. Beispiele: Beim 90-kW-TSI-Motor mit 1,4 Litern Hubraum, der in verschiedenen VW-Modellen erhältlich ist, ist das „I“ rot eingefärbt. Der stärkere 118-kW-TSI trägt das „S“ und das „I“ in roter Farbe auf der Heckklappe (Eine Ausnahme bilden jedoch der Golf VI Cabriolet und der Tiguan, hier sind alle Buchstaben rot). Beim 2,0 Liter großen TSI-Motor mit 125 kW ist das „I“ rot und beim 147 kW bzw. 155 kW sind stets die „SI“-Buchstaben rot eingefärbt.

Volkswagen forciert die Entwicklung innovativer Volumenmodelle mit nachhaltigen Antrieben. Die umfassende Modellpalette überzeugt mit maximalem Fahrspaß bei minimalem Verbrauch dank innovativer und effizienter Benzinmotoren. Das Angebot reicht von sparsamen MPI-Motoren (Multipoint Injection) bis hin zu modernsten TSI-Motoren, wie z. B. dem neuen Golf Motor 1,5 TSI ACT BlueMotion mit 96 kW/130 PS mit aktivem Zylindermanagement (ACT) und Segelfunktion.

References

1. Вахитов Ю. Р. Агрегаты наддува двигателей. Уфа, 2012. 158 с.
2. Луканина В. Н., Шатрова М. Г. Двигатели внутреннего сгорания : Теория рабочих процессов. М., 2010. 479 с.
3. https://www.volkswagen.at/tsi

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LOADING OF THE TELESCOPIC BOOM OF LOADER CRANE WITH HEXAGONAL PROFILE

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The growing volumes and expanding range of goods carried by transport companies inevitably raise the question to the carriers on the necessity of having the trucks equipped with a loader crane (KMU) in the fleet. This is especially important considering the constant increase in the density of urban development, which often limits the possibility of using stationary lifting devices. KMUs now successfully perform not only loading and unloading operations, but they are also widely used in erection technologies, which require flexibility, accuracy of special operational movements, smooth of transfer and stability of the load position. The growth of popularity of KMUs is largely due to designs of the used booms. Exactly the boom determines the possibilities of the loader crane both in terms of the load-carrying capacity and the boundaries of the operational area.

The construction of a boom must meet the following essential requirements [2]: the shape of a section must be suitable for the economically feasible production of the booms; to reduce the contact forces between individual telescopic sections, they must be designed with such a shape that there would be minimum extra forces in the contact zones; the small gaps to provide lateral stability and small angle of twist should be foreseen between the sections; high-strength steels with a fine structure may be used to reduce the weight. At this, the high load capacity of these steels can be implemented only in the absence of the possible buckling (local loss of resistance) in the thin walls of the cross-section of the boom. When checking local resistance, both longitudinal forces in the boom and forces acting in a direction transverse the boom must be considered. To ensure durability and prevent deflections, as can happen with lattice boom structure, the boxlike booms are used for loader cranes. Modern designs of loader cranes have many varieties of boom cross-sections. It should be noted that for the fundamental improvement in operational performance the designers went towards increasing the number of faces in the cross-section of the box. Researches in the field of the booms of the cranes have shown that the more faces in the profile, the more effective the loading is divided across the cross-section. Figure 1 shows some cross-sections that are used for sections of boom cranes and loader cranes [4]. Each of the showed profiles has its advantages and disadvantages. For example, cross-section 1, despite its simplicity, so far widely used by American company Manitex for cranes with a load-carrying capacity of up to 45 tons. Boxlike profile is used by manufacturers of rough-terrain cranes Terex, Grove, Tadano, Kato on models with a load-carrying capacity of up to 80 tons.

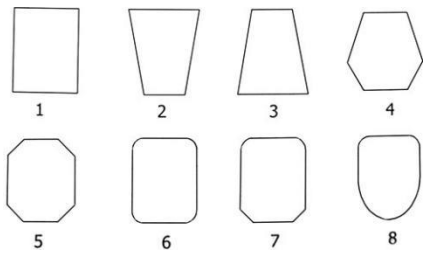

Fig. 1. A variety of cross-sections of telescopic sections of boom cranes and loader cranes

Hexagonal profile of a boom (Fig. 2) was first developed and presented to customers by Swedish company Hiab. Due to its shape and large bearing surface, the boom perfectly holds the load, has increased service life, favorable ratio of own weight and strength. Now after Hiab hexagonal cross-section is used by many manufacturers of loader cranes.

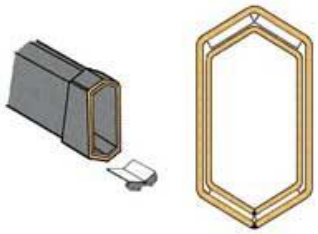

Fig. 2. Hexagonal profile of the boom of loader cranes

Today profiles of rectangular cross-section are used only in the loader cranes with small load-carrying capacity. In some cases, rectangular cross-section is replaced by trapezoidal. Sometimes lower belt of cross-section is performed broad (cross-section 3 Fig. 1) and sections with such a profiles form massive and relatively short telescopic booms. In another variant of the 4-faceted profile, the upper belt of the cross-section is broad, and the thickness of this flange is substantially reinforced (cross-section 2 Fig. 1). It is considered that such a profile greatly reduces the risk of curvature when bending with loading.

To evaluate the load of the construction elements of a hydraulic manipulator, we will develop a three-dimensional solid-state model (Fig. 3) and carry out a computer simulation of the processes using the hybrid (solid state and surface) parametric modeling system using the Autodesk Inventor 2014 program.

The loader crane (Fig. 3) consists of a nonrotational frame (1) with retractable legs (9), a supporting-rotating device (2), a rotating column (3) and handle (4), a telescopic boom with main (5) and retractable sections (6, 7, 8). A nonrotational frame (8) welded from steel roll-formed profiles receives all the loads that arise during operation, and thus unloads the frame of the base chassis. Retractable legs (9), each with separate control, provide the hydraulic manipulator with the necessary stability.

Support-rotating device (3) intended to locate a rotational column, handle and telescopic boom and ensure their smooth circular rotation around the horizontal axis, as well as the elevation to the desired angle and height.

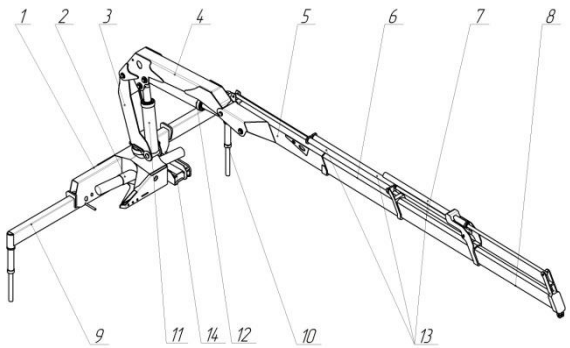

Fig. 3. Installation of loader crane

The developed three-dimensional parametric models of the process equipment of the hydraulic manipulator allow to make quick adjustments to design, handle various layout and kinematic schemes, determine the necessary additional parameters (movement of the design elements, distribution of safety factor, frequency and thermal analyses, shock loading tests, fatigue tests, etc.).

The use of three-dimensional modeling in the design and calculation of process equipment of road vehicles significantly reduces the time for design and calculations, which in turn increases the economic impact of design work, leading to lower final price of the product, allows to visualize objects, to process a large number of options of technical solutions in the shortest time.

References

1. Гончарук О. М., Клін В. Б. Дослідження динамічної стійкості стріл поворотних кранів: актуальні проблеми меліоративного і водогосподарського будівництва. Львів : Вища школа, 1973. 175 с.
2. Гохберг М. М. Металлические конструкции подъемно-транспортных машин: машиностроение. Ленинград, 1976. 456 с.
3. Іванченко Ф. К. Розрахунки вантажопідйомних і транспортуючих машин. Київ : Вища школа, 1973. 573 с.
4. Соколов С. А. Металлические конструкции подъемно-транспортных машин : учебное пособие. Санкт-Петербург : Политехника, 2005. 423 с.

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FEATURES OF ESP AND ESC AUTOMOTIVE SYSTEMS

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ESC (or ESP) is considered by many as one of the greatest achievements in the field of automotive safety and motor racing in particular. The principal difference of the stabilization system from such traditional elements of passive safety as belts and pillows is that they are designed to save lives, as well as preserve the health of the driver and passenger in an accident, but ESC (or ESP) is used to prevent accidents.

For reference, ESC stands for Electronic Stability Control, and ESP – Electronic Stability Program. In fact, the goals of both coincide, and research and testing empirically demonstrate their effectiveness. According to British experts, who based on statistics, equipping the ESP car helps reduce the risk of a serious traffic accident by 25%. At the same time, Swedish researchers are inclined to believe that this active safety system helps to reduce the likelihood of being involved in a fatal accident in bad weather conditions by 35%.

This is a grim prospect, which, nevertheless, must be subjected to a thorough analysis, which is why in Europe, the mandatory equipment of all new ESP cars has been fixed at the legislative level. Such an initiative was implemented in 2014, up to this point such an important system was included only in the list of additional

equipment available to rather expensive models. At the same time, the prototype of this electronic system was patented as far back as 1959, and it was possible to implement it on a mass production model only by 1994.

How do they work? With so many electronic systems installed in the car, each of which has its own abbreviation, many car owners absolutely do not understand what the fundamental difference between them is. Further complicating the situation is the fact that different active names are used to designate active safety devices that are close to their destination, which in most cases are determined by the manufacturer.

For example, the ESP (Electronic Stability Program) may be known as ESC (Electronic Stability Control), VSC (Vehicle Stability Control or Electronic Stability Program), VSA (Vehicle Stability Assist) or Dynamic Stability Control (DSC). Sustainability). Some automakers use their own "brands" to promote ESP, so you may encounter, for example, DSTC (Dynamic Stability and Traction Control) from Volvo or PMS (Porsche Stability Management) from Porsche. So, now we have decided on the possible variants of names, let's see how ESP works.

Adding a third safety feature to the ABS and traction control. In order for your car to be equipped with an ESP system, it must be equipped with ABS (anti-lock braking system) and TCS (Traction Control System). In the simplest case, these two elements of active safety are designed to improve manageability and predictability, and also to maintain control over the car during braking and acceleration, respectively, therefore their intervention in the control process is reduced only to control of linear acceleration.

ESP complements them and introduces a third controllable measurement, since it is responsible for moving the car in a direction perpendicular to the trajectory of movement, in which phenomena such as under-steering or over-steering occur – a skid. In more advanced versions, it is in constant interaction with the electronic engine control unit to maximize the efficiency of its work.

According to statistics, ESP can prevent up to 80% of drifts, which is an excellent indicator, especially against the background of the fact that about 40% of accidents occur because of this phenomenon. Nevertheless, it is worth remembering the words of Scotty from the Star Trek movie: "You can change the laws of physics!". Of course, the capabilities of active security systems are not limitless, and this should not be forgotten. If the driver oversteps the line when the loss of control over the car is inevitable, none of the existing systems will prevent serious consequences.

Since ESP provides additional security along with ABS and TCS, it is hardly surprising that it uses most of the equipment from these systems to operate. Using sensors to measure the speed of individual wheels, as well as information from lateral acceleration sensors and transverse speed sensors, the ESP control unit constantly monitors the lateral movements of the vehicle and compares them with the steering wheel position. If the car does not respond to the movement of the steering wheel as it is programmed, or the specified angle of rotation, as well as the speed is too high, ESP will begin to slow down the wheels, trying to maintain a straight path. In this case, braking is carried out with active interaction with ABS, which eliminates the blocking of one of the wheels. The very essence of the work

of the system under consideration is to start actively promoting the process of controlling the machine even before the driver realizes that he is beginning to lose control.

The system works constantly, regardless of the mode of driving. And the mechanism of its influence completely depends on the situation and design features of the car. For example, if the beginning of the rear axle slip is fixed in a sharp turn, the electronics begins to smoothly reduce the amount of fuel supplied to the engine, ensuring a decrease in its speed. If this is not enough, then the gradual slowing down of the front wheels begins. If the car is equipped with an automatic transmission, the ESP allows you to forcibly activate the winter mode of operation, providing the possibility of switching to a lower gear.

References

1. Кукурудзяк Ю.Ю., Ребедайло В.В. Метод автоматизованого діагностування системи запалювання та системи керування автомобільним двигуном: монографія. Вінниця, 2010. 143 с.

2. Кубата В.Г., С.В. Лубенець, В.Я. Фролов Спеціалізовані електронні системи АТЗ: навчальний посібник. Харків, 2012. 272 с.

Khmelnytskyi B. O.

ANTI-LOCK BRAKING SYSTEM

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The need for the anti-lock braking systems (ABS) is justified. At straightforward motion during braking of a car there are different forces acting on its wheel: the car weight, braking force and lateral force, figure. The strength of the forces depends on many factors such as the speed of the car, the size of the wheels, the condition and design of the tires and the roadway, the design of the braking system and its technical condition.

In the straight-line motion of a vehicle with constant speed, there is no difference in the speed of rotation of the wheels. In this case, there is no difference between the given speed of the car and the average speed of rotation of the wheels co-ordinated with it.

But as soon as the process of intense braking begins, the speed of the car starts to exceed the average speed of the wheels, as the body “overtakes” the wheels under the influence of the force of inertia of the car mass.

In this situation there is a uniform moderate slip phenomenon between the wheels and the road. This slip is a working parameter of the braking system.

Physically working slip in contrast to the emergency skid is realized due to the flexing of the wheels tread, the displacement of small fractions on the surface of the road, and due to the depreciation of the car suspension. These factors keep the car from the skid and reflect the usefulness of the working sliding of the wheel

while braking it. It is clear that at the same time, the slowdown in wheel rotation is gradual and manageable, but not instantaneous, as with locking.

The value λ is called the slip coefficient and is measured as a percentage. If λ = 0%, then the wheels rotate freely without affecting the friction road resistance. The slip coefficient λ = 100% corresponds to the wheel skid when it moves into a locked state. At the same time, the braking efficiency, stability and handling of the vehicle during braking are considerably reduced.

In the event of the appearance of the sliding effect, in which there is still a normal rolling of the wheels between them and the road there is a uniformly increasing force, the resistance of the friction which is expressed by the coefficient of adhesion in the direction of motion, which is a function of the slip and creates the force of car braking.

For most road surfaces, with the values of γ, and hence the braking force, in the range of 10% to 30%, the coefficient of clutch in the direction of motion reaches the maximum value, and this value is called critical. Within these limits, the cross-linking ratio has a rather high value, which ensures steady movement of the vehicle during braking, if the side force acts on the vehicle.

In the case of emergency braking, a significant amount of effort on the brake pedal can cause locking of the wheels. The tire engagement with the road surface is sharply weakened, and the driver loses control of the car.

Anti-lock braking systems are designed to provide continuous monitoring of the force of engagement of the wheels with the road and accordingly adjust the braking effort applied to each wheel at each given moment. ABS produces a redistribution of pressure in the branches of the hydraulic drive of the wheel brakes in such a way as to prevent wheel locking and at the same time achieve maximum braking power without losing control of the car.

The main task of the ABS is to support the relative sliding of wheels in narrow limits near the critical in the process of inhibiting. In this case, optimum braking performance is provided. For this purpose it is necessary to automatically adjust the braking torque which is supplied to the wheels during the braking process.

There are many different ABS designs that solve the problem of automatic control of the brake torque. Regardless of the design, any ABS must include the following elements:

• sensors, whose function is to provide information, depending on the adopted control system, the angular velocity of the wheel, the pressure of the working body in the brake actuator, the deceleration of the car, etc.;

• control unit, usually electronic, where the information from sensors is received, which, after the logical processing of the received information, gives the command to the executive mechanisms;

• actuators (pressure modulators), which, depending on what came from the control unit, reduce, increase or maintain the pressure in the brake drive of the wheels.

Adjustment process with ABS brake wheel is cyclic. With a large swing of cyclical fluctuations in pressure, comfort is disturbed when braking the “pull-up”, and the elements of the car feel additional load.

The speed determines the cyclic frequency of the change in brake torque. An important property of the ABS should be the ability to adapt to changing braking conditions (adaptability) and, first of all, to change the coefficient of adhesion during the braking process.

A large number of principles (algorithms of functioning), for which the ABS works, has been developed. Among them, the most widely used algorithm is the operation of retarding the braking wheel.

References

1. Волков В.П., Дюкарев Н.В., Волков Ю.В. Эволюция тормозного управления автомобиля. Харьков, 2018. С.55-59.
2. Антиблокувальна система [Електронний ресурс] – URL: http://ustroistvo-avtomobilya.ru/tormoznaya-sistema/abs/antiblokirovochny-e-tormozny-e-sistemy-abs.

Kolbasov D. A.

AIR MOTOR: DEVELOPMENT AND RESEARCH

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Language advisor – Cand. Ped. Sc., Assoc. Prof. Rudenko N. V.
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At the end of the first and beginning of the second decades of the twenty-first century, quite significant landmark events took place in the global automotive industry, which were commented on by the press: a number of large automotive companies at prestigious car dealerships presented the first prototypes of passenger cars designed specifically for compressed air, as well as hybrid models, running on gasoline and compressed air. For example, at the Los Angeles Motor Show on November 19–28, 2010 three air cars were presented at once: the Cadillac Aera, Honda Air and Volvo Air Motion [1].

The appearance at the car dealerships of such serious developments of a number of large automobile companies can be regarded as a kind of signal that the problem of introducing compressed air into motor vehicles as a driving force is recognized as relevant and, we can say, already put on the agenda of the development of environmentally friendly road transport, first of all car. This is also evidence that experimental and computational studies, the results of which are devoted to this work, are highly relevant.

The urgency of conducting research in this area and, above all, experimental, is also dictated by the very limited amount of experimental data in the literature, which is essential for calculating the actual working process of a piston air motor. Over the past decades, the attention of automobile builders to solve the problems of using compressed air for vehicle (CU) traffic has increased markedly, and is likely to increase further as the environmental situation in the world worsens and the cost of fuel oil and natural gas increases [2].

In Ukraine, at the Kharkov National Automobile and Highway University (HNADU) in 2007, an experimental model of a four-cylinder piston crank four-cylinder V-shaped pneumatic motor with a two-line rotary air distributor of rotary motion was created and tested for hybrid power plant of the Tavria automobile circuit spool.

This power plant with a capacity of 0.6–0.8 kW was mounted on the chassis of a car weighing 300 kg and passed the road tests. The working pressure of nitrogen was 10–12 atm.

In 2010–2011 A car built on the basis of a serial VAZ-2104 and running on compressed air was tested [3].

The conversion of the base internal combustion engine into an air motor was performed by O. B. Zbarsky in full accordance with the scheme presented in the patent of the author. The test results of a car with an air motor are considered unsatisfactory. It was decided to continue research on the finalization of the gas distribution mechanism.

Demand for such cars, without a doubt, potentially exists, since it is in itself an environmentally friendly vehicle, and the energy carrier (air) is inexhaustible.

This allows us to conclude that in the second decade of the XXI century in the global automotive industry there has been an increase in the scale of research and development work on the creation of cars on compressed air.

References

1. Абрамчук Ф. И. О достоинствах и целесообразности применения поршневого пневмодвигателя в составе автомобильной гибридной силовой установки / Ф. И. Абрамчук, А. И. Воронков, И. Н. Никитченко // Вестник ХНАДУ: сб. науч. тр. – 2010. – Вып. 48. – С. 200–205.

2. Пат. 49714 UA МПК FB43/00. Пневматичний двигун / Збарський О.Б.; заявник та патентовласник О. Б. Збарський. – №U200911310; заявл.06.11.2009; опубл. 11.05.2011, Бюл. № 9.

3. Воздухомобили. Автомобили, работающие на воздухе / Редакционная статья // Еженедельник «АвтоФотоПродажа». – 2008. – № 46. – С. 2–3.

Kravchenko S. Yu.

MAIN CHARACTERISTICS OF SNOW BLOWERS

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Previously, we could see snow removal equipment only on our streets and avenues. It was used exclusively by utilities for snow removal and usually it was a large tractor or grader. Today, small snow blowers are quite common. Many users have long appreciated all the advantages of a home snow blower. People buy snow blowers not only for using at their private houses or country houses. More powerful models of snow blowers work in the public utilities. They clear the park paths or places where heavy equipment cannot enter.

A snow plough (snow blower, snow blowing machine) is a special device designed for cleaning snow in certain areas by capturing it, grinding and throwing it in a certain direction. Let us consider the main characteristics of snow blowers:

1. Type of movement.

Depending on how the snow blowers move, they are self-propelled and non-self-propelled. Non- self-propelled snow blower is a mechanical snow blower that moves due to the movements of the operator. Self-propelled snow blower moves independently, which allows it to get closer by its class to motor-blocks or even mini-tractors.

Non- self-propelled snow plough has a smaller size and weight, so it is easier to use in areas where there is no possibility to turn around. This type of snow blowers is more careful regarding the surface cleaned. On the other hand, it is difficult for a non-self-propelled snow blower to remove frozen snow with a big cover height.

A self-propelled snow plough can move itself and it can remove snow of any density on fairly large areas, but it is more expensive than non-self-propelled one.

A non-self-propelled snow blower can be recommended to buy for using at private households. It will do the job and will cost relatively cheap.

2. Type of engine.

Depending on the type of engine, snow blowers, like saws, are divided into gasoline and electric ones.

• Electric snow blowers are predominantly non-self-propelled machines that use electric power for their work. They are characterized by a relatively small engine power (about 2-3 horsepower) and a rather large compactness.

• Petrol snow blowers are characterized by greater engine power (up to 10-15 hp); they can be both self-propelled and non-self-propelled. For ordinary household needs, you can buy an electric snow blower – it will help clear a relatively small area where there is access to the power supply.

If there is no normal access to the power supply, or you need to clean up a relatively large area, then it is better to choose a petrol snow blower.

3. Starting type.

The snow blower can be started from manual or electric start.

Manual start means jerking of the handle. When electrically starting, the snow blower starts using an electric starter powered by an internal battery or an electricity network. Electric start is more convenient, but manual one is more reliable, especially in winter conditions.

4. Coverage parameters.

Time and efficiency of its work depends on coverage parameters of the snow blower. These parameters include the width of the grip and the height of the grip.

The width of the grip is the width distance that the snow blower cleans in one pass. The greater the width the less you need to go back and forth with a snowplough to clean the desired space.

Most electric and non-self-propelled gasoline-powered snow blowers have the width of the grip varying within 30-55 cm. Medium-sized and powerful snow blowers can have a width within 60-80 cm.

The height of the grip is the height of the snow cover that the snow blower can handle. This indicator is more homogeneous for different models of snowploughs and is within 40-50 cm.

It is obvious that there is no point to overpay for the extra 5-10 cm of height or width of the grip, although this is the matter of preferences.

5. Other characteristics.

Some other important characteristics of operation of snow blowers include the following:

• Snow throw distance. It can be within one to four meters by cheap snow blowers; professional snow blowers can throw out snow for a distance of 10 meters or more.

• Availability of headlights. If you want to remove the snow at night – the ability to work of a snow blower with headlight will be most welcome.

• Heated handles (steering). This feature allows warming the hands of the operator in the process.

The most recommended snow blowers are made by such manufacturers as Husqvarna, MTD, Snapper, Texas, or by cheaper ones – such as Patriot. For example, the model of the Danish brand Texas, Snow King 5318WD. This is the device which has 4.5 horsepower, width of grip 53 cm and height of 51 cm. It can throw out snow at the distance of 11 meters, and the price for it is quite reasonable.

References

1. Blackburn, Robert R. Snow and Ice Control: Guidelines for Materials and Methods.-Transportation Research Board, 2004.

2. Sack, Ronald L. Snow Engineering: Recent Advances. - Taylor & Francis, 1997.

3. Как выбрать снегоуборщик. *Журнал агронома №1* URL: https://agronomu.com/bok/3089-kak-vybrat-snegouborschik-dlya-dachi-sovety-i-rekomendacii.html

Krysanov D. V.

TRENCHLESS TECHNOLOGIES AND METHOD OF STATIC PUNCTURE OF THE SOIL

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Language Advisor – Cand. Pedag. Sc., Assoc. Prof. Borzenko O. P.
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The increase of scope of works on building and reconstruction of underground communications in Ukraine (especially in urban conditions) requires the improvement of technologies and corresponding mechanization means. With this, one of the most effective areas is trenchless technologies, the use of which does not require excavation of trench along the axis of communication, that, in turn, results not only in sharp reduction of earth-moving scope, but also allows to save

the asphalt pavement of roads and pedestrian ways from destructions, green plantations of parklands, etc.

At building of new engineering networks or reconstruction of old ones, there is a necessity to cross different sort of obstacles in urban conditions, such as highways, tram tracks, pedestrian ways and small architectural forms (kiosks, bandstands, fences, etc.). The performing of works is especially complicated in central part of city, i.e. in more densely built-up part. Basic communications here are distributive networks, that provide the supply of water, heat and gas in houses, and also sewer collectors and cable networks of the different purpose. Their laying under the roads is carried out, as a rule, in protective cases: steel, asbestos-cement or polyethylene pipes, diameter of which reaches 300-500 mm, and length is 20-25 m.

The substantial disadvantage of the static soil puncture setup is a discrepancy between the created trajectory and the design one. Considerable deviations from the design trajectory substantially reduce the use of given technology within the limits of length of area of puncture to 20-30 m. Therefore, search of ways of improvement of the execution of works, namely, the increasing of accuracy of the puncture trajectory or upgrading the equipment with the possibility of its adjustment is a very important and relevant issue.

Method of static puncture of soil is one of the first and most simple methods of trenchless technology of laying the communications and is a development of horizontal mining hole by inducing the cone tip into the soil. This method is recommended to apply for the laying of pipes with a diameter of up to 350 mm in clay and loamy soils. There are the cases of puncturing the soil of up to 500 mm.

Technology of works consists in the following. At first, two pits of necessary sizes, starting and receiving ones, are excavated. Puncture setup is mounted in starting pit. By reciprocal movements of the hydro cylinders, the puncture head together with add-on foldable rod is induced into soil towards receiving pit. In receiving foundation pit the puncture head in changed for a reamer, to the rear side of which a pipe is fastened. Then in reverse direction the foldable rod is drawn out from the soil, extending a mining hole with the simultaneous drawing-in of the pipe.

Depending on soil and necessary diameter of communication, a mining hole shall be enlarged with the step-by-step drawing-in of reamers, increasing the further diameter by 40 mm [3]. Trenchless technologies of development of mining holes allow to decrease the scope of earthmovings and to reduce substantially the terms and cost of building and installation works. In comparison with a trench technology, they have the following advantages [2]:

- the labour intensiveness and cost of construction of transitions through operating highways, railways and tramways, canals, rivers, airfield facilities and other obstacles;
- the violation of the rhythm of normal traffic, rivers navigation, the work of seaports and airports is reduced;
- the damage to the environment is minimized;
- the need for drainage works in areas with high humidity or high groundwater levels is eliminated;

- the transporting of the developed soil is reduced or fully eliminated;

- the scope of restorative and recultivation works decreases (for the trench method, the area occupied by the territory for construction is ten times more than for trenchless methods);

- the terms of construction are significantly reduced;

- the safer conditions are provided for work of builders and casual passers-by.

One of main criteria of effective application of trenchless technologies is a condition of development of soil with its drawing-up from a mining hole. Proceeding from the above, all existing trenchless technologies can be divided into three large groups: development of mining hole by pressing the soil in its walls; development of mining hole with drawing-out of soil; and the combined method of development of mining hole.

From the foregoing, the following conclusion can be made. The static puncture setups find wide application through their simplicity of construction and exploitation, operational reliability. For the increase of efficiency of the static puncture setups, multi-year research was carried out to allow the operative adjustment of the puncture trajectory. At present, technologies and methods for controlling the trajectory of the movement of the operational puncture part are developed, based on the construction of its head and the alternation of its rotational and forward movement.

References

1. Бородавкин П. П. Подземные магистральные трубопроводы. Москва : Недра, 1982. 384 с.

2. ВСН 179-85. Инструкция по рекультивации земель при строительстве трубопроводов. Изд. офиц. Москва : Миннефтегазстрой, 1985. 36 с.

3. Лысиков Б. А., Кауфман Л. Л. Подземная инфраструктура городов: опыт зарубежного строительства : монография. Донецк : Норд-Пресс, 2004. 204 с.

Kulisch S. S.

ERHÖHUNG DER DAUERHAFTIGKEIT UND DER ABNUTZUNGSFESTIGKEIT VON HYDROSTATISCHER ANTRIEBSTEILE GEFESTIGT MIT NEUER TI-CR-N-LEGIERUNG, DIE DURCH PLASMA-METHODE VERWENDET WIRD

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Das Studium der Muster der Veränderungen in der Struktur und den Eigenschaften von Materialienim Arbeitsprozess und die Entwicklung von Methoden zur Erhöhung der Dauerhaftigkeit der Arbeit der Teile des hydraulischen Antriebs ist ein aktuelles Problem.

Die Beschichtung von Titannitrid auf einen Teil eines Volumen-Hydraulikstellglieds hat die tribotechnischen Eigenschaften erheblich beeinflusst: Erhöhter Verschleißwiderstand, verringerter Reibungskoeffizient. Die Wirksamkeit dieser kritischen Teile hängt jedoch von der Dauerhaftigkeit ab, wobei in diesem Fall die Gefahr der Rettungsfläche auf null reduziert oder reduziert wird, und von einem so wichtigen Indikator wie der Korrosionsbeständigkeit.

Auf der Grundlage der Analyse von Arbeiten zur Verwendung von Plasmabeschichtungen [8, 9] wurden wir ausgewählt, um das Ti-Cr-N-System mit einem vorherigen Ionenbeschuss der Chromoberfläche abzudecken.

Cr wurde als Material für das Ionenbombardement gewählt, da es die Möglichkeit bietet, die Substrattemperatur vor dem Beschichten zu senken und die Gefahr eines Abriebs der Oberfläche zu vermeiden.

Der Ionenbeschuss erhöht die Dichte der Keimbildungszentren, reduziert die Anzahl der Leerstellen und die Zeit, leitet die Wärmeenergiedirekt in die Oberflächenzone ein und stimuliert die Diffusionsprozesse.

Ionenbeschuss führt zur Verringerung der Korngröße und trägt zur Bildung nanokristalliner Filme bei. Durch Steuern der Energie- und Flussdichte von bombardierenden Ionen ist es möglich, die Größe der Körner zu steuern.

Es ist bekannt, dass die beste Kombination aus Festigkeit und plastischen Eigenschaften auftritt, wenn die Korngröße weniger als 10 nm beträgt [10]. Daher wurde der Einfluss der Ionenenergie auf die Korngröße während der Ausfällung der Ti-Cr-N-Beschichtung betrachtet.

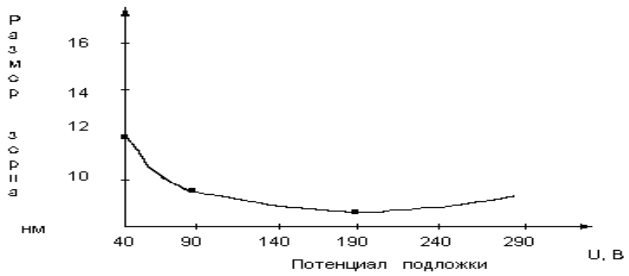

Abb. 1.1- Abhängigkeit der Größe der Körner der Beschichtung Ti-Cr-N vom Potential des Substrats von Stahl 38X2MIOA.Pfeilstrom 80 A, Stickstoffdruck 7 Pa

Wir sehen, dass die minimalen Korngrößen innerhalb von 7 bis 8 nm liegen, wobei sich das Substrat 150 (dies ist ein negatives Potential, das positive Ionen zum Substrat beschleunigt). Es besteht die Tendenz, die Korngröße von 12 auf 5 nm zu verringern, wobei das Substratpotential von 0 auf 150 ° steigt, wobei das Wachstum der Körner weiterzunimmt. Der Wachstumsprozess beruht auf einer Erhöhung der Temperatur in der Oberflächenschicht, die unter der Wirkung eines Ionenbeschusses erhitzt wird.

Studien haben gezeigt, dass die Körnung umso kleiner ist, je niedriger die Temperatur des Substrats ist. Daher ist es in jedem speziellen Fall erforderlich, den Abscheidungsprozess zu optimieren, um die gewünschten Ergebnisse zu erzielen.

Für die Beschichtung von Ti-Cr-N wurde die Installationskammerumgebaut. In der Mitte der Vakuumkammer ist eine zylindrische Schale mit den Teilen montiert, die auf die Beschichtung aufgebracht werden. An den Seitenflanschen der

Vakuumkammer befinden sich Plasmaquellen, die auf den Vakuumlichtbögen basieren, die Metallkathodenenthalten. Eine der Quellen des Plasmas (Kathode) war Evaporated Ti und der Rest der beiden - Cr.

Die Gleichmäßigkeit der Beschichtung in der Dicke wurde durch die Wahl der Rotationsgeschwindigkeit der Auskleidunggewähr leistet. Die optimale Rotationsgeschwindigkeit beim Aufbringen einer Dreikomponentenbeschichtung beträgt 10 U / min.

Das entwickelte Verfahren brachte Ti-Cr-N-Beschichtungen mit der folgenden Korrelation der Bestandteile (Gew .-%) Ti von 10 bis 75 auf; Cr 5-70; N von 15 - 21.

Für die Sichtbarkeit ist die grafische Darstellung der Antwortoberfläche in den Abbildungen 1.2 - 1.6 dargestellt.

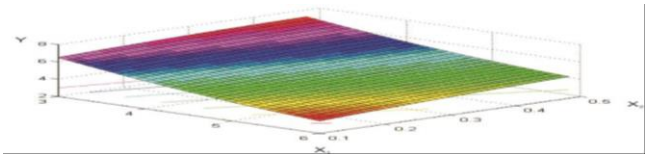

Abb. 1.2 - HRC-Oberflächenreaktion 42

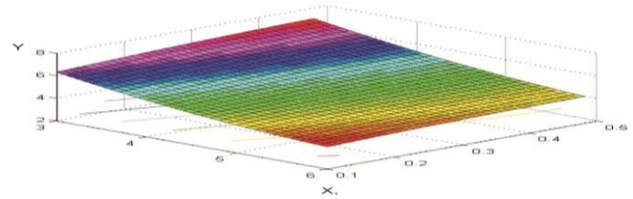

Abb. 1.3 - HRC-Oberflächenreaktion 43

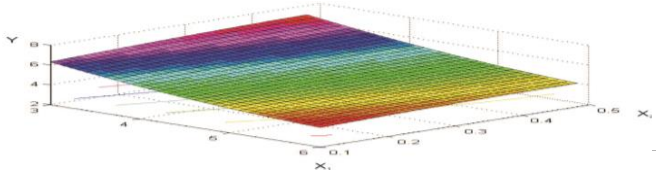

Abb. 1.4 - HRC-Oberflächenreaktion 44

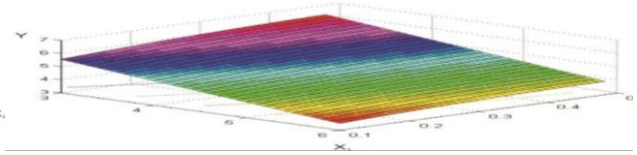

Abb. 1.5 - HRC-Oberflächenreaktion 45

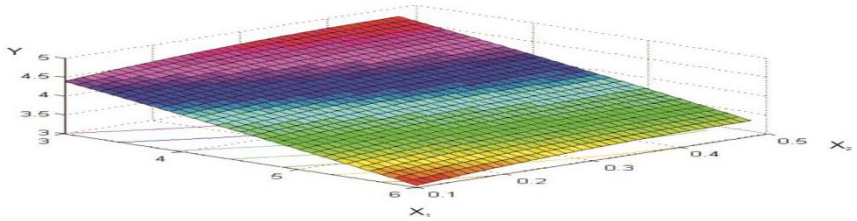

Abb. 1.6 - HRC-Oberflächenreaktion 46

So, es wurde eine neue Beschichtung eines Ti-Cr-N-Systems mit einem Vorionenbeschuss auf die Cr-Oberfläche entwickelt, die es ermöglicht, die Temperatur der Substraterwärmung vor dem Beschichten zu verringern und die Möglichkeit einer Verschlechterung auszuschließen. Ti-Cr-N-Beschichtung wird mit dem folgenden Verhältnis der Bestandteile (Gew .-%) Ti von 10 bis 75 aufgetragen; Cr 5-70; N von 15-21. Bestimmen Sie durch Röntgenphasenanalyse die Zusammensetzung der aufgetragenen Beschichtung. Die Neuheit der entwickelten Beschichtung wird durch die Patentnummer 331864 vom 25.04.08 bestätigt.

Mit Hilfe der Theorie der Planung des Experiments wurde festgestellt, dass der geringste Verschleißwert auftritt, wenn die Oberflächenhärte auf die Oberfläche

von HRC45 aufgebracht wird, die Oberflächenrauheit 0,16beträgt und die Dicke der aufgebrachten Beschichtung 6 Mikrometer beträgt.

Literatur

1. Аврунин А.Г. Обзор мирового и отечественного рынков гидрооборудования. *Мир техники и технологий*. 2009.№ 8(93). С. 10–14.
2. Аврунин Г.А. Методика расчета объемного гидропривода для двухпоточной гидромеханической коробки передач. *Промислова гідравліка і пневматика*. 2009. № 1(23). С. 15–20.
3. Аврунин Г.А. Объемный гидропривод и гидропневмоавтоматика : учебное пособие. Харьков : ХНАДУ, 2008. 412 с.
4. Нахайчук О.В. Выбор критериев разрушения для оценки деформируемости заготовок. *Вісник Східно-укр. нац. ун-ту ім. В. Даля*. 2006. № 6. Ч.2. С. 24–28.
5. Приймаков А.Г. К вопросу о рациональном выборе допускаемых напряжений в машиностроении. *Механіка та машинобудування*. 2004. №2. С. 57–63.
6. Рыжков Ю.В. Повышение эксплутацационных характеристик деталей гідропередач. *Мир техники и технологий.* 2009. №8(93). С. 16–17.
7. Рыжков Ю.В. Эффективный метод повышения износостойкости узлов объемного гидропривода. Материалы 4-й международной конференции «Стратегия качества в промышленности». Варна. Болгария, 2008. Т. 1. С. 406–408.
8. Ситников А.А. Назначение параметров точности при разработке конструкций деталей с износостойким покрытием. Изд. вузов : Машиностроение. 2004. № 10.

Leontenko A.

TRUCK CRANES

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Before 1960, cranes carried additional booms with them to increase height, which increased operating costs. In 1959 crane expert R.H. Neal, hydraulics specialist F.Taylor, and design director Bob Lester integrated all three and modernized cranes. The Coles Hydra Speedcrane appeared in 1962, further modified with the 10-ton fully telescopic hydraulic boom in 1966, followed in 1968 by the 30-ton "Husky" military versions with four-wheel drive. In 1972, Steels was forced to merge with the Acrow Group, losing some of their most valuable employees, including Don Hassel and Johnny Johnson who started a new manufacturing processes plant. With backing from the British Crane Hire Corporation they acquired a small factory unit and ordered every single element of their product from subcontracted suppliers. In 1976, the Cosmos team created a 25-ton crane that combined several state-of-the-art developments [3].

Sunfabs founder, Eric Sundin, started a factory in Arbrå 1925 to produce skis under the name Sundins. The Swedish military became aware of the innovative ski manufacturer and began buying large quantities of skis, whereupon the company grew rapidly. After a fire in 1927, the ski factory moved from Arbrå to Hudiksvall. The company grew quite rapidly from its early premises. In 1936 Eric Sundin bought an old industry plant at Hudiksvall harbour, where operations were moved. In the 1960s, Sundins was one of the world's largest ski manufacturers. In addition, demand increased constantly, both at Sunfab pumps and Hiab cranes. It was too much for a family to manage themselves. Therefore in 1965 Hiab was sold to an investment company. Eric Sundin, however, continued to work on Sundin's factories until he passed away in 1975. In the 80s competition increased from ski manufacturers all around Europe, which resulted in Sundins discontinued its ski manufacturing, 1989. In the early 90s Sundin's factories changed name to Sunfab Hydraulics AB. In addition to that they developed the well-known SC-pump they also developed a hydraulic motor. By this time Sunfab delivered about 8 000 pumps a year. Today, the number of sold pumps and motors is over 40 000 a year and Sunfab is a well known brand all over the world [3].

In fact, their versatility is such that it can be hard to keep track of what kind of mobile crane is required. Truck crane is a jib type crane, which can be equipped with turret-boom equipment and moves without load, without requiring special ways and which stability is provided by gravity. Automobile cranes are assembled on the chassis of commercially produced trucks with front and rear outriggers mounted on the frame to ensure stability when the crane is operating with a load and to increase its elevating capacity. They can move independently on dirt roads and climb up to 20 °. The main advantage of automobile cranes is their high mobility, which makes it possible to quickly move them to objects remote from each other. Hydraulic Cranes: Run on hydraulics, oil is pushed from one cylinder to another to give this type of crane its awesome strength. Hydraulic mobile cranes are reliable, so it comes as no surprise that they’re the most common. Most cranes today are hydraulic because of their safety features and smooth operation.

All Terrain Cranes: As the name suggests, this type of crane is an all wheel drive crane that can travel on both highways and gravel roads to get the crane into position for the lift. With the new engineering advancements in crane set up, these cranes are now ideal for remote job site locations like wind farms. Compared to the heavy lifting power of a crawler crane, all terrain cranes are easier to set up and move around the job site which means they can help the installation crews get the job done quicker. Rough Terrain Cranes: Specially designed to operate off road, rough terrain cranes have all-wheel drive capabilities and rubber tires to help them drive ditches and potholes on the road. With lower capacity lifting abilities, these cranes work well in situations where the lift radius and rough ground conditions don’t need high or heavy lifts. Many iron framed buildings implement the use of rough terrain cranes. Crawler Cranes: Working in partnership with telescopic and lattice booms, crawler cranes are self-propelled cranes on tracks. They are incredibly powerful machines that range from 90 to 1200 ton in capacity. Typically crawler cranes are used in bridge construction, concrete tilt up and wind farm installation projects. Carry Deck Cranes: This type of mobile crane can rotate on a

full 360 degrees axis, making them perfect for operating in confined construction areas. Exactly as the name suggests, carry deck cranes have small decks where they can lift and place equipment, like barrels, onto it's deck and relocate it to another location on the job site [4].

Truck crane today is one of the most popular types of special equipment. The construction of facilities, the construction of various metal structures, the movement and transportation of goods over short distances - these are the areas of application of modern mobile lifting devices. The market of truck cranes is traditionally divided among themselves by the largest domestic manufacturers "Ivanovets", "Chelyabinets", "Galician" and "Klintsy", as well as manufacturers from Germany, Japan and China, among which are such brands as Liebherr and XCMG.

Reference

1. Автомобільний кран URL: https://ru.wikipedia.org/wiki/Автомобильный_кран (дата звернення: 15.12.2018).

2. Mobile crane URL: https://en.wikipedia.org/wiki/Mobile_crane (дата звернення: 15.12.2018).

3. Truck's history URL: https://www.sunfab.com/about-us/history.aspx (дата звернення: 15.12.2018).

4. Mobile crane URL: https://www.tntcrane.ca/what-is-a-mobile-crane (дата звернення: 15.12.2018).

Lyubimov Yu. Yu.

AUTOMATION AND REMOTE CONTROL OF TOWER CRANES

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At the moment most tower cranes are controlled from the cab (at height) which creates certain inconveniences in operation, for example, at least 2 people (a coordinator and an operator) are required to install an object on a local position. This paper describes the development, creation, installation and operation of equipment for remote control of a tower crane (directly from the ground, near a moving object).

Micro Controller Unit (MCU) is a microchip designed to control electronic devices. To build the Control block, we will use the ATmega2560 microcontroller installed on the base of the Arduino mega 2560 board (Fig. 1).

The board has 54 digital inputs / outputs (14 of which can be used as PWM outputs), 16 analogue inputs, 4 UART serial ports, a 16 MHz crystal oscillator, a USB connector, a power connector, an ICSP connector and a reset button.

This board will serve as the control centre of the tower crane (TC).

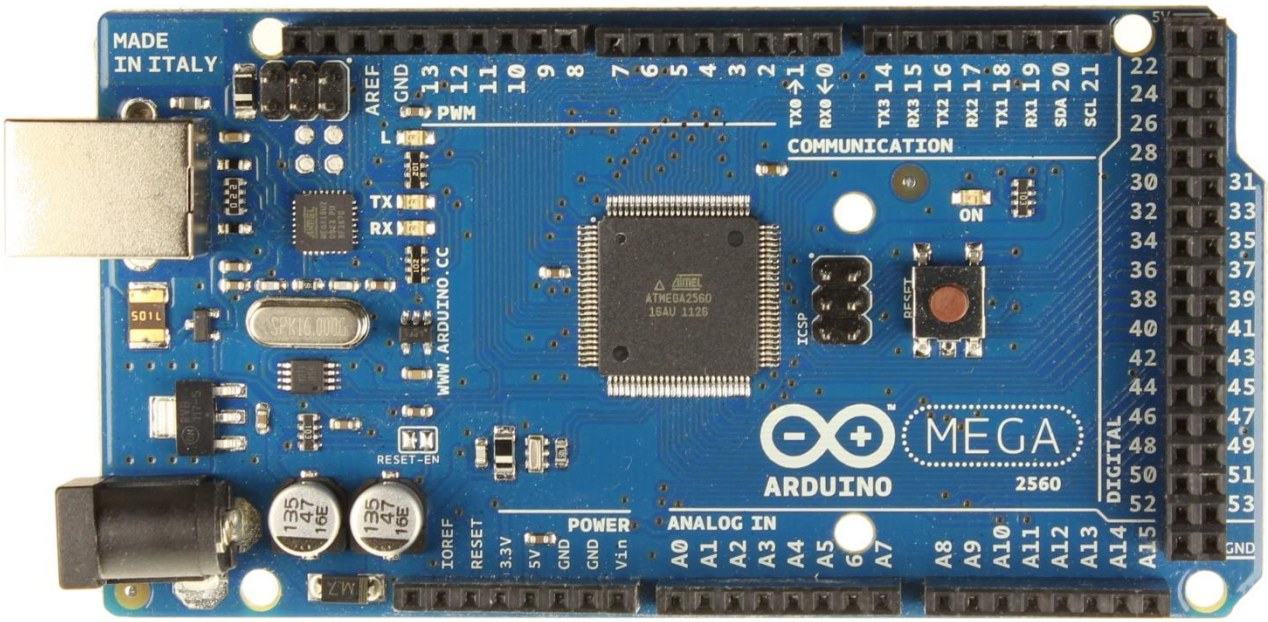


Fig. 1. – ATmega2560 microcontroller installed on the base of the Arduino mega 2560 board

The connection between the TC control block and the control element can be carried out by 3 ways:

- Bluetooth module;
- WiFi module;
- Radio module (2.4 GHz).

As the operability testing will be held in the laboratory, there is no need to use radio and Wifi modules (due to short distances). So we select the bluetooth module HC-06 (Fig. 2).

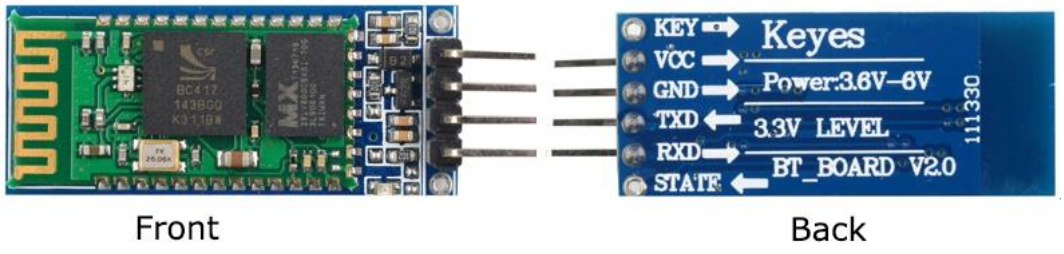
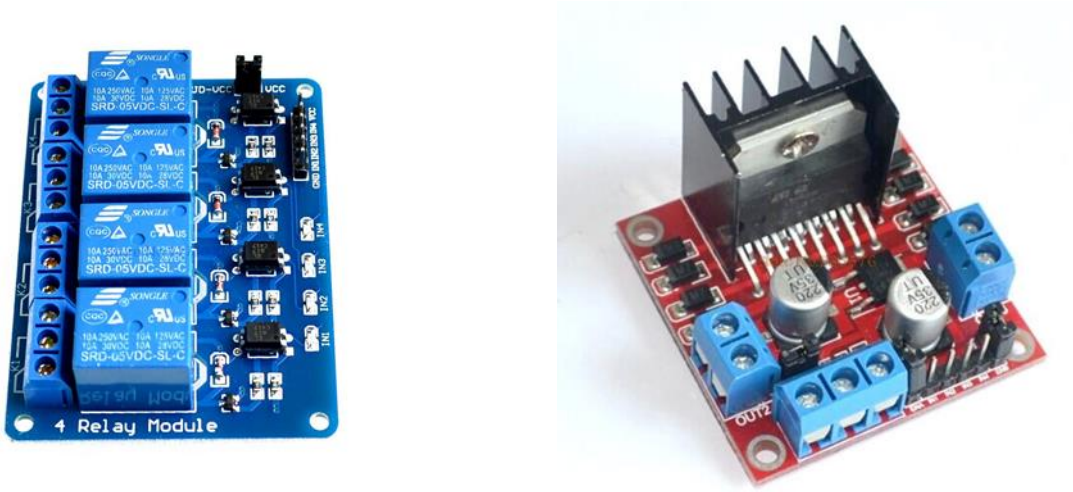


Fig. 2. – The connection between the TC control block and the control element by Bluetooth module HC-06

A 4x relay module and ln298 engine driver will be used to supply the voltage to the drives (Fig. 3).

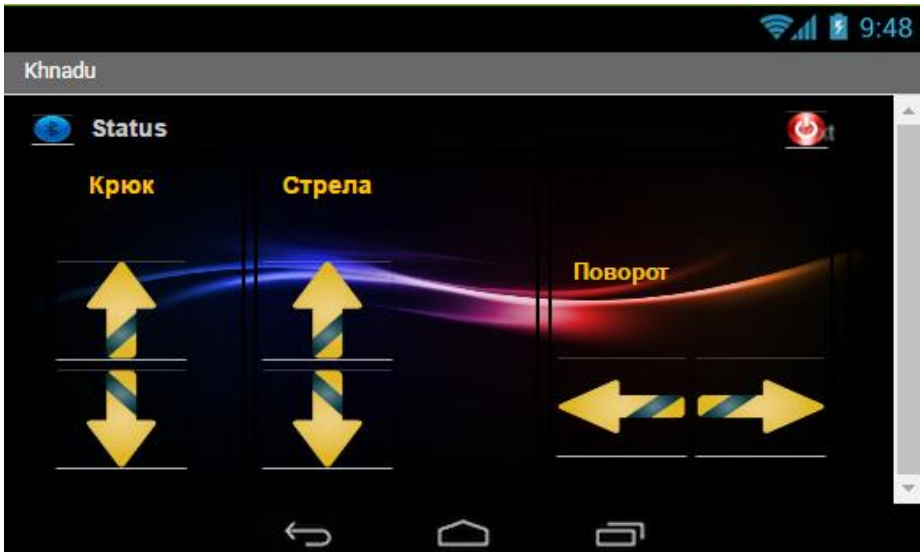
The drive rotating the crane and the load lifting drive will be connected to the relay module (a) because the current consumption is higher than 2A, and the lift boom drive to the driver of the engine (b) because it allows you to adjust the lifting speed of the crane element.



a b

Fig. 3. – A 4x relay module and ln298 engine driver

A smartphone on the Android operating system (5.1) will be used as the control body. It uses the original application with a graphical interface.



In total, the interface has 2 areas: this is directly the control area and the status area.

The control area has 6 commands: two for each element of the crane, and the status bar displays the status of the connection to the crane and the button off.

The application was written in the “app inventor” environment using a block programming system, which simplifies subsequent upgrades and improvements. Depending on the button pressed on the smartphone screen, it sends a command to the “Bl module” installed on the crane from where the command is read. The delay between pressing and executing a command is less than 10ms, which provides a good working condition.

Marchenko A.

SELECTION OF RATIONAL TECHNICAL AND ECONOMIC PARAMETERS OF A HYBRID VEHICLE

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Language Advisor – Dr. Ped. Sc., Prof. Saienko N. V.
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Research of the negative effects of motor transport complex development allows to identify two ways of road transport effect on the environment considering its insufficient level of environmental and technological perfection. Firstly, motor transport consumes significant amount of natural and raw materials, especially non-renewable and scarce energy resources such as oil or gas, and secondly – pollutes environment. These problems can be solved comprehensively due to the development and implementation of hybrid and electric vehicles.

For today there is no single concept of building hybrid power plants; each manufacturer is implementing their own version of hybrid technology. Hybrid power plants are classified by the method of connecting the motor and the storage device to the drive: consecutive, parallel, consecutive parallel. General Motors Corporation introduces a consecutive hybrid scheme in the hybrid electromobile Chevrolet Volt. The international industrial company Honda Motor Corporation is developing hybrid vehicles Honda Insight, Honda Civic Hybrid, Honda CR-Z and others using the parallel scheme. Toyota Motor Corporation produces hybrid vehicles of the line Toyota Prius, Lexus RX400h, Lexus GS450h and others using consecutive parallel technology.

The purpose of the research is to choose and substantiate rational technical and economic parameters of the hybrid vehicle according to the principle of hybrid vehicle construction: economic, energy, environmental parameters.

The energy principle of hybrid power plant construction considers the motion of a hybrid vehicle in terms of optimal energy consumption (fuel and electricity) taking into account the efficiency of the electric and internal combustion engines.

It is practically advisable to apply traction electric drive with the speed of up to 22.22 m/s, and at higher speeds to use ICE according to the principle of energy hybrid power plant construction. Herewith the ratio of electric motor power to ICE power is within 1/2 ... 1/1. The cars built on the economic principle include the Toyota Prius of versions 2 and 3, in which the maximum speed of electric drive reaches 16.67 m/s.

The simulation results show that the increase of the vehicle weight almost directly proportionally leads to the increased power of the ac converter-fed motor for supporting the stable established speed. At the same time, the increase of the established speed causes the increase of the ac converter-fed motor power by the exponential dependence with the same weight of the vehicle.

Thus, the main parameters determining the cost of the electric vehicle motion are its weight and velocity. At speeds over 22.2 m/s the required power of the ac converter-fed motor increases significantly and these modes of operation are not economically profitable. According to this simulation it can be concluded that the most economical mode for the electric vehicle is within the range of 0 ... 16.7 m/s.

The minimum power consumption from the traction car batteries with the established speed of a vehicle in “only electricity” mode is a bit less than 8.3 m / s. This value is confirmed by the data of the experiment, carried out on Toyota Prius and the hybrid concept of ZAZ Lanos pickup, which was created at the Department of automobile electronics.

The maximum power consumption of the traction car batteries is determined at the established maximum calculated speed 38.9 m/s (140 km/h) which exceeds the minimum rate of power consumption from traction car batteries of the established speed 8.3 m/s almost 4.5 times for any weight of the vehicle. Power consumption from traction car batteries at the lowest estimated rate in 2.78 m/s exceeds 1.7 times the minimum power consumption energy for any weight of a vehicle.

The simulation results show that the most economical mode is within 5.56 ... 11.1 m/s of established speed of the vehicles with different weight. To overcome in the “only electricity” mode maximum distance it is necessary to move on the established speed rate about 8.3 m / s. The increase of vehicle weight from 800 kg to 2000 kg reduces the distance almost in 2.5 times.

The results of the simulation prove that the best economical mode is within 5.56…11.1 m/s of the established speed for vehicles of various weights. To overcome in the mode “only electricity” the maximum distance of motion it is necessary to move at an established speed of nearly 8.3 m/s. The increase of the vehicle weight from 800 kg to 2000 kg decreases length of run 2.5 times.

The increase the speed of the vehicle from 8.33 m/s to 38.89 m/s leads to the increase in equivalent fuel consumption almost 4.5 times. Herewith the equivalent fuel consumption at speeds up to 25 m/s is less than 1 liter/100 km for vehicles weighing 2000 kg, and for vehicles weighing up to 800 kg equivalent fuel consumption at speeds up to 25 m/s is less than 0.4 liters/100 km.

The results of the simulation show that the maximum mileage of 90 km can be reached for a vehicle weighing 800 kg with the established speed of 8.3 m/s and power capacity of traction car batteries 8.64 kW/h that corresponds to power capacity of 30 car batteries of the TS-LFP90AHA type. The increase of the vehicle weight almost directly proportionally reduces the length of run. In similar conditions the vehicle with the weight 1200 kg covers the maximum length of run in 62 km, the one weighing 1600 kg – 47 km, a vehicle weighing 2000 kg – 38 km.

The length of run is affected by the established speed. The increase in the established speed in the mode “only electricity” from 8.3 m/s to 22.2 m/s decreases the length of run twice, while the increase in the established speed of the vehicle from 8.3 m/s to 22.2 m/s decreases the length of run three times. Reducing the established vehicle speed in “only electricity” mode from 8.3 m/s to 2.78 m/s reduces the length of run 1.7 times.

The hybrid concept based on the ZAZ Lanos pickup that complies with the economical principle of hybrid power plants construction was designed at the Department of automobile electronics. To supply power to the electric drive of the hybrid concept 20 series-connected car batteries TS-LFP90AHA with the total power capacity of 5.76 kW·h are used. In order to increase competitiveness and economic attractiveness of environmentally friendly vehicles, they should be sold

in the budget segment, and as for functional features and specifications they should exceed the best foreign prototypes, e.g. Toyota Prius. When designing a hybrid vehicle in the budget segment the most promising is the economic principle of designing hybrid power plants, which implements all basic advantages of hybrid vehicles, such as movement in the mode of the electric car, charging from stationary electric network and others.

References

1. Бажинов О. В., Смирнов О. П., Сєріков С. А., Двадненко В. Я. Синергетичний автомобіль. Теорія і практика: моногр. Х.: ХНАДУ, 2011. 236 с.

2. Гібридні автомобілі: моногр. / О. В. Бажинов, О. П. Смирнов, С.А. Сєріков та ін. Х.: ХНАДУ, 2008. 327 с.

3. Смирнов О. П. Аналіз схемних рішень побудови автомобіля з гібридною енергетичною установкою. *Вестник ХНАДУ*. 2006. № 32. С. 41–43.

Martynenko S. A.

APPLICATION OF INFORMATION SYSTEMS IN TRANSPORT

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Information system is a collection of organizational and technical means for the storage and processing of information in order to ensure the information needs of users. According to DSTU 2392-94, information system (IS) is a communication system that provides collection, search, processing and forwarding of information.

Information systems have long been quite widespread (in one form or another) in the life of humanity. This is due to the fact that the existence of civilization requires the exchange of information.

In any information management system, three types of tasks are solved: 1) tasks of situation assessment (sometimes referred to as pattern recognition tasks); 2) tasks of transforming the description of the situation (settlement problems, modeling tasks); 3) tasks of decision-making (including optimization).

Information systems include: technical means of data processing, software and related personnel. The four components form an internal information base: means of recording and collecting information; means of transfer of relevant data and messages; means of preservation of information; means of analysis, processing and presentation of information.

Modern development of electronics and microprocessor technology has led to constant electronic monitoring of vehicle parameters, traffic, navigation.

Implementation of monitoring translates the organization of transport processes to a higher quality level, which increases the efficiency of overall management.

The monitored information received by the driver of the vehicle is provided by: increasing vehicle reliability and safety; rapid decision-making in case of unforeseen circumstances. With the help of information systems it is possible to solve the following problems: to increase the speed of information processing, to minimize errors in the collection and processing of information, which increases the speed and accuracy of decision-making; to increase the amount of information being processed and the number of options for making a well-founded decision in order to ensure the optimal use of resources and a worker's responsibility.

Transport tools for monitoring are as follows: sensors and on-board computer systems for monitoring the vehicle condition; sensors of passing the vehicles through control zones with recording characteristic features; on-board modules for navigation and communication; the unit of the navigator with the receiver and the calculator, the radio transmitter and the radio; navigation satellite systems that provide determination of the location of vehicles up to 10 m on the electronic map of the area; cellular and satellite communication and information exchange systems; computer data processing; neuro computer image recognition technologies.

Currently, a large number of various automatic information systems (AIS) with a very wide range of uses are being developed and implemented. In the AIS, all functions of data management and processing are carried out by technical means without the participation of a person (for example, automatic control of technological processes).

Automated information system is an interconnected set of data, equipment, software, personnel, standard procedures that are intended for collection, processing, distribution, storage, presentation of information according to requirements. The information system, as a management system, is closely linked to both systems for storing and delivering information. It covers a set of tools and methods that allow the user to collect, store, transmit and process selected information.

Electronic control modules have become the main direction of improvement of cars and their indicators. They are equipped with an engine, wheel drive, transmission, clutch, braking, steering, etc. All this makes it possible to switch to a fully automated driving car, so the modern car is often named "computer on wheels".

In modern truck designs and manuals, integrated systems of electromechanical control (EMC) are used that greatly improve the performance of vehicles, reduce maintenance costs, improve a driver's comfort and maintain the efficiency of maintenance.

EMC is integrated in all three components of the car's design: mechanics – engine, transmission, brakes and other systems that ensure the movement of vehicles, their handling and safety; electricity – ignition, headlights, computer control systems; transport logistics – monitoring of vehicles, passenger registration systems, payment systems, etc. Therefore, the latest generation of vehicles has an on-board data transmission network that supports the exchange of messages under certain rules-protocols. This allows all EMC nodes of "cars" to understand each

other. When necessary, data is transferred from one protocol to another due to using special gateways.

References

1. Гайдамакин Н. А. Автоматизированные системы, базы и банки данных. Вводный курс: Учебное пособие. М.: Гелиос АРВ, 2002. 368 с.
2. Грицунов О. В. Інформаційні системи та технології. Навчальний посібник. Х.: ХНАМГ, 2010. 222 с.
3. Избачков Ю. С. Информационные системы: учебник. СПб., 2008. 656 с.
4. Методи та засоби мультимедійних інформаційних систем: навч. посіб. / Т. М. Басюк, П. І. Жежнич. Львів, 2015. – 426 с.

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HIGH PRESSURE FUEL PUMP

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The high pressure fuel pump is abbreviated to the injection pump. This device is one of the most complex in the design of a diesel engine. The main task of such a pump is to supply diesel fuel under high pressure. The pumps provide fuel to the cylinders of a diesel engine under a certain pressure, and also strictly at a certain moment. Portions of the supplied fuel are measured very accurately and correspond to the degree of engine load. Pumps are distinguished by the method of injection. There are pumps of direct action, as well as pumps with battery injection.

Direct-acting fuel pumps are mechanically driven by a plunger. The processes of injection and fuel injection occur at the same time. In each individual cylinder of the diesel internal combustion engine, a certain section of the injection pump delivers the required dose of fuel. The pressure that is necessary for effective spraying is created by the movement of the plunger of the fuel pump.

The fuel injection pump with battery injection is characterized by the fact that the actuator of the working plunger is influenced by the pressure forces of the compressed gases in the cylinder of the internal combustion engine itself, or by means of springs. There are fuel pumps with a hydraulic accumulator, which have been used in powerful low-speed diesel internal-combustion engines. It is worth noting that systems with a hydraulic accumulator are characterized by separate injection and injection processes. Fuel under is pumped by the fuel pump into the battery under high pressure, and only then goes to the fuel injectors. This approach provides effective atomization and optimum mixing, which is suitable for the entire range of loads on the diesel unit. The disadvantages of this system include the complexity of the design, which caused the unpopularity of such a pump.

The device experienced an evolution. The tightening of environmental regulations and requirements for emissions of harmful substances into the

atmosphere led to the fact that high-pressure mechanical fuel pumps for diesel cars were replaced by electronically controlled systems. The mechanical pump simply could not provide the dosing of fuel with the required high accuracy, and was also unable to respond as quickly as possible to dynamically changing engine operating conditions. World-famous manufacturers Bosch, Nippon Denso and others offered electronic fuel management systems. These developments were based on the VE fuel pump. Such systems made it possible to achieve an increase in the accuracy of fuel metering into each cylinder separately. The introduction of electronic systems ensured a decrease in the instability of the combustion process of the fuel-air mixture between the cycles, as well as the reduction in irregularities during the operation of a diesel engine at idle.

Some systems had a quick-action valve in their design, which made it possible to divide the process of fuel injection into two phases. Two-phase injection resulted in a final decrease in the stiffness of the mixture combustion process itself.

The accuracy obtained in the process of controlling the injection system provided reduction in emissions of toxic substances due to a more complete combustion of the fuel-air mixture, and the higher efficiency of such combustion increased the engine efficiency and increased the total power of the power plant.

The principle of the system is as follows. The computer receives corresponding signals from various sensors. The position of the gas pedal, engine speed, coolant temperature and fuel temperature are taken into account. The electronic control unit receives data on the lift of the injector needle, the speed of the vehicle, the charge pressure of the air and its inlet temperature.

The ECU processes the information received from the sensors and then sends a signal to the high pressure pump. This ensures that the required and optimal amount of fuel is delivered to the injectors. Additionally, the best injection advance angle is provided, taking into account the specific conditions of the engine operation. Any additional load is immediately noted by the ECU, a signal comes to the pump and an increase in fuel supply occurs to compensate for the increased loads.

The electronic control unit monitors the operation of the glow plugs. The computer monitors the incandescent period, the glow plugs and the post-glow period. All this happens taking into account the dependence on temperature.

The ECU is responsible for creating signals that allow for the adjustment of multiple processes. The control unit stabilizes the rotational speed in idle mode, adjusts the recirculation of exhaust gases with the definition of indicators on the signals of the mass air flow sensor. The block compares the signals in real time from the sensors with the values that are programmed in it as optimal. Next, the output signal is transmitted from the ECU to the servo-mechanism, which ensures the necessary position of the metering coupling. In this case high precision regulation is achieved.

References

1. Афонин С.В. (ред.) Впрыск дизельных двигателей. Легковые и грузовые автомобили, судовые установки, яхты, стационарные установки. Батайск, 2004. 148 с.

2.Guzzella, L. Sciarretta, A. Vehicle Propulsion Systems. Berlin, 2007. 213 p.

Mastepan O. A.

MATERIAL AND TECHNICAL SUPPORT OF MONITORING AND EVALUATING THE QUALITY OF SERVICES OF THE VEHICLE MAINTENANCE AND REPAIR

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To carry out its activities, the auto service enterprise must have various work equipment. The totality of work equipment makes up the material and technical base of the enterprise. The material and technical base is the foundation for the quality of auto service, as it creates all the necessary conditions for serving customers with a full range of services.

Material and technical support is a way of organizing the activities of the enterprise. This method allows to combine the efforts of various units that produce and sell goods and services in order to optimize financial, material and labor resources. The enterprise uses these resources to realize its economic goals. In the course of its operation, the company needs a whole range of material and technical means. The process of material and technical support of production is aimed at timely delivery of the necessary material and technical resources to the warehouses of the enterprise or immediately to the workplaces.

The material and technical resources include: raw materials, materials for the product completing, technological equipment (devices, cutting and measuring tools), new vehicles, computing equipment and other equipment, as well as fuel, energy, water. In other words, everything that comes to the enterprise in the form of things and energy belongs to the elements of the material and technical support of production.

These issues are solved by the service of the material and technical support of the enterprise, which calculates the needs of the enterprise in various materials, and also determines the sources of their supply. The structural scheme of the material and technical base is shown in Figure 1.

The smooth functioning of the production is provided by the units of material and technical supply. The main task of the enterprise's units of supply is the timely and optimal provision of production with the necessary material resources. In this regard, the topic of economic and timely procurement of raw and other materials is very relevant.

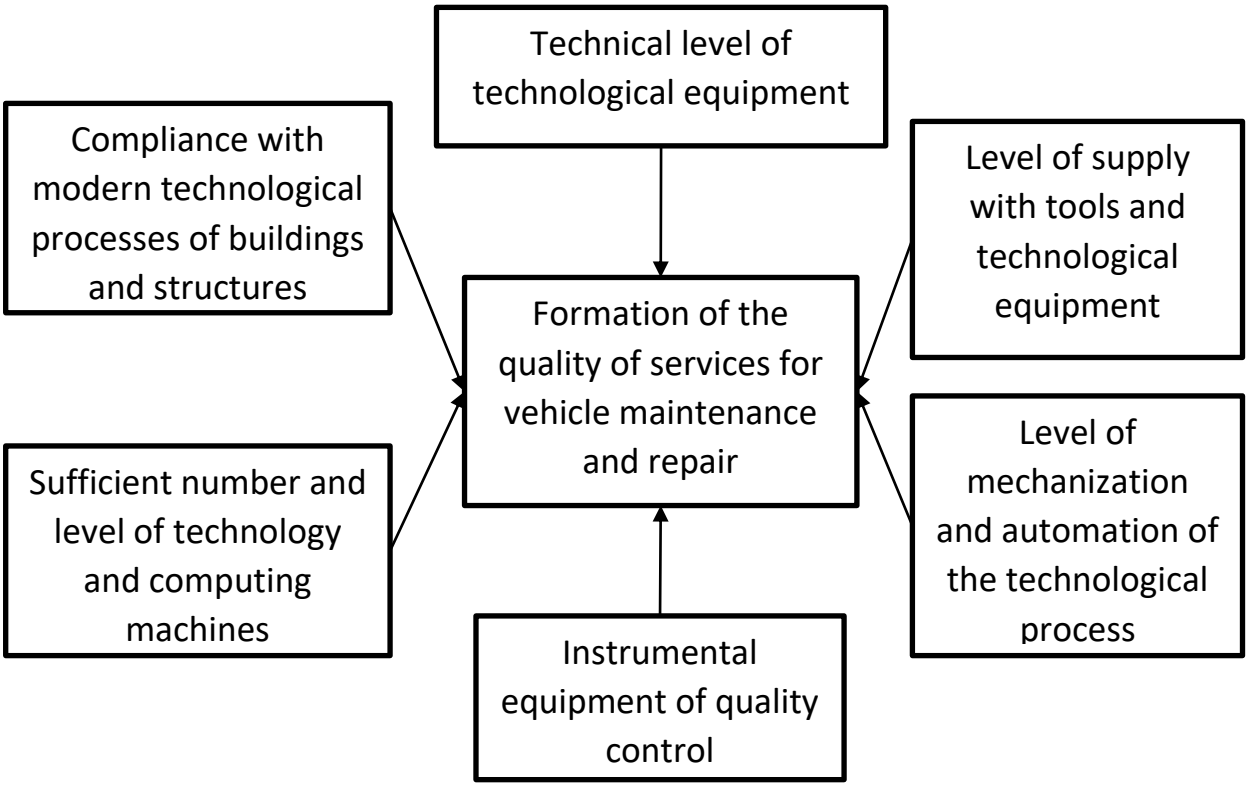

Figure 1. The structural scheme of the enterprise material and technical base

The main indicators of material and technical support are the following:

- determination of a sufficient amount of material resources for a specified period of time;
- identification of excessive or deficient types of material values;
- determination of transport and procurement costs in the total costs for the acquisition of material values;
- calculations of indicators of the rational use of materials in the production process;
- determination of costs due to the forced replacement of some materials with others, etc. [1].

In addition, different (planned, regulatory, actual) factors of utilization of materials in production, their share of expenses in the cost of finished products, etc. are calculated.

So, the plan of material and technical support of the enterprise is carried out in the following sequence:

- Preparatory work (provision with the forms, instruction, etc.);
- Determining the source of the supply of the needed materials;
- Calculating the need for the material resources;
- Developing the norms of production stocks [2].

References

1. Магомедов Ш. Ш., Беспалова Г. Е. Управление качеством продукции: учебник. М., 2010. 336с.

2. Волгин В. В. Автосервис: создание и сертификация: Практическое пособие. М.: Издательско-торговая корпорация «Дашков и К», 2006. 620 с.

3. Латышев М. В., Сергеев А. Г. Управление качеством в процессах автосервиса: моногр. Владимир: Изд-во ВлГУ, 2005. 160 с.

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THE ANALYSIS OF 5TDF ENGINE

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The history of motor-building knows many unusual developments. Along with the traditional in-line and V-shaped engines, for more than a hundred year history, engineers have invented opposite, star-shaped, rotary and other types of motors. Many of them are still at the stage of experimental development, but some unusual solutions were mass-made. Such an innovative engine is 5TDF – tank diesel engine, nicknamed "suitcase".

The 5TDF is a two-stroke diesel engine mounted on T-64 tanks, and in a modified 5TDMA version – on T-72, T-64BM and T-55AGM. It is mass-produced from the mid-60s up to now at Malyshev Plant (Kharkiv). However, the origin of the motor goes back to more ancient times to Germany.

5TDF is a two-stroke diesel engine with turbocharging, having 5 working cylinders. In some sources, its configuration is mistakenly called the opposite, but in fact the motor belongs to the category of engines with oncoming piston movement. A peculiarity of this type of engine is the use of 2 pistons per cylinder, that is, 5TDF has 10 pistons located in 5 "boilers".

The engine does not have classic cylinder heads because the crankcase with crankshafts are located on the sides (it has a horizontal orientation). It is for close to a rectangular, flat shape (the width of the internal combustion engine, "lying" in the engine transmission compartment of the tank, much more than its height), the military called this engine a "suitcase".

There are two crankshafts in 5TDF, but the main torque (70%) is only on one. The remaining 30% is transmitted to it from the second shaft through the main gear. In addition, one crankshaft is rigidly connected to the turbocharger, helping it unwind at low revolutions. Due to the tight coupling, fuel injection and exhaust gas suction are also carried out.

There is no gas distribution mechanism in 5TDF in the classical sense: no camshafts, valves and tappets. Pistons moving inside the cylinder towards each other, and then in opposite directions, approach the TDC (top dead center), suck, compress the fuel until it ignites and release the exhaust gases. In the process, they make two strokes (back and forth or left and right –it depends on which side to look at it), that is, a two-stroke motor.

As TDC is shifted relative to the cylinder center towards one of the shafts, the pistons move asymmetrically. Due to this, the inlet and exhaust ports do not

open simultaneously. When one piston approaches the LDC (lower dead center), it opens the inlet port through which the turbine supplies air, and then (when passing TDC) the nozzles inject fuel, that is ignited by air heated by pressure in the cylinder.

Then the piston located on the inlet side continues to move toward the piston from the exhaust side, it moves in the same direction, opens the outlet port, and moves to its LDP, after then it changes its direction. When it closes the outlet port the piston on the inlet side opens the inlet, the turbine pumps air, that is again compressed by counter-moving pistons, and the working cycle of the motor repeats.

The peculiarity of 5TDF fuel system is versatility. The engine is designed for diesel fuel, but it can also work on kerosene, gasoline and other petroleum products. Switching between them is done by setting the intake mechanism for a specific type of fuel.

The counter location of the pistons has reduced the size of the motor, having high energy efficiency with relatively small volume. With volume of 13.6 liters, 5TDF produces from 700 hp, and the upgraded versions of 5TDMA engine develop up to 1050 hp.

While modernizing it the engineers managed to extend the working life of the power plant to 500 hours and more along with moderate fuel consumption. The specific consumption of diesel fuel in 5TDF is about 160 grams / hour per horsepower. For comparison, the gas turbine engine (used in the same American M1 "Abrams") requires 1.5–2 times more fuel for horsepower.

Despite the advantages, such as compactness, high power, fuel efficiency and multi-fuel capability 5TDF has some disadvantages. The “suitcase” is very difficult to produce and very expensive, so the basic version of the newer T-72 tank uses more traditional B-46 diesel engine with V12 configuration. However, the motor has been developed. In Kharkiv 6TD engine (with one more cylinder) was created on the basis of 5 TDF.

T-80 tanks that directly replaced T-64 were produced in parallel in Saint Petersburgh and Kharkiv. The modification of Kirov Plant was equipped with a gas-turbine power plant, while the 6TD diesel engine was installed at Malyshev Plant.

As for 5TDF directly and its further upgrades, these motors are produced in small quantities in Kharkiv and today. T-64 and T-72 tanks are equipped with their updated versions modernized to meet modern requirements. However, the motor is gradually being replaced by even more powerful 6TD, that are the part of the tanks in Ukrainian armed forces and some of them are exported.

References

1. Двигатель 5ТДФ. Техническое описание. М – 1977.
2. https://www.youtube.com/watch?v=cxIgVPwwpTk
3. https://en.uos.ua/produktsiya/bronetehnika/60-tankovie-dizelnie-dvigateli

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AUTOMATION, ROBOTICS AND THE FACTORY OF THE FUTURE

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At one Fanuc plant in Oshino, Japan, industrial robots produce industrial robots, supervised by a staff of only four workers per shift. In a Philips plant producing electric razors in the Netherlands, robots outnumber the nine production workers by more than 14 to 1. Camera maker Canon began phasing out human labor at several of its factories in 2013.

This "lights out" production concept—where manufacturing activities and material flows are handled entirely automatically—is becoming an increasingly common attribute of modern manufacturing. In part, the new wave of automation will be driven by the same things that first brought robotics and automation into the workplace: to free human workers from dirty, dull, or dangerous jobs; to improve quality by eliminating errors and reducing variability; and to cut manufacturing costs by replacing increasingly expensive people with ever-cheaper machines. Today's most advanced automation systems have additional capabilities, however, enabling their use in environments that have not been suitable for automation up to now and allowing the capture of entirely new sources of value in manufacturing.

Falling robot prices. As robot production has increased, costs have gone down. Over the past 30 years, the average robot price has fallen by half in real terms, and even further relative to labor costs. As demand from emerging economies encourages the production of robots to shift to lower-cost regions, they are likely to become cheaper still.

Accessible talent. People with the skills required to design, install, operate, and maintain robotic production systems are becoming more widely available, too. Robotics engineers were once rare and expensive specialists. Today, these subjects are widely taught in schools and colleges around the world, either in dedicated courses or as part of more general education on manufacturing technologies or engineering design for manufacture. The availability of software, such as simulation packages and offline programming systems that can test robotic applications, has reduced engineering time and risk. It's also made the task of programming robots easier and cheaper.

Ease of integration. Advances in computing power, software-development techniques, and networking technologies have made assembling, installing, and maintaining robots faster and less costly than before. For example, while sensors and actuators once had to be individually connected to robot controllers with dedicated wiring through terminal racks, connectors, and junction boxes, they now use plug-and-play technologies in which components can be connected using simpler network wiring. The components will identify themselves automatically to the control system, greatly reducing setup time. These sensors and actuators can also monitor themselves and report their status to the control system, to aid process control and collect data for maintenance, and for continuous improvement and troubleshooting purposes. Other standards and network technologies make it similarly straightforward to link robots to wider production systems.

New capabilities. Robots are getting smarter, too. Where early robots blindly followed the same path, and later iterations used lasers or vision systems to detect the orientation of parts and materials, the latest generations of robots can integrate information from multiple sensors and adapt their movements in real time. This allows them, for example, to use force feedback to mimic the skill of a craftsman in grinding, deburring, or polishing applications. They can also make use of more powerful computer technology and big data–style analysis. For instance, they can use spectral analysis to check the quality of a weld as it is being made, dramatically reducing the amount of postmanufacture inspection required.

Robots take on new roles. Today, these factors are helping to boost robot adoption in the kinds of application they already excel at today: repetitive, high-volume production activities. As the cost and complexity of automating tasks with robots goes down, it is likely that the kinds of companies already using robots will use even more of them. In the next five to ten years, however, we expect a more fundamental change in the kinds of tasks for which robots become both technically and economically viable.

Making the right automation decisions. With so much technological potential at their fingertips, how do companies decide on the best automation strategy? It can be all too easy to get carried away with automation for its own sake, but the result of this approach is almost always projects that cost too much, take too long to implement, and fail to deliver against their business objectives.

A successful automation strategy requires good decisions on multiple levels. Companies must choose which activities to automate, what level of automation to use (from simple programmable-logic controllers to highly sophisticated robots guided by sensors and smart adaptive algorithms), and which technologies to adopt. At each of these levels, companies should ensure that their plans meet the following criteria.

Platforming and integration. Companies face increasing pressure to maximize the return on their capital investments and to reduce the time required to take new products from design to full-scale production. Building automation systems that are suitable only for a single line of products runs counter to both those aims, requiring repeated, lengthy, and expensive cycles of equipment design, procurement, and commissioning.

The technology required to permit this integration is becoming increasingly accessible, thanks to the availability of open architectures and networking protocols, but changes in culture, management processes, and mind-sets will be needed in order to balance the costs, benefits, and risks.

References

1. https://www.sciencedirect.com/science/article/pii/0921889089900304

2. https://www.mckinsey.com/business-functions/operations/our-insights/automation-robotics-and-the-factory-of-the-future

3. https://www.industryweek.com/robotics/future-robotics-manufacturing-moving-other-side-factory

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SOFTWARE ENGINEEIRING

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History. When the first digital computers appeared in the early 1940s, the instructions to make them operate were wired into the machine. Practitioners quickly realized that this design was not flexible and came up with the "stored program architecture" or von Neumann architecture. Thus the division between "hardware" and "software" began with abstraction being used to deal with the complexity of computing.

Programming languages started to appear in the early 1950s and this was also another major step in abstraction. Major languages such as Fortran, ALGOL, and COBOLwere released in the late 1950s to deal with scientific, algorithmic, and business problems respectively. David Parnas introduced the key concept of modularity and information hiding in 1972 to help programmers deal with the ever-increasing complexity of software systems.

The origins of the term "software engineering" have been attributed to various sources. The term "software engineering" appeared in a list of services offered by companies in the June 1965 issue of COMPUTERS and AUTOMATION and was used more formally in the August 1966 issue of Communications of the ACM (Volume 9, number 8) “letter to the ACM membership” by the ACM President Anthony A. Oettinger;, it is also associated with the title of a NATO conference in 1968 by Professor Friedrich L. Bauer, the first conference on software engineering. At the time there was perceived to be a "software crisis". The 40th International Conference on Software Engineering (ICSE 2018) celebrates 50 years of "Software Engineering" with the Plenary Sessions' keynotes of Frederick Brooks and Margaret Hamilton.

In 1984, the Software Engineering Institute (SEI) was established as a federally funded research and development center headquartered on the campus of Carnegie Mellon University in Pittsburgh, Pennsylvania, United States. Watts Humphrey founded the SEI Software Process Program, aimed at understanding and managing the software engineering process. The Process Maturity Levels introduced would become the Capability Maturity Model Integration for Development(CMMi-DEV), which has defined how the US Government evaluates the abilities of a software.

Profession. Legal requirements for the licensing or certification of professional software engineers vary around the world. In the UK, there is no licensing or legal requirement to assume or use the job title Software Engineer. In some areas of Canada, such as Alberta, British Columbia, Ontario, and Quebec, software engineers can hold the Professional Engineer (P.Eng) designation and/or the Information Systems Professional (I.S.P.) designation. In Europe, Software Engineers can obtain the European Engineer (EUR ING) professional title.

The United States, since 2013, has offered an NCEES Professional Engineer exam for Software Engineering, thereby allowing Software Engineers to be licensed and recognized. NCEES will end the exam after April 2019 due to lack of

participation. Mandatory licensing is currently still largely debated, and perceived as controversial. In some parts of the US such as Texas, the use of the term Engineer is regulated by law and reserved only for use by individuals who have a Professional Engineer license.

The IEEE Computer Society and the ACM, the two main US-based professional organizations of software engineering, publish guides to the profession of software engineering. The IEEE's Guide to the Software Engineering Body of Knowledge - 2004 Version, or SWEBOK, defines the field and describes the knowledge the IEEE expects a practicing software engineer to have. The most current SWEBOK v3 is an updated version and was released in 2014. The IEEE also promulgates a "Software Engineering Code of Ethics".

Impact of globalization. The initial impact of outsourcing, and the relatively lower cost of international human resources in developing third world countries led to a massive migration of software development activities from corporations in North America and Europe to India and later: China, Russia, and other developing countries. This approach had some flaws, mainly the distance / timezone difference that prevented human interaction between clients and developers and the massive job transfer. This had a negative impact on many aspects of the software engineering profession. For example, some students in the developed world avoid education related to software engineering because of the fear of offshore outsourcing (importing software products or services from other countries) and of being displaced by foreign visa workers. Although statistics do not currently show a threat to software engineering itself; a related career, computer programming does appear to have been affected. Nevertheless, the ability to smartly leverage offshore and near-shore resources via the follow-the-sun workflow has improved the overall operational capability of many organizations. When North Americans are leaving work, Asians are just arriving to work. When Asians are leaving work, Europeans are arriving to work. This provides a continuous ability to have human oversight on business-critical processes 24 hours per day, without paying overtime compensation or disrupting a key human resource, sleep patterns.

While global outsourcing has several advantages, global and generally distributed - development can run into serious difficulties resulting from the distance between developers. This is due to the key elements of this type of distance that have been identified as geographical, temporal, cultural and communication (that includes the use of different languages and dialects of English in different locations). Research has been carried out in the area of global software development over the last 15 years and an extensive body of relevant work published that highlights the benefits and problems associated with the complex activity. As with other aspects of software engineering research is ongoing in this and related areas.

References

1. https://jserd.springeropen.com/ Journal of Software Engineering Research and Development

2. https://softwareengineeringdaily.com/category/all-episodes/exclusive-content/articles
3. https://www.developerdotstar.com/mag/articles_top.html

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THE RADIAL LIFT SKID STEER LOADER AND THE VERTICAL LIFT SKID STEER LOADER

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Nowadays, construction equipment manufacturers are tailoring their machine specifications to customer's exact needs and applications. Well known earth-moving equipment manufacturers, now offer two different types of lift-arm designs, the radial lift skid steer loader and the vertical lift skid steer loader [5].

In the world of skid steers, there are two lift options – radial or vertical. Although both machines perform all the same tasks from digging and loading to grading and stacking, there are differences you should be aware of. Generally, people typically prefer the vertical lift [1].

Just looking at the two machines (Fig. 1) you probably wouldn't notice any difference. The difference between vertical lift and radial lift involves the path that the load takes as it is being lifted. This path is a direct result of the geometry of the skid steer (or compact track loader) arm. On a radial lift machine, the load follows a curved path. On a vertical lift machine, the load follows an S-shaped curve that almost looks like a straight line, as if the load was being lifted vertically. How a load is raised may not seem like a big deal, but the structural differences involved have a significant impact on what types of jobs a machine is best adapted to [5, 2].

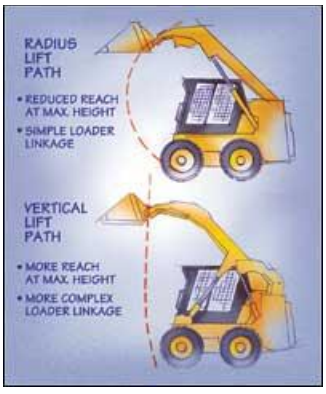

Fig. 1. Vertical Skid Steer Loader and Radial Skid Steer Loader

Radial Skid Steer Loaders

- Radial lift machine provides greater forward reach for more than 80% of the lift-arm path including a greater max reach at mid-range heights.
- Great for dumping materials over a wall, backfilling, unloading flatbed trucks.

- More for flat work with greater push capabilities.

Vertical Skid Steer Loaders

- Vertical lift path machines provide more reach at full height without decrease in performance.
- Vertical lift path machines keep load closer to machine.
- Can lift more than radius lift path machines.
- Good for clearing high-sided truck boxes and hoppers.
- Good for placing heavy material pallets.

Both vertical lift and radial lift machines have their pros and cons. In a nutshell, the vertical lift machines excel at material handling while the radial lift machines shine when it comes to heavy digging and earth moving [5, 2].

The radial lift design was on the very first skid steers made. This design gets its name from the fact that the loader boom arms rotate on a single pivot point, causing the lift path to arc out until the pin height, and then back as it reaches full height. The radial lift design ties the loader boom arms directly into the chassis in the rear and nests them against the lower chassis in the front. Therefore, pushing or digging work is done with the whole chassis [3].

Additionally, when loading pallets on a flatbed, the radial lift machine will have more reach at the bed height. The downside is that at this height, the skid steer loader is at the "most tippy" position. This is also the position that "tip load/rated operating capacity" is measured, and why vertical lift skid steer loaders of the same spec will have a higher rated operating capacity than a radial lift skid steer loader. Above this position, the bucket rotates back, causing the operator to lose reach the higher the boom goes. Due to the simpler design of the radial lift linkage, radial lift skid steer loaders tend to be less expensive than their vertical lift counterparts. But since radial lift machines are used in tougher applications like breaking, prying, grading or hard digging, they tend to be equipped with slightly more horsepower than vertical lift skid steer loaders [3].

The vertical lift linkage design was actually invented by New Holland 40 years ago in 1972, with the introduction of the L35 skid steer loader (the industry's first vertical lift skid steer loader equipped with the patented Super Boom lift linkage). The vertical lift design uses two pivot points that allows the boom to raise the bucket straight up to full height. This provides more reach the distance from the front of the unit to the bucket at full height. The greater the reach, the easier it is to evenly load a truck from the center. With enough reach, loading can be done from just one side of the truck, which saves time and helps in cramped areas. This is why vertical lift skid steer loaders are preferred for loading high-side trucks, feed carts and other taller containers [3].

Vertical lift skid steer loaders also have superior hinge pin height (dump height), which is key to clearing tall truck sides and obstacles. When working near confined areas, such as next to buildings or trucks, the operator of a vertical lift skid steer loader doesn't have to worry about the swing when raising the boom. Due to their lift path, vertical lift skid steer loaders tend to keep the bucket or forks fairly level while lifting and lowering, without the operator having to compensate

for the change in angle. A vertical lift skid steer loader can be very versatile on a jobsite, handling a variety of material handling and load-and-carry applications [3].

In conclusion. The major difference between the radial-lift and vertical-lift skid steer is the geometry of each lift arm. A radial-lift machine will perform the same job as a vertical-lift machine, it's just that one happens to be better suited for each job. Some contractors will still use a vertical-lift machine excavating and some will use a radial-lift machine with forks lifting pallets [4].

References

1. Radial Lift vs Vertical Lift Skid Steers. Construction Equipment Parts … URL: https://www.conequip.com/wp/radial-lift-vs-vertical-lift-skid-steers/.

2. Radial Lift versus Vertical Lift SSLs and CTLs. URL: http://info.texasfinaldrive.com/shop-talk-blog/radial-lift-versus-vertical-lift.

3. Vertical vs. Radical. Compact Equipment. URL: https://compactequip.com/skid-steers/vertical-vs-radial/.

4. Vertical-lift skid steers versus Radial-lift. Total Landscape Care. URL: https://www.totallandscapecare.com/green-industry-news/radial-lift-vs-vertical-lift-skid-steers/.

5. What is the difference between a Radial Lift Skid Steer Loader and Vertical Lift Skid Steer Loader? URL: http://duranterentals.blogspot.com/2015/05/difference-between-radial-lift-skid.html

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CLASSIFICATION AND FEATURES OF MODERN PAVERS

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Many modern pavers are equipped with an electronic control system that allows automating the process of feeding, distributing and spreading the material. The paver can additionally be equipped with the following: control sensor for feeding the material on the distribution auger; slope sensor, which controls the angle of the slab to the horizon; one or two height sensors that control the thickness of the layer being spread [1].

Classification of pavers:

1. By the way of movement.

Trailed paver works on the basis of a dumper and is a cyclic action machine. The preparation of a trailed paver for operation involves the preliminary set of the width and thickness of the spread layer, and after that it is connected to the dumper with the connection device. Further, the dumper raises the body and reloads the asphalt concrete mixture into the bunker of the paver. During the spreading of asphalt, the asphalt trailer moves with the dumper. After emptying the bunker, the dumper stops and the paver is reconnected to another dumper. The advantage of the trailed pavers is the simplicity of construction, disadvantage - low

productivity due to the need for a constant change of dumpers. **Semi-trailed paver** has additional working equipment, works together with a tractor or motor grader. Does not require constant change of tractor. **Travelling paver** is a machine of continuous action, which provides continuous spreading of asphalt. Travelling pavers are classified by productivity on light up to 75 tons/hour, medium 75-150 tons/hour, heavy 150-300 tons/hour and super heavy over 300 tons/hour [2].

2. According to the type of undercarriage.

Crawler pavers are characterized by the presence of not only super-powerful high-performance machines but also compact sidewalk pavers with a minimum spreading width of 60 cm for works connected with the asphalt pavement, walking and bike lanes. They are divided into two-bearing and four-wheeled [2].

Wheel pavers belong to a group of small and medium-size machines that work in urban conditions, where frequent moving from site to site is required. The transport speed of the wheel pavers can reach 20 and more km/h (as opposed to slow-moving crawler machines) [2].

Combined pavers have caterpillars as an operating stroke and pneumatic wheel part as a transport one. Such combination allows to achieve high quality direct performance of asphalt spreading in combination with the high speed of transportation of equipment between construction sites [2].

Rail pavers are used in the spreading of cast asphalt concrete mixtures [2].

The disadvantage is the additional costs for the laying of roads for the movement of a paver and the complexity of the transportation of such equipment directly to the site.

3. By the way of heating the smoothing plate.

The gas system provides faster and even heating of the plate, in addition, it is constructively simpler, more repairable and allows to save on more expensive components of the electric heating system [1].

Quite often, there is a need for asphalting the pedestrian ways, sidewalks, small areas near buildings, sports grounds, as well as places where the possibility of maneuvering large road vehicles is limited. In these cases, the spreading of asphalt and its smoothing can be done manually, and sealing with a vibroplates or manual rollers. However, under such conditions it is impossible to ensure the flatness of the surface and the uniform distribution of the spread material. To solve these problems, small-sized paving asphalt pavers with a stacking width of 0.6 m were specially designed. This type of pavers can be used both in the caterpillar and in the wheel stroke [1].

Popular domestic and foreign manufacturers of pavers: Europe, USA: Vogele (concern Wirtgen Group), ABG (concern Volvo), Dynapac (concern Atlas Copco Group), Bitelli, Bomag, Marini, Demag, Volvo, Caterpillar, Roadtec, Cedarapids (corporation Terex).

In recent years, the number of proposals on the market for road construction equipment has increased significantly due to the emergence of products of Chinese production (XCMG, Zoomlion, Changlin, Jiangsu Huatong). A significant share of this production consists of crawler and wheel pavers. Despite the stated quality and reliability of products produced by drawings of such famous manufacturers as Vogele and Dynapac, with the use of European components Sauer Danfoss, Deutz,

Cummins, Bosch-Rexroth, and even using Japanese technology of the Company “NIIGATA”, this product can be competitive to more famous European producers only in price, but not in the quality of work and reliability of the technology itself [3].

At present, the unconditional leaders in the quality and reliability of the manufactured equipment that have gained world recognition are the representatives of the German and Swedish engineering companies Vogele and Dynapac. Asphalt laying equipment of American production is also quite high-quality and high-tech, but its significant minus, which affects the choice of domestic consumer, is the high price and lack of components [3].

References

1. Грифф М. И. Строительные машины мира. Машины для уплотнения дорожных и аэродромных покрытий. Асфальтоукладчики, дорожные катки и виброплиты : учебное пособие. Москва : АСВ, 2008. 351 с.

2. Заржевский А. Англо-русский словарь по машиностроению и металлообработке. Москва : Советская энциклопедия, 2010. 664 с.

3. Чернох С. Справочник по машиностроению. Москва : Машиностроение, 1991. 728 с.

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INNOVATIVE INTERNAL COMBUSTION ENGINES

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There's no such thing as a perfect invention: we can always make something better, cheaper, more efficient, or more environmentally friendly. Take the internal combustion engine. You might think it's remarkable that a machine powered by liquid can hurl you down the highway or speed you through the sky many times faster than you could otherwise travel. But it's always possible to build an engine that will go faster, further, or use less fuel. One way to improve an engine is to use a turbocharger – a pair of fans that harness waste exhaust power from the back of an engine to cram more air into the front, delivering more "oomph" than you'd otherwise get. We've all heard of turbos, but how exactly do they work? Let's take a closer look!

What is a turbocharger?

Have you ever watched cars buzzing past you with sooty fumes streaming from their tailpipe? It's obvious exhaust fumes cause air pollution, but it's much less apparent that they're wasting energy at the same time. The exhaust is a mixture of hot gases pumping out at speed and all the energy it contains—the heat and the motion (kinetic energy)—is disappearing uselessly into the atmosphere. Wouldn't it be neat if the engine could harness that waste power somehow to make the car go faster? That's exactly what a turbocharger does.

Car engines make power by burning fuel in sturdy metal cans called cylinders. Air enters each cylinder, mixes with fuel, and burns to make a small explosion that drives a piston out, turning the shafts and gears that spin the car's wheels. When the piston pushes back in, it pumps the waste air and fuel mixture out of the cylinder as exhaust. The amount of power a car can produce is directly related to how fast it burns fuel. The more cylinders you have and the bigger they are, the more fuel the car can burn each second and (theoretically at least) the faster it can go.

How does a turbocharger work?

If you know how a jet engine works, you're halfway to understanding a car's turbocharger. A jet engine sucks in cold air at the front, squeezes it into a chamber where it burns with fuel, and then blasts hot air out of the back. As the hot air leaves, it roars past a turbine (a bit like a very compact metal windmill) that drives the compressor (air pump) at the front of the engine. This is the bit that pushes the air into the engine to make the fuel burn properly. The turbocharger on a car applies a very similar principle to a piston engine. It uses the exhaust gas to drive a turbine. This spins an air compressor that pushes extra air (and oxygen) into the cylinders, allowing them to burn more fuel each second. That's why a turbocharged car can produce more power (which is another way of saying "more energy per second"). A supercharger (or "mechanically driven supercharger" to give it its full name) is very similar to a turbocharger, but instead of being driven by exhaust gases using a turbine, it's powered from the car's spinning crankshaft. That's usually a disadvantage: where a turbocharger is powered by waste energy in the exhaust, a supercharger actually steals energy from the car's own power source (the crankshaft), which is generally unhelpful.

How does turbocharging work in practice? A turbocharger is effectively two little air fans (also called impellers or gas pumps) sitting on the same metal shaft so that both spin around together. One of these fans, called the turbine, sits in the exhaust stream from the cylinders. As the cylinders blow hot gas past the fan blades, they rotate and the shaft they're connected to (technically called the center hub rotating assembly or CHRA) rotates as well. The second fan is called the compressor and, since it's sitting on the same shaft as the turbine, it spins too. It's mounted inside the car's air intake so, as it spins, it draws air into the car and forces it into the cylinders.

Now there's a slight problem here. If you compress a gas, you make it hotter (that's why a bicycle pump warms up when you start inflating your tires). Hotter air is less dense (that's why warm air rises over radiators) and less effective at helping fuel to burn, so it would be much better if the air coming from the compressor were cooled before it entered the cylinders. To cool it down, the output from the compressor passes over a heat exchanger that removes the extra heat and channels it elsewhere.

Where does the extra power come from?

Turbochargers give a car more power, but that extra power is not coming directly from the waste exhaust gas—and that sometimes confuses people. With a turbocharger, we harness some of the energy in the exhaust to drive the

compressor, which allows the engine to burn more fuel each second. This extra fuel is where the car's extra power comes from. All the exhaust gas is doing is powering the turbocharger and, because the turbocharger isn't connected to the car's crankshaft or wheels, it's not directly adding to the car's driving power in any way. It's simply enabling the same engine to burn fuel at a faster rate, so making it more powerful.

Advantages and disadvantages of turbochargers

You can use turbochargers with either gasoline or diesel engines and on more or less any kind of vehicle (car, truck, ship, or bus). The basic advantage of using a turbocharger is that you get more power output for the same size of engine (every single stroke of the piston, in every single cylinder, generates more power than it would otherwise do). However, more power means more energy output per second, and the law of conservation of energy tells us that means you have to put more energy in as well, so you must burn correspondingly more fuel. In theory, that means an engine with a turbocharger is no more fuel efficient than one without. However, in practice, an engine fitted with a turbocharger is much smaller and lighter than an engine producing the same power without a turbocharger, so a turbocharger car can give better fuel economy in that respect. Manufacturers can often now get away with fitting a much smaller engine to the same car (such as a turbocharged V6 instead of a V8, or a turbocharged four-cylinder engine instead of a V6). And that's where turbocharged cars get their advantage: working well, they might save up to 10 percent of your fuel. Since they burn fuel with more oxygen, they tend to burn it more thoroughly and cleanly, producing less air pollution.

More power for the same engine size sounds wonderful, so why aren’t all engines turbocharged? One reason is that the fuel economy benefits promised by early turbochargers didn’t always turn out as impressively as manufacturers (eager to seize any marketing advantage over their rivals) liked to claim. One 2013 study, by Consumer Reports, found small turbocharged engines giving significantly worse fuel economy than their "naturally aspirated" (conventional) counterparts and concluded: "Don't take turbocharged engines' eco-boasts at face value. There are better ways to save fuel, including hybrids, diesels, and other advanced technologies." Reliability has often been a problem too: turbochargers add another layer of mechanical complexity to an ordinary engine – in short, there are quite a few more things to go wrong. That can make maintenance of turbos significantly more expensive. By definition, turbocharging is all about getting more from the same basic engine design, and many of the engine components have to suffer higher pressures and temperatures, which can make parts fail sooner; that's why, generally speaking, turbocharged engines don't last as long. Even driving can be different with turbos: since the turbocharger is powered by the exhaust gas, there's often a significant delay ("turbo lag") between when you put your foot on the accelerator and when the turbo kicks in, and that can make turbo cars very different (and sometimes very tricky) to drive.

Perov O. S.

DETERMINATION OF RESISTANCE TO CAR MOTION ON INCOMPLETE RESULTS OF RUNNING MEASUREMENTS

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In this article the preliminary verification of the method for estimation of C_x and f of a car by the incomplete results of running distance measuring, in particular - on the running way from 160 to 80 km / h, from 130 to 80, from 50 to a stop - but without a path from 80 to 50 km / h is offered.

To calculate the dynamics of the car you need to know the coefficients of air resistance C_x and rolling resistance *f*. It is believed that the most accurate information about the C_x is given by blowing in a tube. This is not true. First, in a tube, the force of air resistance is measured at one high speed. Secondly, the air flow around the car in the tube is partially modeled - in most car tubes the wheels do not rotate, the floor is fixed.

Road tests are free from these disadvantages. But they require a horizontal straight section of road at least 2 km long, low traffic intensity and the weather – positive temperature, no precipitation, light wind. All this limits the ability to conduct tests on the road and thereby increases their value.

The task of the study is to develop a method for estimating the coefficients of air resistance and rolling according to incomplete measurements of the run-out path, published in the «Autoreview» journal.

There is an already known method for calculating air resistance coefficients Cx and total road resistance ψ for crunning j_1 and j_2 at speeds v_1 and v_2 of a vehicle of mass *m* with a frontal area F (the formulas of the original are rewritten in our notation):

$$C_x = \frac{6 \cdot m \cdot (j_1 - j_2)}{F \cdot \left(v_1^2 - v_2^2\right)}; \psi = \frac{28{,}2 \cdot \left(j_2 \cdot v_1^2 - j_1 \cdot v_2^2\right)}{10^3 \cdot \left(v_1^2 - v_2^2\right)}$$

The method is recommended for speeds up to *100 km / h*. The paper proposes additions that remove this limitation and increase accuracy: the air density ρ in kg / m3 and the accounting weight of the rotating masses of the car β, and, most importantly, the coefficient K_v proposed by the authors, estimating the expected change in the rolling resistance coefficient with increasing speed from v_2 up to *v1*;

$$C_x = \frac{2 \cdot \beta \cdot m \cdot (j_1 - j_2 \cdot K_V)}{F \cdot \rho \cdot \left(v_1^2 - v_2^2 \cdot K_V\right)}; \psi = \frac{\beta \cdot \left(j_2 \cdot v_1^2 - j_1 \cdot v_2^2\right)}{g \cdot \left(v_1^2 - v_2^2 \cdot K_V\right)},$$

$$K_V = \frac{A \cdot v_1^2 + B \cdot v_1 + C}{A \cdot v_2^2 + B \cdot v_2 + C},$$

All the improvements described above improve the mathematical model and the method of determining the coefficients, but do not make it ideal. The

dependence of the results on the choice of speeds v_1 and v_2 is revealed. It is shown that the best results are given by the combination v_1 = 103 ... 123 km / h and v_2 = 27 ... 39 km / h. The reliability of the results depends on the quality of the original values.

Checks on public roads do not give the desired quality, and there are no ground tests for university or private researchers. Professional tests on auto polygons are made on orders and their results are not published. So the only way is to trust the magazines that conduct their own tests and publish their results. Currently, this is "Auto Review" and "Driving."

Unfortunately, their articles do not provide a complete picture of resistance. “Auto Review” gives incomplete measurement results: running from *160* to *80 km / h*, from *130* to *80*, from *50* to a stop – but without a path from 80 to 50 km / h (and sometimes - only *130-80* and *50-0* or only *50-0*). "Driving" gives even less values: from *120* to *50 km / h* and from *50* to zero. In our method it was offered to select a path value of *80–50 km / h* according to the least squares criterion, which allowed us to construct a complete coastline diagram (VP, vp) according to “Autoreview” data and calculate the resistance coefficients using it.

References

1. BOSCH. Автомобильный справочник: Пер. с англ. – ЗАО «КЖИ «За рулем», 2-е изд., перераб. и доп. Москва, 2004. 992 с.
2. Рабинович Э.Х., Кемалов З.Э., Сосновый А.В. Определение сопротивлений движению автомобиля методом однократного выбега // Автомоб. транспорт: Сб. науч. трудов, вып. 22. Харьков, 2008. С. 46-48.
3. Нікітін Д.В. Обґрунтування параметрів дорожнього діагностування автомобілів. Кваліфікаційна робота магістра. Рукопис. Харків, ХНАДУ, 2012. 75 с.
4. Волков В.П., Рабинович Э.Х., Белогуров Е.А., Никитин Д.В., Руденко Е.Е. Сопротивление движению легкового автомобиля на скоростях 30…160 км/ч / // Міжвуз. зб. (за галузями знань «Машинобуд. та металообробка», «Інж. механіка», «Металургія та металознавство»). Вип. 36. Луцьк, 2012. С. 46-51.
5. Рабинович Э.Х., Волков В.П., Белогуров Е.А. Оценка коэффициентов сопротивлений движению автомобиля по пути выбега // Укр. метрологічний журнал. Харків, 2010. №4. С.47-52.

Pohorilyi I. V.

ANALYSIS AND ESTIMATION OF INFLUENCE OF PARAMETERS SMALL PNEUMATIC WHEEL FRONTAL LOADER ON OUTPUT DESCRIPTIONS AUTOSHAKE MODE OF HIS LADENING

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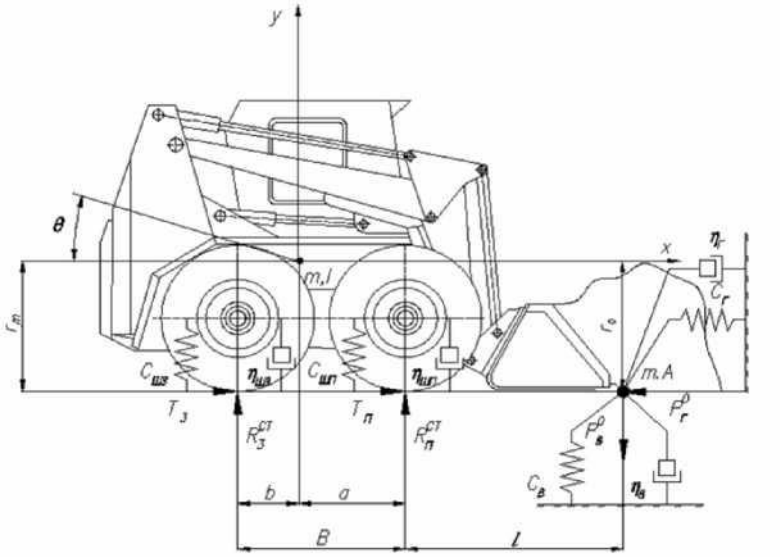
Using worked out before mathematical model of small frontal loader at his self-excited oscillations the analysis of influence of his separate parameters is executed on descriptions of this type of laden.

Introduction. There are several advantages of small building and travelling machines that can work in the straitened terms and execute mobile turns with the minimum losses of time that are known. In comparison to other wheeled machines small loaders, for example, possess the row of fundamental structural features. Many modes of loading operations of such loaders are not investigational, that largely prevents to creation to the high-efficiency and reliable small technique. One of such modes is the mode of self-excited oscillations of loader.

Analysis of publications. There are works [1,2,3,4], on the use of the separate modes of loading of small loaders, including mode of self-excited oscillations.

In works [3,4] a dynamic chart (pic.1) is offered and the mathematical model of small loader is worked out at self-excited oscillations, the analysis of influence of separate parameters of loader is conducted on descriptions of a flutter mode of his loading.



Picture 1. Equivalent dynamic chart small pneumatic wheel frontal loader

Aim of work and raising of task. Hired is logical continuation of works [3,4]. The aim of work is an increase of operating qualities of small pneumatic wheel loader due to research of his specific dynamic mode of loading at self-excited oscillations.

The basic task of work is theoretical research of influence of basic parameters of loader on descriptions of a flutter mode of his loading.

Mathematical model of small loader and initial conditions at her decision. In work [3] the equivalent dynamic chart of loader at his self-excited oscillations (pic.1) and his mathematical model are worked out. In the same work initial conditions over are brought for the decision of mathematical model.

Research methods. The method of research is applied in-process carries

theoretical character.

For research of a mechanical flutter system of small loader was MathLab 6.5 software is select, because this package allows deciding differential equalizations with a few degrees of freedom.

Results of theoretical researches

1. Influence on a flutter process of distance from an underlayment to the point A (see a pic. 1).

Basic data:

$a = 0,75$ m; $b = 0,4$ m; $l = 1,3$ m; $m = 4100$ kg; $l = 1.38 \cdot 10^4$; $g = 9,81$ m/s^2;

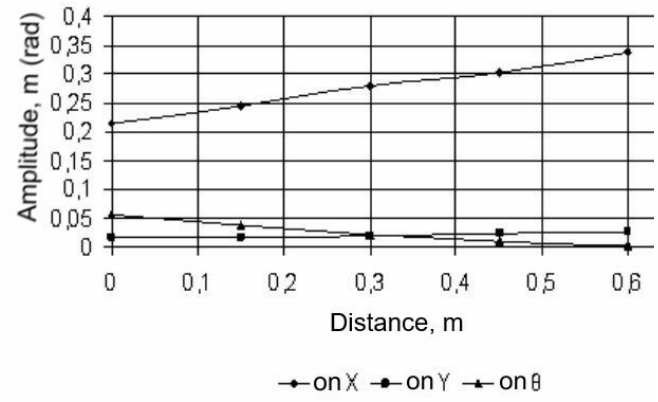
$\psi_o = 0,8$; $r_m = 0,9$ m; $r_k = 0,47$ m; $\omega_k = 2$ s^{-1}; $\alpha_1 = 0,109125$; $\alpha_3 = 0,002825$;

$C_{шп} = 500000$ N/m; $C_{шз} = 500000$ N/m; $C_г = 50000$ N/m; $P_в^o = 10000$ N; $C_в = 50000$ N/m;

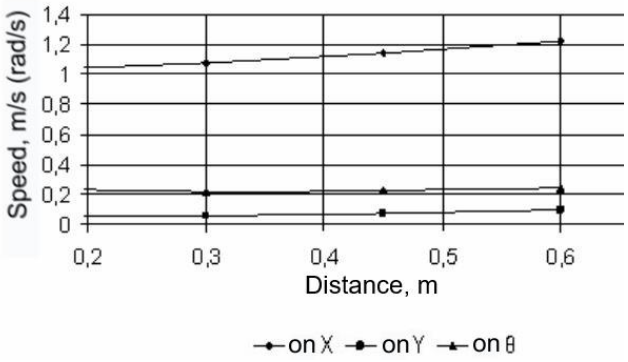
$\eta_{шп} = 5000$ Ns/m; $\eta_{шз} = 5000$ Ns/m; $\eta_г = 3500$ Ns/m; $\eta_в = 3500$ Ns/m; Pg=33000 N;

variable quantity

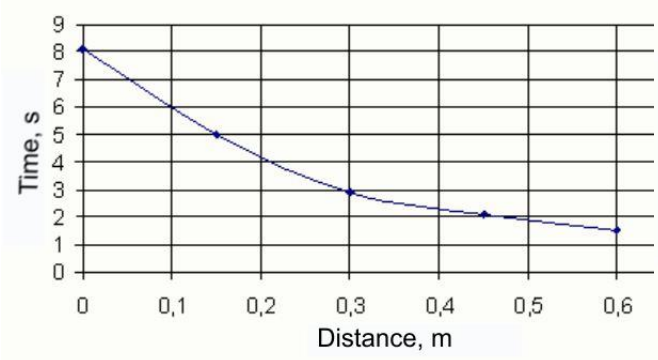
$r_\upsilon = 0,3 - 0,9$ m.



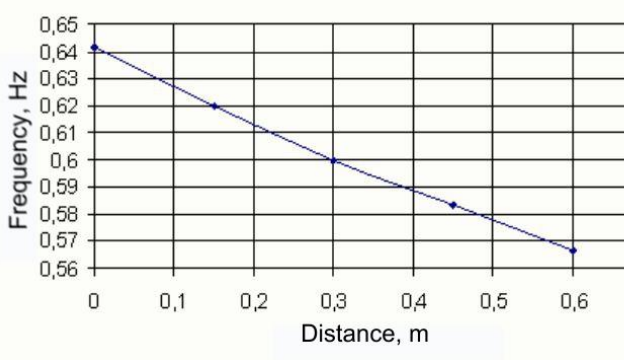
Picture 2. Influence of r_υ on oscillation amplitude



Picture 3. Influence of r_υ on speed of moving



Picture 4. Influence of r_υ on a process establishment of the stationary modes self-excited oscillations



Picture 5. Influence of r_υ on frequency of vibrations

- From a chart (pic. 2) evidently, that distance from an underlayment to the point A notedly influences on amplitudes of vibrations on X and Θ and practically

does not influence on the coordinate of Y. In an interval from a 0 - 0,6 m amplitude practically goes down to the zero, at the same time amplitude of vibrations on X increases in 1,5 times.

- On a picture 3 evidently that, r_υ practically does not influence on speed of moving on the coordinates of Θ and Y, and not considerably influences on speed on X.
- The size of r_υ considerably influences on the process of establishment of the stationary modes. For example, in the interval of values of r_υ from 0 to 0.3 m, time of establishment of self-excited oscillations goes down more than in 2 times (pic. 4).
- In the interval of r_υ = 0 - 0,6 m frequency of self-excited oscillations diminishes (pic. 5).

2. Influence of vertical effort on a working organ on an oscillation process.

Basic data:

a = 0,75 m; b = 0,4 m; l = 1,3 m; m = 4100 kg; l =$1.38 \cdot 10^4$; g = 9,81 m/s^2;

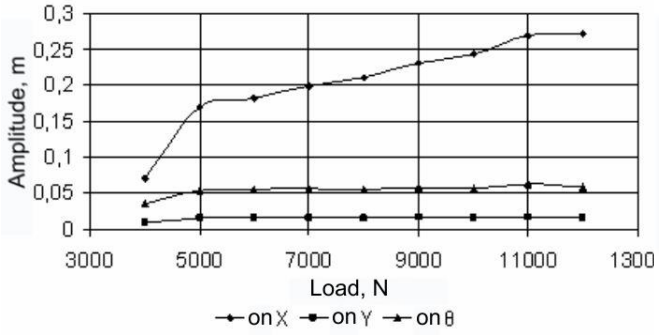
ψ_o = 0,8; r_m = 0,9 m; r_υ = 0,9 m; r_k = 0,47 m; ω_k = 2 s^{-1}; α_1 = 0,109125; α_3 = 0,002825;

$C_{шп}$ = 500000 N/m; $C_{шз}$ = 500000 N/m; $C_г$ = 50000 N/m; $C_в$ = 50000 N/m;

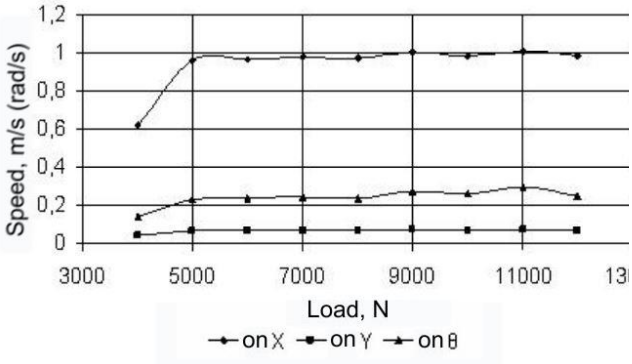
$\eta_{шп}$ = 5000 Ns/m; $\eta_{шз}$ = 5000 Ns/m; $\eta_г$ = 3500 Ns/m; $\eta_в$ = 3500 Ns/m; Pg=33000 N;

variable quantity

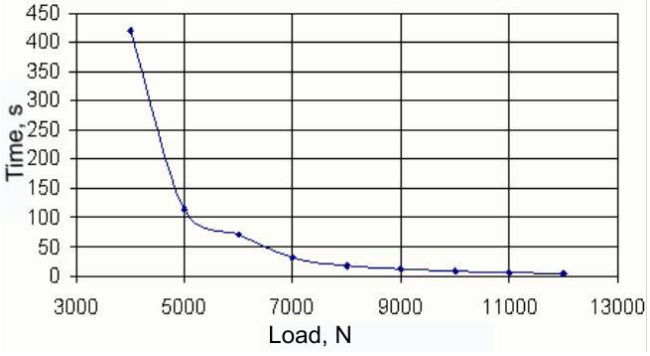
$P_в^o$ = 4000 – 12000 N.



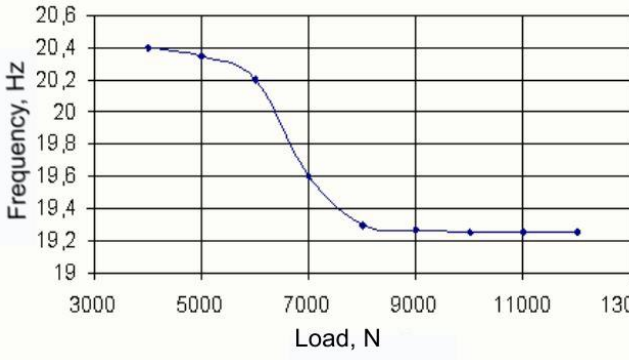
Picture 6. Influence $P_в^o$ on amplitudes of vibrations



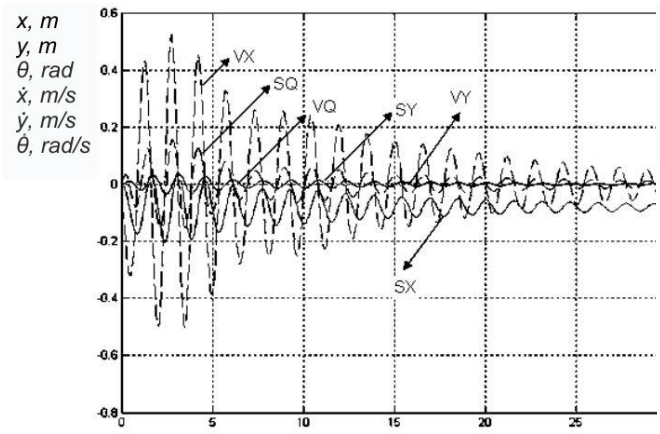
Picture 7. Influence $P_в^o$ on speed of moving



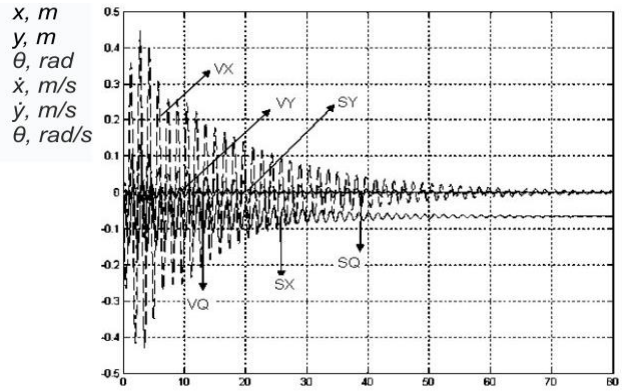
Picture 8. Influence $P_в^o$ on the process of establishment of the stationary modes self-excited oscillations



Picture 9. Influence $P_в^o$ on frequency of vibrations



where SX, SY and SQ - accordingly moving on the axes of X, Y and Θ VX, VY and VQ - according to speed on the axes of X, Y and Θ
Picture 10. Shake process at $P_в^o$ = 0 N



where SX, SY and SQ - accordingly moving on the axes of X, Y and Θ VX, VY and VQ - according to speed on the axes of X, Y and Θ
Picture 11. Shake process at $P_в^o$ =1000 N

- In a range 4000-5000 N on the coordinates of X and Θ amplitude of moving and speed of moving increases intensively, farther on X amplitude of moving has a height but with less intensity (pic. 6, 7).
- Time of beginning of the permanent mode, and frequency of vibrations goes down on all area (pic. 8, 9).
- At $P_в^o$ = 0 – 4000 N on this type of soil is observed an attenuation shake process (pic. 10, 11).

3. Influence circuitous speed of wheels on an oscillation process

Basic data:

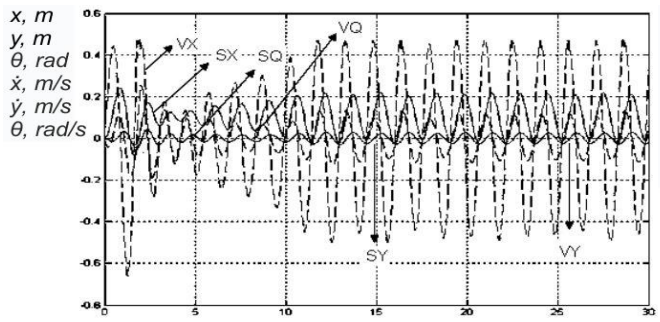
a = 0,75 m; b = 0,4 m; l = 1,3 m; m = 4100 kg; l =$1.38 \cdot 10^4$; g = 9,81 m/s^2;

ψ_o = 0,8; r_m = 0,9 m; $r_υ$ = 0,9 m; r_k = 0,47 m; ω_k = 2 s^{-1}; α_1 = 0,109125; α_3 = 0,002825;

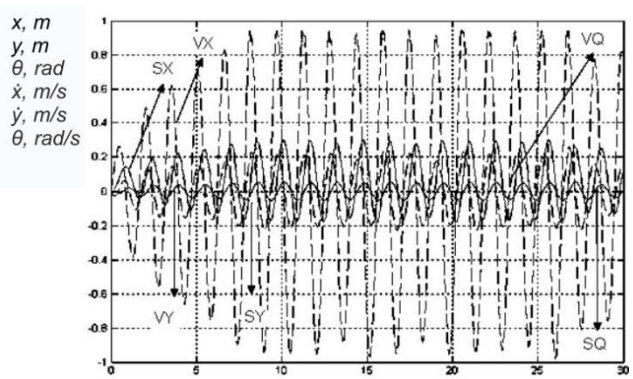
$C_{шп}$ = 500000 N/m; $C_{шз}$ = 500000 N/m; $C_г$ = 50000 N/m; $C_в$ = 50000 N/m;

$\eta_{шп}$ = 5000 Ns/m; $\eta_{шз}$ = 5000 Ns/m; $\eta_г$ = 3500 Ns/m; $\eta_в$ = 3500 Ns/m; Pg=33000 N;

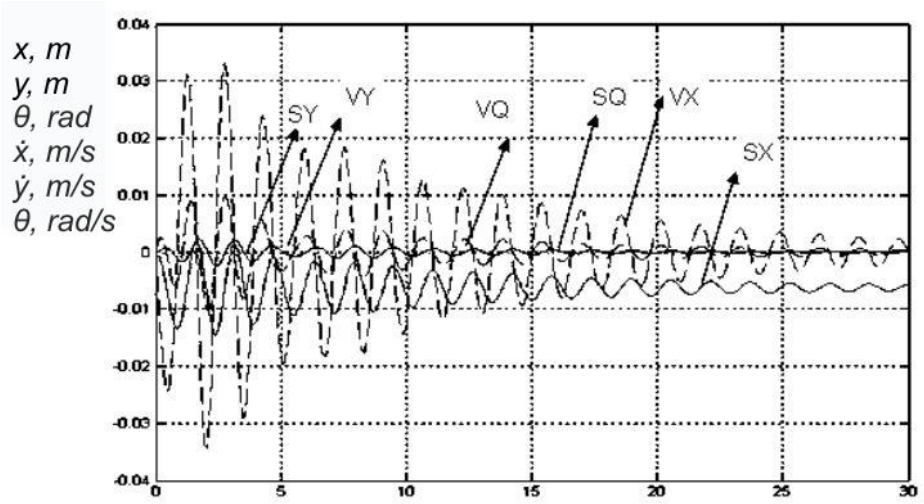
$P_в^o$ =10000 N; variable quantity ω_k = 1 – 4 s^{-1}



where SX, SY and SQ - in relation to moving on the axes of X, Y and Θ VX, VY and VQ - in relation to speed on the axes of X, Y and Θ
Pic. 12. Oscillation process at ω_k = 1 s^{-1}



where SX, SY and SQ - in relation to moving on the axes of X, Y and Θ VX, VY and VQ - in relation to speed on the axes of X, Y and Θ
Picture 13. Oscillation process at ω_k = 2 s^{-1}



where SX, SY and SQ - in relation to moving on the axes of X, Y and Θ
VX, VY and VQ - in relation to speed on the axes of X, Y and Θ
Picture 14. Oscillation process at $\omega_k = 4\ s^{-1}$

- At $\omega_k = 1\ s^{-1}$ observed gallops, and after permanent mode of self-excited oscillations (fig. 12).
- At $\omega_k = 2\ s^{-1}$ there is the permanent mode of self-excited oscillations (pic. 13).
- At $\omega_k = 3.5\ s^{-1}$ and more auto-oscillation is not observed, arising up vibrations go out slowly gradually (pic. 14).

Conclusions. 1. Basic conformities to law and descriptions of oscillation processes of loading of small pneumatic wheel loader are set in theory.

2. Influence of separate parameters of loader is set on data-outs and descriptions of his self-excited oscillations that allows in certain limits to optimize designer decisions at his planning.

References

1. Никулин П. И. Теория криволинейного движения колесного движителя / Никулин П. И. – Воронеж, 1992. – 212 с.

2. Назаров Л. В., Особенности поворота малогабаритного погрузчика типа ПМТС 1200 / Назаров Л. В., Истомин В. П., Разаренов Л. В.// Вестник ХНАДУ/ Сб. науч. тр. – Харьков: ХНАДУ. – 2004. – Вып. 25. – С. 54 – 58.

3. Назаров Л. В., Эквивалентная динамическая схема и управления движения малогабаритного фронтального погрузчика при автоколебаниях / Назаров Л. В., Розенфельд Н. В., Истомин В. П., Щербак О. В., Бережной И. В.// Вестник ХНАДУ / Сб. науч. тр. – Харьков: ХНАДУ. – 2005. Вып. 28 – С. 32 – 34.

4. Назаров Л. В., профессор, д. т. н.,. Теоретичні дослідження динаміки малогабаритного пневмоколісного фронтального навантажувача при автоколиваннях / Назаров Л. В., профессор, д. т. н., Істомін,В.П. доцент, к. т. н., ХНАДУ, Овсянніков С. І., доцент, к. т. н., ХНУСХ, Разарьонов Л. В., Жинжера А. І., інженери, Лещенко А. В., студенти, ХНАДУ.// Вісник ХНАДУ / Сб. науч. тр. – Харків: ХНАДУ. – 2007. Вип. 38 – С. 13 – 17.

Semyvolos S. A.

MECHANICAL LOSSES IN PISTON INTERNAL COMBUSTIN ENGINES

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Mechanical losses in the theory of internal combustion engines are considered as the expended frequency of the indicator power to overcome all types of resistance to the movement of parts, air and fluid in the engine. According to various estimates for different internal combustion engines, the share of mechanical losses in relation to the indicator power ranges from 15 to 25%. This suggests that a quarter of the gas energy in a piston engine is lost. Larger values (25%) refer to domestic engines, lower values (15%) to foreign ones.

The main causes of high mechanical losses are:

1. Errors of design and technical support of the main parts;
2. Neglect of the tropological aspect of the engine as a technical system;
3. Lack of knowledge about the level of mechanical losses in the design that is being designed . First of all, the lack of calculation methods and experimental control of friction parameters in the main moving pairs of the internal combustion engine.

$$N_i = N_e + N_м;$$
$$p_i = p_e + p_м;$$
$$p_м = p_m + p_{г.в} + p_{д.м}.$$

Friction loss 60 - 75%.

The hydraulic losses T 10 - 20%.

Drive auxiliary mechanisms 15 - 20%.

In [1] the main methods for determining mechanical losses are presented. The most accurate and reliable method is the comparison of indicator and effective power. To do this, remove and process the indicator diagram to obtain the indicator power. In the same experiment, the effective power is determined, the difference between them is the power of mechanical losses.

$$N_i - N_e = M_{м.п}.$$

Also in the work method is shown off cylinders. This method consists in the fact that when one cylinder is turned off, the effective engine power is lower by the power that is produced in one cylinder, then there is

$$N_{ix} = N_{e(\mathrm{i})} - N_{e(i-1)}.$$

In the same way, all cylinders are shut off .

When using the cylinder shutdown method, the absolute value of the power of mechanical losses

$$N_{mex} = \sum_{1}^{i} N_{ix} + N_{e(i)} ,$$

then this method is similar to the previous one, with the difference that it does not require indexing of individual engine cylinders.

The method of cranking the engine from an unauthorized energy source. The essence of this method is that the engine runs at optimum operating mode and after turning off the fuel supply or ignition, the engine rotates a balanced dynamomachine with the same rotational speed.

Also, there are such methods of single and binary run.

The single run-on method is a variation of the turning method , the only difference is that when the fuel supply is turned off or the ignition is turned off, the crankshaft is rotated due to the kinematic energy of its moving parts.

$$N = \frac{J\omega}{75} \cdot \frac{d\omega}{d\tau} .$$

And the double run-on method consists of two runs with the same rotational speed, which occur in various conditions: the first run is the shutdown of external loads (such as brakes); and the second in idle mode.

$$N = \frac{k^2}{75} \cdot Jn \frac{d\omega}{d\tau},$$

where $k = \frac{\pi}{30}$ - constant value.

The article presents the dependence for calculating the pressure of mechanical losses. Dyachenko V. G. [2] offered dependency in this form

$$p_{мп} = a + b\frac{n}{n_н},$$

where a and b are constant coefficients,

n – crankshaft rotational speed on which are calculated mechanical losses,

$n_н$ – nominal crankshaft speed.

In the first formula, the power of mechanical losses can be estimated using dependencies. For a more accurate determination of the power of mechanical losses, it is necessary to conduct an experimental study of one of the methods considered.

References

1. Stefanovsky B. S. Tests of internal combustion engines / B. S. Stefanovsky, E. A. Skobtsov, E. K. Korsi et al. // Moscow: Mashinostroenie, 1972, 58 p.

2. Dyachenko V. G. Theory of internal combustion engines, Textbook / V.G. Dyachenko // H. HNADU, 2009. 500 p.

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MODERN TECHNOLOGY IN CARS

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Control of road transport: appointment, capabilities and technologies Modern GPS/GLONASS trackers are equipped with a digital accelerometer, which is capable of recording data on possible accidents, collisions, upheaval and unplanned body climbs of corporate vehicles, informing the owner. Today, the market offers a variety of different GPS/GLONASS vehicle monitoring systems, differing in functionality and autonomy. With the help of a smart phone, you can monitor the location of an object equipped with a GPS/GLONASS tracker.

Installing a transport control system is an opportunity to receive information about routes and downtime, fuel consumption, and speed in real time. The use of monitoring systems allows you not only to find out where the car is, but also protect it from theft or evacuation. Control of vehicles, including the analysis of their technical condition, route and location, allows increasing the safety of transportation and efficiency of the business. There is a wide range of vehicle control and monitoring solutions for the choice of companies whose activities are related to the operation of vehicles.

Purpose of vehicle transport control systems monitoring of transport is an effective solution to the problem of trackings the location and movement of vehicles, the technical condition of the latter. Such systems help to solve a wide range of business and social tasks in practice. They allow: through monitoring to identify the exact coordinates of the location of the vehicle, its speed of movement, fuel consumption; to system at size the collection of statistics to optimize the development of optimal configurations of routes; assist in ensuring security (for example, in the event of an accident, the car control system can transmit the crash signal to the rescue service automatically via satellite communications); to monitor the observance of the schedule of movement of the vehicle (this task is of particular importance for road freight companies and organizations engaged in passenger transport).

The areas of application of the monitoring and control systems of transport all technological solutions offered on the market today, which are responsible for monitoring and controlling vehicles, have one goal - to promptly provide reliable information about the car and its location, which can then be applied in accordance with the client's business needs. Which companies benefit from using transport monitoring and control systems? Insurance companies' Innovative telematics solutions allow the process of setting insurance rates to take as a basis individual

performance indicators for cars rather than average figures. In turn, drivers benefit from the use of vehicle control systems. So, insurers, based on these telematics complexes, are able to identify reliable drivers and include them in the list of participants in discount programs.

The use of telematic systems improves the quality and efficiency of corporate transport and, on average, reduces the cost of fuel and the maintenance of a fleet by 20–25%. Leasing companies Telematic systems can reduce the risks of misuse of leased vehicles, as well as its irrevocable theft (the car can be detected using GPS/GLONASS). In addition, the leasing company will be able to obtain current data on the technical condition of the car (modern complexes are able to carry out technical control of vehicles). Taxi companies Vehicle tax controls have also been adopted by many taxi companies. The use of telematics can improve the quality of services, ensuring maximum safety for passengers and increasing the efficiency of vehicle use. So, the time noticed malfunction can not only reduce the cost of repairs, but more importantly, prevent the inactivity of the car unit. It is important to understand that the loyalty of clients will depend on the coherence of the enterprise's work.

Automakers and dealers Car control systems can also do good service to automakers and such innovative products diagnose the condition of cars, notifying the owners in online or offline mode of faults. As a result, the client significantly saves both on the cost of repairs and on the timing of their implementation.

Passenger transportation Equipping with technical means of controlling the use and movement of vehicles, as we have already mentioned, is an indispensable condition for licensing for companies providing mass passenger transportation services. Telematics not only contributes to the observance of the schedule of the vehicle, but above all increases the safety of transportation.

Technology for monitoring the health and location of the car Telematic equipment is most often represented by a small device that looks something like a USB flash drive. The device is integrated into the vehicle OBD-connector. As a rule, the systems of monitoring and control of motor transport have a three-link structure: instruments of satellite navigation GLONASS/GPS; fuel consumption level sensors; additional equipment - passenger traffic sensor, digital video camera, etc. The principle of operation of transport monitoring and control systems consists mainly in tracking both spatial and temporal coordinates of the vehicle.

There are two ways of monitoring activity: online data transfer; offline data transfer (information is read from the tracking device and analyzed after the vehicle arrives at the control room). In the first case, a mobile device is installed in the car, consisting of a satellite signal receiver, a reservation module and a coordinate broadcast. The latter transmits information via cellular networks.

The second type of systems does not imply the presence of a GSM module in the monitoring device, which allows saving on mobile communication services. However, it has long lost its relevance. A significant disadvantage of offline systems is that to get data from them you need docking with a computer, which means additional time and often inconvenience (even when using Bluetooth).

The most advanced are the complexes equipped with ultra-sensitive three-dimensional accelerometers (G-sensors), as well as vibro-acoustic sensors, allowing

to establish the fact of an accident and avoid false positives. Unlike traditional accelerometers, telematics complexes are able to unambiguously determine whether damage was caused due to the adverse effects of environmental factors (for example, pits on the road) or there was a minor traffic accident. Types of vehicle control systems GPS trackers and beacons.

A car tracker is a special device that can be equipped with a vehicle in order to monitor its movements, as well as track its location point through the functionality of the GPS / GLONASS modules. The received data is transmitted via the GPRS channel to the sending user. Many of the GPS trackers and controllers currently offered to have an open protocol for interacting with the server and provide an opportunity to configure operating modes using SMS, CSD, or GPRS connections.

Technical vehicle inspection systems (on-board diagnostics systems). The term on-board diagnostics (OBD) is directly related to the concept of vehicle self-diagnosis. OBD gives the mechanic or the owner himself access to valuable data on the functioning of the vehicle components. For the first time, on-board diagnostics systems appeared in the late 60s of the last century, and their functionality was then incommensurably less than it is now. So, if there was a malfunction on board the car, the lamp-indicator gave a signal that reported only about the fact of the problem, but did not clarify exactly where its roots lie.

Nowadays, OBD devices use a standard digital connector, which transmits information online in parallel with the technical trouble codes themselves. Telematic (intellectual) control systems of automobile transport. The creation and implementation of telematic systems in recent years has become one of the main trends in the automotive industry. Such complexes are often called intelligent systems, since in addition to collecting information; they carry out its analysis and even give some recommendations.

As a rule, the control of motor vehicles implies the collection and analysis of data not only on movements and location, but also on speed, fuel consumption, brake pad condition, current tire pressure, etc. This allows you to significantly reduce operating costs and optimize processes. The effectiveness of telematic control and accounting of vehicles is not in doubt. And although in our country their use is still the exception rather than the rule, experts say that in the near future the use of the complexes will increase rapidly.

References

1. Михович С.Г., Прусенко Є.Д., Стороженко М.С., Седов А.В., Арінушкіна Н.С., Грищенко Т.М. Технологія будівництва автомобільних доріг : Вища школа, 2008 р.

2. Кіяшко І.В., Жданюк В.К., Прусенко Є.Д., Догодайло О.О., Фоменко О.О. Методичні вказівки до вибору основних машин для ремонту та утримання автомобільних доріг : Вища школа, 2016 р.

3. ГБН В.2.3-37641918-554 Шари дорожнього одягу з кам’яних матеріалів, відходів промисловості і грунтів, укріплених цементом. : Укравтодор, 2013 р.

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TYPES AND ORGANIZATION OF CAR REPAIRS

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The minor repair must ensure the guaranteed performance of the car on the run to the next scheduled repair, and this run must be not less than the mileage to the next TO-2, in the event of failure, unplanned minor repairs are performed, when parts and units in volume are replaced or restored, depending on the technical condition of the car.

Major repairs must ensure the serviceability and full (or close to full) life of the vehicle or the unit by restoring and replacing any assembly units and parts, including basic ones. The base is called the part with which the assembly of the product begins, attaching assembly units and other details to it. In cars, the base part has a frame, in units – body detail, such as engine block or a gearbox crankcase.

Repair is a set of operations for repairing the malfunction or performance of parts.

The necessity and expediency of repair of cars are conditioned, first of all, by not evenness of their constituent parts. It is known that it is impossible to create a uniform car, all parts of which would wear evenly and have the same lifetime. Therefore, during the operation of the cars, they undergo periodic maintenance and, if necessary, minor repair, which is carried out by replacing individual units at service stations. This allows maintaining cars in a technically good condition.

In the course of long-term operation, cars reach such a state when their repair in the conditions of motor-repair plant becomes technically impossible or economically inexpedient. In this case, they are sent to the centralized current or major repairs at car repair companies or car repair plants.

Concerning major repairs – they must ensure the serviceability and full (or close to full) life of the vehicle or the unit by restoring and replacing any assembly units and parts, including basic ones. The base is called the part with which the assembly of the product begins, attaching assembly units and other details to it. In cars, the base part has a frame, in units – body detail, such as engine block or a gearbox crankcase.

The main source of economic efficiency of major repair of cars is the use of the remaining resource of their parts. Approximately 75% of the vehicle parts that arrived at major repair can be reused after an unplanned repair, or even after minor repairs.

Details that have completely exhausted their resources and are subject to replacement make up 25 ... 30% of all details. These are pistons, piston rings, rolling bearings, rubber – technical products, and others. The number of parts, the wear of working surfaces which are within the permissible limits, which allows them to be used without repair, reaches 30-35%. The remaining parts of the car, about 40 ... 45% can be reused only after their restoration, they include most of the more complex parts of the car.

The cost of restoring these parts does not exceed 10 ... 50% of the cost of their manufacturing.

The cost of major repair of the car does not exceed 60 ... 70% of the cost of a new car. High efficiency centralized repair led to the development of auto repair production, which has always occupied a significant place in the industrial potential of our country.

The organizations of repair of cars in our country has constantly been paid great attention to.

The significant growth of motor transport causes an increase in the volume of work on capital repairs of cars. Execution of these works requires high labour costs and the involvement of a large number of skilled workers.

In connection with this, it is necessary to significantly increase the productivity of the capital repairs of cars. Resumes for staff in automotive and motor transport enterprises should thoroughly examine the processes of major repairs of cars using modern equipment.

References

1. Канарчук В.Є., Дудченко О.А., Чигиринець А.Д. Основи технічного обслуговування і ремонту автомобілів. Книга 1: теоретичні основи. Технологія: підручник. Київ, 1994. 342 с.

2. Черновол М.І., Чабанний В.Я. та ін. Технічна експлуатація автомобілів: Лабораторний практикум. Кіровоград, 2007. 125 с.

3. Лудченко О.А. Технічне обслуговування і ремонт автомобілів. Організація і управління. Київ, 2004. 478 с.

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DEVELOPMENT AND INVESTIGATION OF A STEEL-MOLYBDENUM COATING DEPOSITED BY THE GAS-THERMAL METHOD

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The significant increase of reliability and endurance of units and machine parts is one of the main problems in the development of modern engineering.

This problem can be solved by the urgent development of the new technologies, especially, for the details which work in the condition of friction as well as amortization.

The well-known strengthen technologies have some disadvantages, for example: the microgeometry of details is changed after strengthening, skellering of the of the product`s surface and the appearance of stresses inside it, affects the operability of the machine unit, the need to create special and expensive conditions for the process of strengthening, environmental problems, etc.

This scientific research is devoted to the process of planning and investigation of the structure and the features of piston rings group after coating them with steel-molybdenum.

The coatings were applied to the piston rings group made of high-strength cast iron, used in batch production

At the present time the electrolytic bichromated coating is applyied to the piston rings group.

That is why the researches were conducted simultaneously with the piston rings group, which were reinforcement according to the proposed technology of hardening, the results of the research were compared by the main features, which characterize serviceability of piston rings group during operation.

The proposed technology of hardening consists in applying a coating on cast iron rings by the method of double-wire metallization with independent feeding of steel and molybdenum wires. For this purpose, structural bearing steel 11X18M was selected, the chemical composition of which is given in Table.1.

Table 1. Chemical composition of steel 11X18M

Content of elements,%									
C	Si	Mn	S	P	Cr	Mo	Cu	Ni	Fe
1,1-	0,53-	0,5-	to	to	16,5-	0,5-	to 0,3	to 0,3	rest

Molybdenum is chosen as a material having a melting point of 2620 °C, high heat resistance and corrosion resistance, low thermal expansion coefficient, high hardness and strength at elevated temperatures, significant specific strength. Such a set of properties can significantly improve the quality of the coating.

The method of two-wire metallization creates a complex structure of the coating, in which particles of steel and molybdenum, having different properties (including density), should be distributed in successive layers with different hardness. This will allow to obtain a heterogeneous structure of the coating, ensuring its high antifriction properties.

The piston rings, which were to be covered with the steel-molybdenum coating, were grouped in twenty items. The assembling of the piston rings group was carried out in a special appliance, imitating the bushing of the working cylinder. Rings on the mandrel were assembled in such a way that there was no opening of the locks. On the working surfaces of the piston rings group, a special groove is provided under the coating, which increases the adhesion of the coating to the substrate.

The technological process of applying the steel-molybdenum coating to the piston rings group includes the following stages: preliminary cleaning, bead blasting treatment, spraying.

The bead blasting treatment deals with cleaning the surface of the base coat, increase the surface roughness of the substrate, which increases the total area of the coating adhesion sections with the substrate and the adhesion of the coating.

Molybdenum and steel wires were fed at a certain speed. The coating was applied by electric arc spraying on the same mandrel as shot blasting. The

molybdenum wire is connected to the positive pole of the power source, the steel wire to the negative pole.

The temperature of the piston rings group during the application of the steel-molybdenum coating is 150 ° C. The coating was sprayed to a thickness of 0.8 mm. After the coating was applied, a mechanical treatment was carried out. The thickness of the coating in the final finished ring is 0.5 ± 0.1 mm.

The structure of the steel-molybdenum coating was studied using a metallographic microscope with an increase from x100 to x300.

The industrial etching of the samples was carried out with a Murakama reagent (10 g NaOH, 10 g K_3Fe (CN) $_3$, 10 ml H_2O), which is used to reveal the structure of Mo and other refractory materials.

The structure of the steel-molybdenum coating after etching is shown at the figure 1. The microstructure of the coating is a combination of molybdenum (dark, etching areas) and steel (light, non-etching areas).

The large-dispersed component of molybdenum appears with a larger increase in the structure of the coating, apparently, due to the high rates of crystallization during the coating process (Fig. 2). Besides the two main phases, the other structural components are observed in the coating, which are to be the products of the interaction of steel and molybdenum wires with oxygen and nitrogen, as well as products of interaction between molybdenum and steel in the process of plasma spraying.

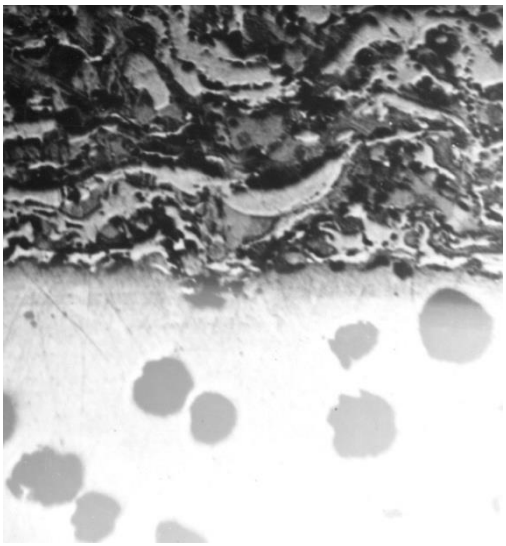


Fig. 1. The microstructure of steel-molybdenum coating by etching, ×115

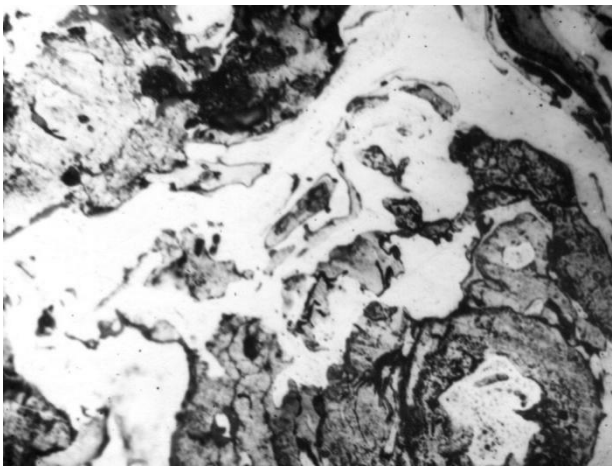


Fig. 2. The microstructure of steel-molybdenum coating`s surface layer, ×400

The pore size of the coating is 5 ... $10*10^{-6}$ m, which is optimal for piston ring group operating with significant force and temperature loads.

The porosity of the coating (up to 12 %) provides an increased oil consumption of the rings, which positively affect both the process of running-in of the working pair of the sleeve-the piston ring and the operation of the piston ring group during operation

The control of the adhesion strength of the steel-molybdenum coating to the substrate is carried out on a special device by twisting the piston ring group with simultaneous bending until the coating was peeled off. The angle of twist at which the coatings were peeled off is not less than 35°, which indicates satisfactory adhesion of the coatings.

The measurement of microhardness showed that for molybdenum it is H_μ= 550 ... 590, for steel H_μ = 460 ... 560 by the thickness of the coating.

The microhardness of molybdenum increased to H_μ = 720 ... 760, and steel - to H_μ = 520 ... 580 After the tests for wearability.

In order to determine the antifriction properties of the received steel-molybdenum coating of piston ring group and the propensity to grasp it with the sleeve the tests were conducted to determine the dependence of the friction coefficient on the load. Samples cut from the chrome and the steel-molybdenum ring group were tested, when rubbing in pair with disc samples from cast iron. The investigations were carried out by using a SMC-2 friction machine under step loading. Lubrication with oil was carried out by dipping, as well as applying it to the working surfaces of the samples before testing.

The obtained data indicate that the steel-molybdenum coating does not adhere to the sleeve cast iron in the entire range of loads. And when rubbing under more severe conditions (with a single lubrication before the test), the friction coefficient at high loads is even less than with excessive lubrication. At the same time, samples of chromium-plated rings can withstand less stresses prior to bulging working under more severe conditions.

Thus, the obtained results indicate a higher resistance to corrosion and better antifriction characteristics of piston rings with a steel-molybdenum coating in comparison with electrolytic chromium plating.

The durability tests were carried out in comparison with chrome-plated piston rings in order to determine the wearability and wear resistance of a steel-molybdenum coating, when it was paired with a sleeve. The test was carried out on a CMC-2 machine with reciprocating motion for two hours under load 1 kN and a sliding speed of 1.3 m / h. Lubrication - immersion in oil.

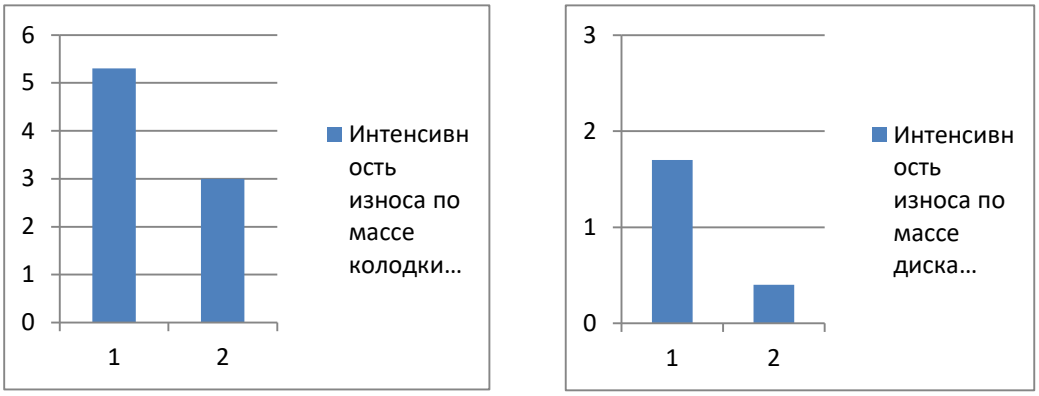
The wear rate by the mass of the disc (liner) and the shoe (ring) treated by the existing technology (electrolytic chromium plating) and after the application of the steel-molybdenum coating are presented for comparison of the histogram in figure 3.

The results indicate that the steel-molybdenum coating is more wear-resistant than electrolytically chrome plated. The steel-molybdenum coating minimizes the mating material to a lesser extent and has a lower coefficient of friction.

The analysis of the obtained results testifies to faster workability of piston ring group with the steel-molybdenum coating. For a piston ring group with a steel-molybdenum coating, a lower wear rate is also characteristic, which is confirmed by the obtained data on the good antifriction properties of these coatings.

Such a complex of parameters of steel-molybdenum coating can be explained by the specific properties of molybdenum oxides, which can have an additional lubricating effect, acting as a solid lubricant. In addition, the high melting point of

molybdenum (2600 ° C) contributes to a lesser propensity to set (weld) the mating materials.



a b

Fig. 3. – The histogram of the intensity of wearability by weight of the pads (rings) «a» and the disc (sleeves), «b»; 1 – chrome plated coating; 2 – steel-molybdenum coating.

Such a complex of parameters of steel-molybdenum coating can be explained by the specific properties of molybdenum oxides, which can have an additional lubricating effect, acting as a solid lubricant. In addition, the high melting point of molybdenum (2600 ° C) contributes to a lesser propensity to grasp (weld) the matched materials.

The difference in the parameters of the crystalline structure of molybdenum and Fe_{α}, which is the basis of the metallic matrix of cast iron facilitated decrease in setting. Molybdenum crystallizes with the formation of a body-centered cubic lattice with a period a = 3.1474, whereas in Fe_{α} a = 2.8665 (in chromium, the lattice period is a = 2.8829).

Summary

1. The technology for applying a steel-molybdenum coating is proposed.
2. The investigation of the structure of the steel-molybdenum coating showed that it has a heterophase structure.
3. The porosity of steel-molybdenum coating provides increased oil consumption of the rings, which positively affects the process of running-in of the working pair of the cartridge-piston ring.
4. The coefficient of friction of the steel-molybdenum coating is 20% lower than that of the chrome plated coating for all the studied loads.
5. The wear rate of the chrome ring is 2 times higher than that of the ring with a steel-molybdenum coating.
6. The piston ring group with a steel-molybdenum coating are characterized by faster workability than rings with chrome plated coating.
7. The basis for a higher complex of antifriction properties and wear resistance of piston rings with a steel-molybdenum coating as compared to chrome plated is given.

References

1. Кудинов В.В. Теория и практика газотермического покрытия / В. В. Кудинов. – М.: Металлургия, 2000.
2. Антошин Е.В. Применение металлических и неметаллических покрытий методом газотермического напыления / Е.В. Антошин. – М.: Инженерия, 2002.
3. Кац Н.В. Напыление металлов / Н.В. Кац. – М.: Инженерия, 2006.

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COMPUTER COLOR MATCHING OF CAR PAINT

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Every car owner may face such a problem as the correct selection of paint for his or her car. Restoration or secondary staining of paint coating may be necessary after an accident, or to eliminate scratches obtained mechanically. So, the selection of paints for cars is a crucial process that requires a careful approach.

In addition, staining may be necessary when the basic coat has lost its original look. If you need to paint one wing or bumper, then the colour should be chosen more carefully so that the shade does not stand out on the existing coating.

It is very difficult to choose the right paint by sight. There are many shades of blue or red, for example. Computer paint colour matching can help here. It is one of the best methods. It is inexpensive and guarantees 100% result. Computer paint colour matching does not require expensive equipment, because everything is done by a certain online program installed.

Computer colour matching has the following advantages:

- No need to paint the entire body when there is only minor damage.
- No disassembly of the element is required, that is, the factory assembly will not be affected.
- No need to use additional equipment (for example, spectrophotometer).

Despite the fact that the method was presented relatively not long ago, it rapidly gained popularity among car owners. Computer colour matching for a car is a special technological process in which the desired colour is selected by car code.

There exists a special program that compares the contrast, colour saturation, and the degree of burnout using the car vin-code. It is worth noting that the car vin-code is individual and is given by manufacturing. After using this method, it will be impossible to determine the difference between the painted part and the old coating.

After processing the data, comparing the proposed colour with the original one, the program will accurately calculate the composition of the new paint. The calculation will clearly indicate the amount of enamel and shades that need to be mixed to obtain the desired colour.

Computer selection of car paint involves a thorough analysis of the paint coating by the spectrograph. Thanks to this device, as well as software, the master compares the colour curves of the car body and paint in order to further identify

discrepancies and choose the optimal variant, and obtains the correct proportions of ingredients, mixing of which will allow to achieve the correct shade. Often this process is delayed if the body colour is complex and has impurities like mother-of-pearl, which make it difficult to determine and mix suitable paint.

When several of the most accurate shades are chosen, the master makes paint samples – that is he paints the metal plates to get an idea of how the paint will look on the metal. These paint samples are compared with the car body, always with good lighting and if the resulting option does not suit the specialist, he refines the composition, adding certain pigments, to obtain the optimal result. This process can often last for several hours or even the whole day, but even if there still is some error, it is invisible to the human eye.

As a rule, the created colours are stored in the workshop database, and the binding is made to the car code. So, if the car owner has to paint gain, the specialist will not be re-engaged in the colour matching process, but he can take the combination of pigments already tested on this car, which will save a lot of time.

In very rare cases, when the car body colour cannot be recreated with the utmost precision, the gradient painting method is used, in which a new shade seems to be blurred with the old one. The master takes into account the bends of the body, especially the incidence of light on the work area, and makes the blurring so that the border between the colours is indistinguishable.

When mixing shades to obtain the desired colour is not recommended to take autoenamels from different manufacturers. They use different chemical components for production, so the result of mixing enamels can be unpredictable both in colour and in quality.

Colour matching systems include: consumables (components) for the preparation of water-borne and traditional automotive paints; equipment for colour matching: mechanized racks, scales, dosing covers, etc.; colour documentation: catalogues, colour directories; computer programs for colour matching: on CD and on-line (for example, Colour Formula Finder).

Colour Formula Finder is easy to use and has such modern features as: different search options for colour formulas; cumulative and absolute weighing; recalculation of formulas after a weighing error; ability to create a personal database; import / export of personal formulas; ability to connect to printer – that is label printing; connection to scales; Price Master Option; contains technical documentation / TDS and Data Material Safety / MSDS (Optional Downloaded from disk).

Computer paint colour matching for the car is not an easy task and cannot be done without the appropriate hardware and software, as well as trained professionals. Accordingly, such a procedure is also somewhat more expensive than a simple repainting, but there will be more confidence in a good result.

References

1. Подбираем краску для авто правильно. *Автолирика*. URL: http://autolirika.ru/pokraska/podbiraem-krasku-dlya-avto-pravilno.html

2. Компьютерный подбор краски для автомобиля. *Устройство*

автомобиля. URL: https://ustroistvo-avtomobilya.ru/kuzov/kompyuternyj-podbor-kraski-dlya-avtomobilya/

3. Как подобрать краску для своего авто. *Красим авто*. URL: http://krasymavto.ru/materialy/kraski/podbor-dlya-avtomobilya.html

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TECHNOLOGY OF CONTROL OF THE SOIL PUNCTURE AND EQUIPMENT FOR ITS REALIZATION

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Technology of the controlled puncture of soil is one of the most progressively developed trenchless methods for building underground communications in modern urban conditions.

After calculations, a technical solution has been presented that confirms the possibility of realizing the process of correction of the head movement during a soil puncture using a hydraulic cylinder with a self-releasing screw pair and a puncturing head with an adapted form of the tip.

The proposed original design of the hydraulic cylinder with the self-releasing screw pair was effectively used in the operation of bidirectional bored piles in the designs of the support contours of machines [1]. This allows to significantly reduce the weight and energy content of the main setup, as well as to not include a separate drive to rotate the work body and to simplify the control process. Also, the hydraulic cylinder can be fixed to the frame of the setup and provide a gradual and gradual-rotational movement of the working body to include a mechanism for changing the shape of its tip.

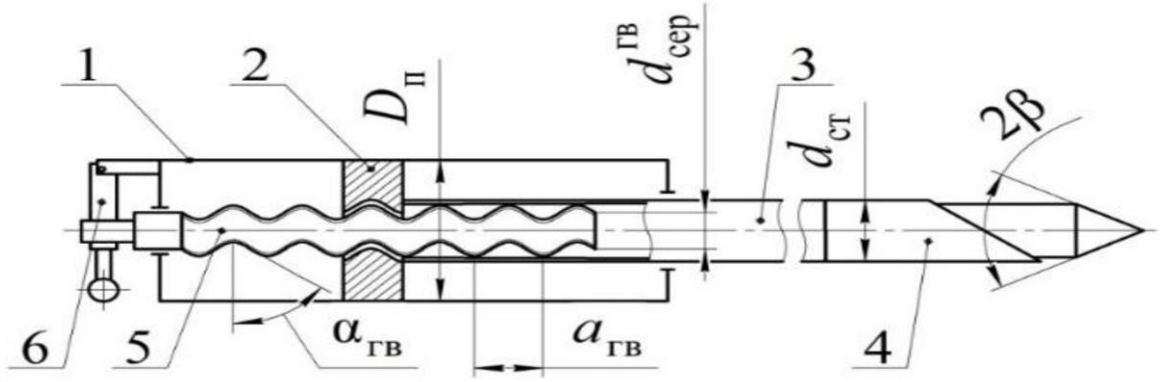

Fig. 1. Kinematic diagram of the screw hydrocylinder drive

$D_п$ – diameter of the piston; $d^в_{ср}$ – average diameter of the screw thread,
$\alpha_в$ – the angle of the lift of the screw line; $a_в$ – screw step;
2β – angle of sharpening of the conical tip;
$d_{ст}$ – diameter of the hydraulic cylinder rod; L – length of the well

The kinematic scheme of the screw hydraulic cylinder is shown in Figure 1. The axial feed of the rod and its rotational feed is performed by activating or deactivating the locking device.

Thus, when the screw is fixed under the pressure of the hydraulic fluid to the piston it gradually moves around the fixed screw together with the nut mounted into it. Also, on the contrary, when disconnecting the clamp, the gradual movement of the piston will be performed along with the free rotation of the screw.

The calculation of the hydraulic cylinder with a gradual movement can be carried out according to the existing method of calculating the standard hydraulic cylinder, from the balance of its effort, with the strength of resistance to the soil puncture.

For experimental research, and then for the working equipment of the setup, a driver was manufactured on the basis of a typical hydraulic cylinder (Figure 2).

Fig. 2. Working sample of a hydraulic cylinder with a self-releasing screw pair for rotation of the working body

At nominal pressure in the hydraulic cylinder P_n = 16 MPa, the axial force of the pressure of the nut on the screw will be P_{os} = 180864 kN, and the maximum torque $M_{акт}^{max}$ = 15562 N/m.

Experimental studies of the indicated drive confirmed its efficiency with ease of maintenance and a low weight.

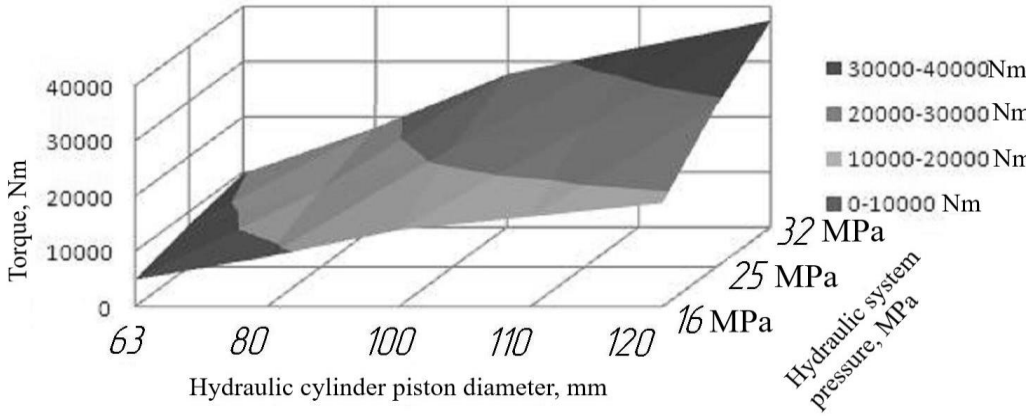

Fig. 3. Dependence of the active torque from the pressure in the hydraulic system and the diameter of the piston of a typical hydraulic cylinder

Active torque can be controlled by specifying the diameter of the piston and the pressure of the hydraulic cylinder. For a manufactured self-releasing screw pair, numerical analysis of drives based on general purpose hydraulic cylinders according to OST 22-1417-79 has been performed. Figure 3 presents the results of numerical analysis that allows to state - a torque of up to 37000 Nm can be created. According to the data [1, 2, 3], such a torque will allow to immerse the screw anchors of IV category with the diameter of the blade Dл = 0.4 ... 0.5 m into the soil.

From the above, the following conclusions can be drawn.

- A driver based on a self-releasing screw pair mounted inside a typical hydraulic cylinder is capable of operating and, under certain parameters, creates a torque of screwing up to 37000 Nm.
- The obtained dependencies for active torque allow to select the required diameter of the hydraulic cylinder at a certain pressure in the hydraulic system.

References

1. Пенчук В. А. Винтовые сваи и анкеры для опор. Донецк : «Ноулидж», 2010. 179 с.

2. Пенчук В. А. Исследование и создание винтовых якорных опор, применяемых для стабилизации строительных машин : дис. … канд. техн. наук : 05.05.04. Москва, 1979. 202 с.

3. Пенчук В. А. Комбинированные рабочие органы землеройных машин : дис. … д-ра техн. наук : 05.05.04. Киев, 2004. 340 с.

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RESTORATION OF CRANKSHAFT OF SHIPS IN RUSSIA

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In the production and operation of ship internal combustion engines (ICE), the most effective means of reducing wear, taking into account specific working conditions, are not always used. For this reason, Russia and other technically developed countries incur high material costs associated with repairs.

One of the main parts of the ship's internal combustion engine, determining the resource of his work, is the crankshaft, the durability of which, in turn, depends on its fatigue resistance and wear resistance of working surfaces. The main reason for the failure of the machines is not their breakage, but the wear of the working surfaces, which makes the problem of reliability and increase of the component life time [3, 49–54]. Premature wear of the working surfaces of crankshafts of more extreme values leads, as a rule, not only to significant costs for repairing or replacing the shafts, but also to losses due to the idle time of the vessel under repair. And the failure of a crankshaft failure can lead to a ship accident.

In the current economic situation, the fleet of ship diesel engines of the Russian fleet is gradually becoming obsolete. Due to the increased wear rates of the working surfaces, many crankshafts work machined to the latest repair dimensions or rejected due to wear above the limit values, not reaching the designated full resource.

More than 50% of the main shipboard engines are imported. In this regard, ship repair enterprises often do not have the opportunity to purchase replacement parts from manufacturers. Therefore, the task of restoring and hardening the working surfaces of crankshafts worn out during operation, instead of replacing the shafts with new ones, becomes relevant.

The emergence of the problem of resource conservation requires the use of progressive and high-tech methods of restoring the worn surfaces of crankshafts.

Crankshaft recovery methods:

1. Without coating – grinding shaft necks for repair size with subsequent hardening method: ultrasonic treatment; diamond smoothing; laser hardening; laser surface doping; nitriding; rubbing geomaterial; ultrasonic processing by geomaterial layer.

2. With coating: surfacing with a wire under a layer of flux followed by heat treatment; plasma surfacing of composite materials; plasma spraying; plasma spraying with simultaneous ultrasonic treatment; plasma spraying followed by laser fusing of the coating; electroplated chrome plating [1, 174–176].

Significant disadvantages of most of the methods used for restoring and hardening the crankshaft journals are their duration, high labor intensity and energy intensity, and low environmental protection.

Currently, methods of laser surface treatment and plasma spraying are used to obtain the required parameters of the surface layer, as well as plasma spraying followed by laser deposition of the coating.

Plasma spraying is one of the most interesting and effective ways of applying protective and hardening coatings on the surface of parts. This is a process in which the applied material in the form of powder or wire is introduced into a plasma jet and is heated in the process of moving with a gas flow to temperatures exceeding its melting temperature, and accelerates during heating to speeds of the order of several hundred meters per second.

There are various coatings that are applied depending on the working conditions. If there is any problem associated with the insufficient service life of a particular part, it is almost always possible to find or create a material that more fully meets the conditions of work of a stressed part than the original material and, therefore, apply it by plasma spraying as a reinforcing coating. The range of materials for spraying and surfacing offered by leading firms includes hundreds of items and is constantly expanding as new practical tasks emerge and are solved.

Using a laser allows the hardening of the surface layer, as well as to restore the crankshaft to the original contour. Laser coating is a suitable process where local heat input and low distortion are required. Moreover, over the past decades this process has reached a high level in surface treatment technologies. Especially powerful diode laser shows itself well in this process. Achievable quality coatings are well suited for bearing surfaces of trunnions. The required mechanical

properties, such as hardness, wear resistance and friction characteristics, can be adjusted and improved compared to the starting material [2, 387–397].

These technologies make it possible to reduce the friction coefficient by 15-20%, to increase the wear resistance of the interface by 2 times, to reduce the temperature in the friction zone by 10%. There is a significant decrease in the roughness parameters of the friction surface, changes in the structure of the surface layer, which leads to a decrease in the friction coefficient and, consequently, to a decrease in the energy level of the contact interaction of the rubbing surfaces. All these positive changes in the technical characteristics of the pairing suggest that it is promising to use these technologies to increase the durability of crankshafts.

References

1. Токликишвили А. Г. Восстановление коленчатых валов судовых среднеоборотных дизелей // Вологдинские чтения. 2010. №78.

2. H. Koehler, K. Partes, T. Seefeld, and F. Vollertsen. "Laser reconditioning of crankshafts: From lab to application" Physics Procedia, vol. 5, 2010. doi:10.1016/j.phpro.2010.08.160

3. Технологическое обеспечение качества восстановленных коленчатых валов дизельных двигателей / А.С.Денисов, В.В. Погораздов, Б.Ф. Тугушев, Е.Ю. Горшенина // Вестник Саратовского государственного технического университета. 2010. № 4 (49).

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ANALYSIS OF PARAMETERS OF SMALL-SIZED LOADERS WITH ON-BOARD TURNING SYSTEM

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Compact skid steer loaders are widespread in many sectors of the national economy: they can be found in the shops of enterprises and in warehouses, in municipal storing and forestry facilities, on road and housing construction sites, agricultural and industrial facilities. Thus, the scope of their application is extremely wide: from home gardens to industrial zones. The versatility and variability of earthmoving and construction equipment is achieved by equipping machines with a large number of types of replaceable working parts which allow us to consider the great potential of this type of equipment.

Their popularity is explained not only by their compact size and maneuverability, but also by their multifunctionality due to the extensive choice of replaceable attachments. The loader independently and with sufficient transport speed moves through the service area, and it is transported to a remote object in the back of a truck or on a tow truck.

On the Ukrainian market, small-sized loaders with an onboard steering system are represented by a number of foreign companies: Bobcat, New Holland,

Mustang, Gehl, Komatsu, Case, Caterpillar, JCB, John Deere, etc. Such machines are equipped with Yanmar, Camins diesel engines, Parking, Case, Caterpillar, John Deere and others. All machines are equipped with hydraulic equipment from companies such as Parker, Bosch Rexroth, Haldex, Marzocchi, Linde, Vickers, Linde, Kawasaki, Caproni, Sauer Danfoss and are presented in a very large selection of their functions, types and specifications.

Compact loaders with manual-controlled hydrostatic transmissions are different from classic-style machines with a shortened base and independent drive of the driving wheels of the right and left sides. This increases their maneuverability and makes it possible to work on construction sites in cramped conditions, due to the possibility of turning the loader around a vertical axis passing through the center of gravity of the machine.

The choice of a PMTS 1200 loader as an object of experimental research is explained by the following considerations. All over the world more than 20 manufacturing companies produce over 100 loader models of similar designs. Analysis and statistical processing of their parameters show that the mass of the machine is determined by the carrying capacity, and the speed of movement and engine power − the mass of the machine. For the analysis of statistical data, 78 models of well-known companies were selected (BOBCAT, Caterpillar, Volvo, JCB, Komatsu, GEHL, Mustang, Case, John Deere, New Holland). Figures 1-4 show data on the weight, speed and gravity of loaders. The listed average parameters are determined by the ratios:

− mass of the loader m depending on its load capacity q;

$$m = 32.08 + 4.12q - 8.463 \cdot 10^{-4} \cdot q^2, \text{ t.}$$

− operating speed V depending on the mass of the loader;

$$v = 9.675 + 1.002 \cdot 10^{-2} m - 9.196 \cdot 10^{-8} \cdot m^2, \text{ km/h.}$$

− engine power N, depending on the load capacity;

$$N = -2.236 + 0.07q - 1.603 \cdot 10^{-5} \cdot q^2, \text{ kW.}$$

− tipping load Q depending on the load capacity q;

$$Q = 52.372 + 1.986q.$$

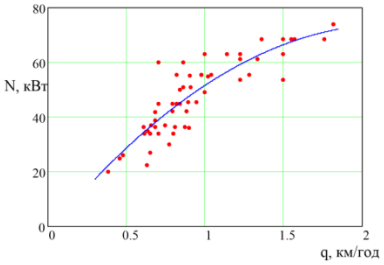

Figure 1. – Plot of loader power versus load capacity

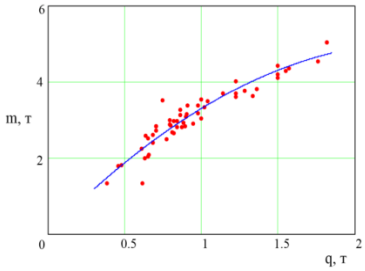

Figure 2. – Plot of loader mass versus load capacity

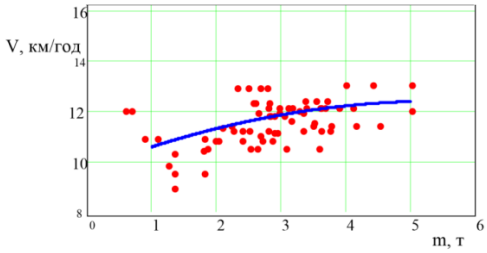

Figure 3. – Plot of the loader speed versus mass

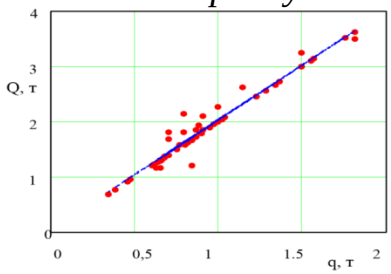

Figure 4. – Plot of tipping load versus load capacity

Comparing the parameters of the PMTS 1200 loader with the average characteristics of a loader of similar capacity, it is easy to see that the PMTS 1200 is close in parameters to the average machine. In particular, with a lifting capacity of 1.2 tons, the weight of the PMTS 1200 is 4.1 tons (for an average loader it is 3.764 tons); the highest speed of movement of the GVMS 1200 is 13 km/h (for an average loader it is 12.236 km/h); PMTS 1200 engine capacity is 44 kW (an average loader has a capacity of 58.512 kW); tipping load for a PMTS 1200 is 1.600 t. For these reasons, the data obtained for the PMTS 1200 loader, considering scale factors, can refer to both existing and newly designed machines of a similar design.

References

1. Бояринцев А. Особенности конструкции универсальных мини-погрузчиков. Новосибирск, 2016. URL: https://sibac.info/archive/technic/4(40).pdf

2. Раннев А. Строительные машины. Москва, 1991. 177 с.

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PERSPECTIVES FOR DEVELOPMENT OF ELECTRIC CARS IN UKRAINE

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Ukrainian market of electric cars is growing rapidly. By the rate of development, it takes the fourth place in the world. Only in January 2018, 793 electric cars were registered in Ukraine, and the most popular model is Nissan Leaf.

Moreover, the government also takes an active part in the promotion of this type of personal transport.

According to the association “Ukravtoprom”, for the period from January to May 2017, the first registration numbers in Ukraine were 958 passenger electric vehicles. In the primary market of passenger cars, the share of such cars was almost 2%. It must be mentioned thought that, compared with 2016, the demand for electric cars has grown by 2.8 times, but the share of new cars has decreased from almost 45% to 18%.

According to AUTO-Consulting, in November 2017, the total number of electric vehicles in Ukraine exceeded 4 thousand units. Most of them are the Nissan Leaf. Thus, the Nissan Leaf first-generation model, mostly 2013-2014, comprises about 90% of all electric vehicles in Ukraine. Further with the noticeable lag is the electric Ford Focus, Tesla Model S, BMW i3, Fiat 500e, Toyota RAV4 EV. Also, but much less, Nissan e-NV200, VW e-Golf, Mercedes-Benz B-Class electric, Mitsubishi i-Miev, Kia Soul EV can be found.

The leader in the number of electric cars is Kyiv with the share of almost 30% of the market. Then comes Kharkiv – 20% of supplied electric cars, Odessa – 18%, Dnieper – only 6%.

In 2017, more than 200 electric vehicles were imported into Ukraine each month. During the entire year, about 2.5 thousand cars were imported. If such a dynamics continues, by the end of 2018, the fleet of electric vehicles may double again, amounting to more than 8 thousand units. The development of the market of electric cars will also contribute to changes to the Tax Code, which in late 2017 was adopted by the Verkhovna Rada. They provide for the abolition of VAT and excise taxes on the import of electric vehicles in Ukraine. The changes came into force on January 1, 2018, but only for a year. According to experts' forecasts, taking into account all factors, buying an electric car in Ukraine will be 17-20% cheaper.

According to the head of the department of digital infrastructure of the Ministry of Infrastructure of Ukraine Alexander Ozeran, after the abolition of excise and VAT, in January 2018, 793 electric cars were registered in Ukraine, which is one third of the number registered for the whole previous year.

But the government does not plan to stop there. The Ministry of Infrastructure intends to initiate the introduction of a tax discount mechanism (which stipulates that the buyer pays the full cost of the car, and the tax compensates 18%) and the cancellation of payment to the Pension Fund at the registration of electric vehicles.

Considerable reserves of lithium and nickel will allow Ukraine to produce accumulators for cars by our own facilities.

Ukraine is one of the leading places in the world by the rate of development of the electric vehicles market. The import of electric cars, moreover, has already developed its resources, stimulated by preferential tax regime, but for today there are no such preferences for own production. Ukraine has the production facilities to ensure the assembly of modern models of cars with electric motors, but there are still no real shifts in this regard.

Ukraine has entered the “top ten” global ranking of countries with the fastest development of the market of electric vehicles. Following 2017, we won the honorable ninth place.

Last year, on the primary market, Ukrainians bought 2697 passenger electric vehicles, with 85% of sales falling on the old cars. Compared to 2016, the market for electric cars in Ukraine has grown by 2.3 times. But it seems that this is not the limit – the Verkhovna Rada canceled the VAT (20%) and the excise tax (109 Euros) on electric cars during their customs clearance by 2018 (the import duty was abolished even earlier). In this regard, both the authorities and experts expect a real electric vehicle boom in Ukraine in the near future. But the measures taken stimulate the import of electric cars to the country, but not their own production.

Yaroslav Pylypchuk, an expert on economic analysis and transport infrastructure of the analytical center “Ukrainian Institute of the Future”, predicts that in Ukraine half of all cars will be either electric cars or hybrid cars by 2030. This is in the baseline scenario, at a pessimistic one – 25% in the optimistic – 75%. But such a jerk is only possible in the event of a sharp increase in the economy and the inflow of investments, as the specialists say.

According to them, in the light of such a dynamics for Ukraine it is logical to adjust its own production of electric vehicles. “About 60-70% of Ukraine could locate the production of electric cars,” said Pylypchuk, clarifying that, in particular, it could be about producing batteries.

In Ukraine, potentially there are enterprises on which full-scale production of electric cars is possible.

References

1. Литры vs ватты: все плюсы и минусы электрокаров. URL: https://www.segodnya.ua/economics/avto/litry-vs-vatty-vse-plyusy-i-minusy-elektrokarov-1105778.html

2. Украина на пороге бума электрокаров: что мешает сделать свою Tesla. URL: https://economy.apostrophe.ua/article/promyshlennost/2018-05-07/ukraina-na-poroge-buma-elektrokarov-chto-meshaet-sdelat-svoyu-tesla/18210

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IMPROVEMENT OF SPECIAL PURPOSE VEHICLE OPERATIONAL CHARACTERISTICS BY MEANS OF HYBRID TECHNOLOGIES

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Operational characteristics of special purpose vehicles can be improved due to the use of a hybrid powertrain with electromechanical transmission. This type of the power train is a transitional stage towards implementation of electric vehicles, whose use is limited or made impossible because of the parameters of the existing energy storage units.

In comparison with the classical transmission for this type of vehicles, the electromechanical transmission with a separate drive gear on every wheel allows:

– to decrease the turning radius due to a possibility to accomplish it on-site;

– to increase off road capacity in difficult road conditions due to the individual control for the power on wheels and its distribution;

– to increase smoothness of movement, controllability and roadholding ability at high speeds and an average speed while moving on roads of general purpose;

– stepless switching of a speed, traction effort and turning radius;

– easiness of transmission automation and the capability for the vehicle to be steered by any crew member with possible remote control when it is necessary;

– widened possibilities to recuperate energy of deceleration and turning;

– the possibility of short-term movement when internal combustion engine is off;

– the possibility for short-term summing up the power of generator and energy storage units;

– the absence of rigid mechanical connections between major units, which facilitates layout design and weight distribution for floating machines.

Over the last 20 years a significant progress has been achieved in the area of power storage units, that resulted in decreasing the size and weight of devices with similar technical characteristics, as well as creation of a traction electric motor with parameters which allow to design competitive electromechanic transmission based on them [1, 140–141].

To provide performance of special work by this vehicle with the weight of 30 tones, which has wheel formula of 8x8 and a sequential scheme of hybrid power train, the power of a diesel generator set must provide supplying the power of 40 kW to every wheel [2, 100–107].

The electromechanic transmission has a coefficient of performance lower than that of a hydromechanical transmission. The main difference is based on the fact that the diesel generator set works constantly in a stationary mode which is characterized by the least specific fuel consumption. According to data of BAE Systems Hagglund, General Dynamics Land Systems, Oshkosh Truck, the use of the hybrid power train allows to decrease fuel consumption by 35% in comparison with the basic variant of a vehicle [3, 16–18].

To provide effective use of the hybrid power train in all modes, it should contain the following units: a diesel generator set, voltage converter (inverter), energy storage (rechargeable batteries), upper level controller (control system), lower level controllers (electromotor drivers), electromotors with gearboxes [4]. The scheme of power supply of the special purpose vehicles is given in Fig. 1.

To meet design requirements and operational characteristics of the vehicle it is necessary to use a separate electromotor equipped with a two-stage gearbox on every wheel gear for efficient use of a torque, to provide movement at the highest speed of 110 km/h and possibility to overcome slopes of about 30°. The generalized results of calculations are presented in table 1 [5].

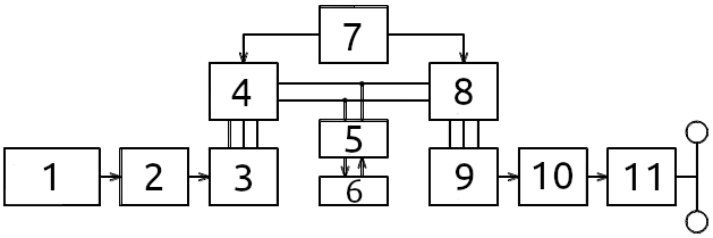

Fig. 1 – Scheme of power supply from the engine to driving wheels

where: 1 – internal combustion engine, 2 – matching gearbox, 3 – traction generator, 4 – traction power generator inverter, 5 – charge and discharge controller, 6 – energy storage units, 7 – upper level controller, 8 – traction motor inverter, 9 – separate gearbox, 10 – wheel reducer.

Table 1

Parameter	Necessary power, kW	Taken power, kW	Calculated value
Motion at 110 km/h (main speed)	240	340	120 km/h
Motion at 5-10 km/h (additional speed)	188-376		9 km/h
Acceleration from 0 to 30 km/h (5 s)	260		3.5 s
Acceleration from 0 to 70 km/h (25 s)	300		21 s
Acceleration from 0 to 110 km/h (35 s)	340		75 s

Using individual gearbox on every wheel is explained by the absence of electro motors, which might provide the whole speed and dynamic range of movements of a special purpose vehicle. The minimal weight and size of electro mechanic transmission, achieved by a rational design, will allow to set more rechargeable batteries with the same weight.

Special purpose vehicle with the hybrid power train allows to obtain flexible and scalable system, which simplifies drone technology implementation based on artificial intelligence or remote control. Drone technologies allow to exclude a human factor in the branches with dangerous or harmful factors, to decrease the number of staff, etc.

References

1. Волонцевич Д. О., Єфремова Г. І. Підвищення рухливості легких гусеничних броньованих машин за рахунок встановлення електромеханічної трансмісії. Проблеми координації воєнно-технічної та оборонно-промислової політики в Україні. Перспективи розвитку озброєння та військової техніки. Київ: ДНУ УкрІНТЕІ, 2017. 400 с.

2. Стримовский С. В. Разработка гибридной силовой установки с электромеханической трансмиссией для военных колесных машин. Вісник

НТУ «ХПІ». Серія: Транспортне машинобудування. Харків: НТУ«ХПІ», 2018. №29.

3. Military application hybrid electrodrive. Army Guide Monthly. 2005. №12 (15), December.

4. Волонцевич Д. О., Ключка Р. В., Собко А. П., Стримовский С. В. Анализ режимов работы гибридной силовой установки с электромеханической трансмиссией на перспективном колесном бронетранспортере. Вісник НТУ «ХПІ». Серія: Транспортне машинобудування. Харків: НТУ«ХПІ». 2018. № 30.

5. Волонцевич Д. О., Веретенников Е. А, Мормило Я. М., Яремченко А. С. Тяговый баланс перспективного колесного бронетранспортера с электромеханической трансмиссией. Вісник НТУ «ХПІ». Серія: Транспортне машинобудування. Харків: НТУ«ХПІ». 2017. № 5.

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A STUDY OF NORMATIVE AND LEGAL REGULATION REQUIREMENTS FOR CALIBRATION LABORATORIES

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Ukraine's accession to international trade organizations and adaptation of the national economy to the conditions of the European community requires the speedy implementation of international requirements in the field of quality management, conformity assessment, metrological support, accreditation (confirmation of competence).

Elimination of technical barriers to trade is based primarily on the achievement of mutual recognition of the results of conformity assessment (including testing, certification), which in turn is based on the unconditional implementation in Ukraine of international requirements for the competence of calibration laboratories in accordance with DSTU ISO/IEC 17025. That is why the solution to the problems associated with the implementation of international requirements for the competence of calibration laboratories is of paramount importance to overcome technical barriers to trade.

According to the law of Ukraine "about Metrology and metrological activity" [1, Art. 1] calibration laboratory – the enterprise, the organization or their separate division performing calibration of means of measuring equipment. The result of the calibration laboratory operation is necessary to ensure the required accuracy and uniformity of measurements.

At the enterprise calibration laboratories provide calibration of measuring equipment directly during its release, repair, commissioning. The main goal is to establish control of metrological characteristics.

Calibration laboratories shall comply with the General requirements for the competence of the testing and calibration laboratories of DSTU ISO/IEC 17025 [2], section 4 of which establishes the requirements for management, section 5 technical requirements. According to this standard [2], the laboratory should have a control

system, document its programs, procedures, techniques that are necessary to ensure quality calibration results. The laboratory shall have a reference base, auxiliary means of measuring equipment and accessories which are necessary for calibration.

The laboratory shall ensure that technical records for each of the laboratory activities contained in the report and sufficient information, if possible, to facilitate the identification of factors that affect the measurement result and associated uncertainty of the measurement, and to make possible the repetition of the activities of the laboratory in conditions as close as possible to the initial. Technical records should include the date and identification of the personnel responsible for each part of the laboratory's activities, as well as the verification of data and results. Primary observations, data and calculations should be recorded when they are received and should be traced to specific tasks.

Laboratories shall ensure traceability of the calibrations carried out in accordance with the international system of units (SI). Traceability of measurement of its standards and measuring instruments with the SI system by calibration or comparison with the corresponding primary standards of SI units.

The activities of the laboratory should be carried out impartially, the management and structure of the laboratory should be aimed at ensuring impartiality. The laboratory should be responsible for the impartiality of its activities and should not allow COMMERCIAL, financial or other influences that threaten impartiality.

The laboratory shall identify the components of measurement uncertainty. In assessing measurement uncertainty, all significant components, including those arising in the sampling process, should be taken into account using appropriate analytical methods.

The laboratory should have a procedure to monitor the reliability of the results. The results data should be recorded in such a way that trends can be observed and, where possible, statistical methods should be used to analyse the results. Such monitoring should be planned and reviewed and, where appropriate, include but not be limited to

Calibration laboratories meeting the requirements of this standard are considered competent.

The authors [3-4] investigated the trends in the development of requirements for the competence of laboratories in the modern world in connection with the use of quality management as one of the main requirements of competence. We analyzed the main nonconformities, classified the nonconformities according to the degree of their impact on competence and identified three categories according to the degree of impact, such as very critical (revocation of accreditation), critical (adjustment in due time), minor (adjustment to the next check).

Thus, for the laboratory to be accredited and considered competent, it must meet all the requirements of standard [2] and internationally recognized recommendations.

References

1. General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005/Cor 1:2006, IDT) : DSTU ISO / IEC 17025:2006. - [Effective from 2007-07-01]. - K.: State Consumer Standard Of Ukraine, 2007. - p. VI-26. - (National standard of Ukraine).

2. The law of Ukraine "On Metrology and metrological activity" № 1314-VII as 02.08.2017 g / Verhovna Rada of Ukraine // Gazette of the Verkhovna Rada (VVR). - Official. view. - K.: Parliamentary publishing house, 2014. - № 30. - St. 1008. – (Normative document of the Verkhovna Rada of Ukraine).

3. Zorgach D. Analysis of the main inconsistencies arising in the accreditation of laboratories, D. Zorgach, V. Novikov, A. Pazyuk / / Standardization, certification, quality. - 2009. - № 4. - P. 52-55.

4. Novikov V. N. Trends in the development of laboratory competence requirements in accordance with ISO / IEC 17025: 2005 / V. N. Novikov / / methods of conformity assessment. - 2006. - № 10 (4). - P. 26-28.

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PROSPECTS FOR DEVELOPMENT OF SOCIAL PARTNESHIP IN UKRAINE

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The system of direct fuel injection is the most up-to-date power supply system for gasoline engines with spark ignition.

The use of a direct injection system can achieve up to 15% fuel economy, as well as reduce the level of harmful substances in the exhaust gases. The system of direct injection includes, the high pressure circuit, includes, a high pressure fuel pump, a fuel pressure regulator, a fuel ramp, a high pressure sensor and an injector.

With direct injection of gasoline into engine cylinders, it is possible to organize the flow of the working process in such a way that on partial load modes the stratification of the fuel-air charge is ensured, and in the modes of maximum power - a homogeneous, homogeneous composition of the fuel-air mixture [5].

The optimal method of internal mixture formation is controlled by an electronic control system, depending on the engine load and the throttle valve position [4].

The main four methods of mixing are used, which allow to obtain: poor layered mixture with the share of exhaust gases; poor homogeneous mixture without the share of exhaust gases; homogeneous stoichiometric mixture with a fraction of exhaust gases; homogeneous stoichiometric mixture without the share of exhaust gases.

The prototype of the designed engine is the injector, four-stroke engine of the MeMZ-307, which is mounted on a passenger car, across the car, in a plane deviating from the vertical by 10 degrees.

The engine uses a valve splitter with a single straight line arrangement of valves with a slope of 21 degrees and an upper distribution of the camshaft

For the organization of bulk-film mixing in a wedge-shaped combustion chamber, a mechanical system of injection with a cuff seal of a plunger, manufactured by the Kharkiv Machine-Building Plant "FED" was used in the installation of an injector in a block of cylinders. The study provides an assessment of the impact of fuel-air layered charge on the cost-effectiveness of the engine of the MeMZ-307 in the zone of basic operating modes n = 3200 min-1. The construction of the wedge-shaped combustion chamber, the cylinder head and the engine in general are unchanged. The drive of the fuel pump is made from the distributor shaft. The injection pressure of the fuel injection is RMB 3.5-4.0 MPa.

Improvement of the processes of internal mixture formation and combustion contributes to intensive turbulization of fuel air charge. Increasing the squeegee's area reduces the time for fuel evaporation, to prepare a more qualitative mixture for its ignition and combustion.

The project calculated the working process for the regime at n = 3200 rpm. and at $\alpha = 0.95$. As a result of the thermal calculation, an indicator was constructed a chart.

It was determined that the rated power of the engine is 36 kW, at the calculated frequency. The specific effective fuel consumption is 261 g / kW * h.

Based on the results of calculating the work process, a dynamic calculation was performed. The forces and moments acting in the crank mechanism of the engine were determined. Also, the loadings acting on the connecting rod and the crankshaft and their bearings were calculated.

On the basis of the dynamic calculation, the calculation of the strength of the main parts of the engine., Which showed that the load acting on these parts do not exceed the permissible ones. This confirms the performance of the design engine design. Also, curves of high-speed characteristics of modernized injection of fuel were constructed, performed taking into account the calculation data of the work process.

With the increase of the crankshaft rotational speed for a basic and upgraded engine, the changes in torque (No) and effective power (Ne) values are practically consistent with each other. Minimum effective specific fuel consumption ge = 261 g / (kWh) of determination at maximum torque at crankshaft rotational speed n = 3200 min on the engine with direct fuel injection system.

On the basis of these data, a technical and economic calculation was made. Upgrading the engine, Improvement of fuel efficiency with the use of direct fuel injection relative to the engine with external fuel formation is up to 7% [3].

The cost of the upgraded engine will be higher, from the cost of the base model, namely 44%. However, the calculations confirm the economic benefit of the consumer. Since the warranty period of the engine is 4 years, the benefit to the consumer was also calculated for 4 years. This benefit amounted to 1809607,8 UAH for 4 years.

Also, since we have achieved a reduction in fuel consumption, and increased power, we have achieved an increase in the resource of the fuel injector. One of the disadvantages of direct fuel injection is the very small resource of the nozzle.

Lubrication system: combined (under pressure and spray). Under pressure, the roots and crankshafts of the crankshaft, the support and cams of the camshaft,

the necks of the crankshaft are lubricated; spraying - cylinders, piston fingers, valve sleeves, gearshift drive of the sensor of the ignition distributor and eccentric drive of the fuel pump. Oil pump single-section, gear, with two internal gear grips and a reduction valve mounted on a crankshaft. Oil filter, with paper filtering element. The filter has a flush valve.

Oil pressure at a temperature of oil 80 ° C at a rotational speed of a crankshaft 66.7c-1 (4000 min-1) 0.3 ... 0.5 MPa. Filling capacity of the system – 3.45l.

2.20 Cooling system: liquid, closed with expansion tank, with forced circulation. Radiator is aluminum, tubular-plate with plastic tanks. Thermostat is a non-separable thermosensitive element with a hard filler. Start of opening of the main valve at 87 ± 2 ° C; full opening at 102 ° C. Cool liquid -Tosol A-40 or Tosol A-65. Filling capacity of the system - seven liters.

References

1. Zhilin S. S. Theory of dvigun_v vnutrishnogo zgoryannya: synopsis of lectures / S. S. Zhilin. - Kharkiv: HNADU, 2006. Part 1. 148 p.

2. Timchenko I.I. Avtomobiln dviguni / I. I. Timchenko, Y. F. Gutarevich, K. Є. Dolganov, M. R. Muzhdabaev; for ed. I. I. Timchenko. Kharkov: Osnova, 1995. 464 p.

3. Abramchuk F. I. Avtomobiln dviguni: Pidruchnik. K .: Aristey, 2004. 476 p.

4. Lukanin V. N. Internal combustion engines. In 3 kN. Prince 2. Dynamics and design: student for universities. / V. N. Lukanin, I. V. Alekseev, M. G. Shatrov et al .; under. Ed .. V. N. Lukanina, M. G. Shatrov. M .: Higher, 2005. 400s.

5. Internal Combustion Engines: Design and Strength Calculation of Piston and Combined Engines: A Student for High Schools Students Trained in the Specialty “Internal Combustion Engines” / D. N. Vyrubov, S. I. Efimov, N. A. Ivaschenko et al .; under. Ed .. A. S. Orlina and M. G. Kruglov. - 4th ed., Pererab. and add. M .; Mechanical Engineering, 1984. 384s

ENGINEERING SCIENCES

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AUTOMATED WATER QUALITY MONITORING SYSTEM

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The growing pace of industry development, not only increases the volume of water use, but also its pollution, so monitoring the status of water bodies is a necessary component of environmental monitoring.

Surface water monitoring is a system of consistent observations, collection, processing of data on the status of water bodies, prediction of their changes and the development of scientifically substantiated recommendations for making managerial decisions that may affect the state of water.

The main purpose of establishing a system for monitoring and controlling the pollution of water bodies is to obtain information on the natural water quality and to evaluate changes in the quality of water as a result of anthropogenic factors.

Surface water monitoring solves the following tasks:

– observing and controlling the level of pollution of the aquatic environment by chemical, physical and hydrobiological indicators;

– the study of the dynamics of the content of pollutants and the identification of conditions under which fluctuations in the level of pollution occur;

– investigation of the regularities of the processes of self-purification and accumulation of pollutants in bottom sediments;

– studying the laws of the removal of substances through the mouth of the rivers in the reservoir;

– assessment and forecasting of water quality status.

Water monitoring programs play a decisive role in various water applications, such as the work of a motor transport company, the study of flora and fauna, etc. [1].

Pure water sources are important not only for aquatic ecosystems and natural habitats, but also for the successful operation of motor transport enterprises. In the past, water quality assessment was based, above all, on labor-intensive measurements for data collection. Techniques tend to test water sources using hand-held devices or samples transported in the laboratory for further water analysis.

Monitoring programs of this type were limited by their inaccurate measurements both in time and in spatial scales. Recent advances in sensory technology, robotics and the Internet have led to significant progress in the use of environmental telemonitoring. In the field of water monitoring, research institutes and environmental agencies have developed static stations or buoys with capabilities for automated measurements, data logging and wireless data transmission.

Despite the fact that online data collection can be achieved through the use of these systems, they were limited to inaccurate measurements and inflexibility of spatial and temporal evaluation. During the last decade, sensor nodes that are capable of performing mobile measurements have been investigated in order to increase the flexibility in gathering information in places of interest on a large-scale area. Monitoring systems using Mobile Sensor Units, Unmanned Vessels, or Autonomous Underwater Vehicles have been designed to provide spatial-temporal measurements of water sources such as pools, lakes, reservoirs, rivers and oceans.

During the last decade, many Internet platforms have been developed and implemented to monitor the water environment. According to the number of units of measurement in the platform system, it can be divided into two main types: systems with a single monitoring station and systems with several sensor nodes in the monitoring network.

A single monitoring station, as a rule, has enough computing and communication resources and power supplies. The main disadvantage of a single station is its inability to provide spatio-temporal monitoring of high resolution in a large geographic area. The monitoring network with several sensor nodes, on the contrary, facilitates the monitoring process both in spatial and temporal scales [2].

In accordance with the mobility of the sensor block in the system the platforms can be divided into static and mobile systems. Static platforms have tracking modules that are installed in specific locations, and provide real-time continuous measurements. These platforms have proven to be effective in supporting the environmental monitoring through the possibility of requisition of data, information processes and wireless transmission. However, they were rather complicated by their inaccuracy and inflexibility in spatial measurement for observing the area. In contrast, mobile platforms consisting of mobile sensor devices are capable of controlling measurement processes by moving on a large spatial scale. These platforms provide the ability to gather information in areas of interest to the field of research.

However, each mobile sensor device often has important resource constraints, such as accumulation energy, which limits the range of research (from a spatial perspective) or the number of sampling points that it can measure before the phenomena in the controlled field change substantially (from the time perspective).

Below is an easy-to-use platform of the Internet of Things. The purpose of this platform is to provide an effective assessment of surface water quality in high-quality spatial-temporal mode. Compared to modern systems, the platform presented improved the behavioural efficiency in several aspects.

Reference

1. Alex Anvari, Jenny Delos Reyes, Ehsan Esmaeilzadeh, Ali Jarvandi, Nicholas Langley and Keyssi Rivera Navia, “Designing an automated water quality monitoring system for west and Rhode rivers,” Proceedings of the IEEE Systems and Information Engineering Design Symposium, pp.131-136, 2009.

2. Dong He and Li-Xin Zhang,“The water quality monitoring system based on WSN,”2nd International Conference on Consumer Electronics, Communications and Networks (CECNet), pp.3661-3664, 2012.

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THE TRUTH ABOUT RECYCLING PLASTIC

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Plastic is among the most popular and important materials used in the modern world. However, its popularity is part of the huge problem and reason why plastics should be recycled. Instead of throwing them away polluting the land and our water bodies, we can optimize the lifespan of plastics by recycling and reusing them.

Plastic recycling refers to the process of recovering waste or scrap plastic and reprocessing it into useful product. Due to the fact that plastic is non-biodegradable, it is essential that it is recycled as part of the global efforts to reducing plastic and other solid waste in the environment.

Plastic recycling is the process of recovering different types of plastic material in order to reprocess them into varied other products, unlike their original form. An item made out of plastic is recycled into a different product, which usually cannot be recycled again.

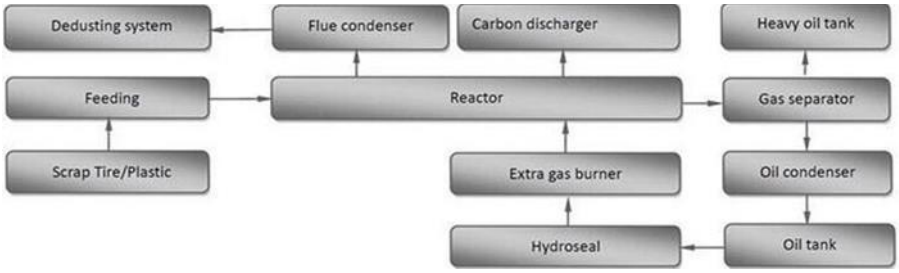
Plastic recycling not only promotes proper utilization of plastic waste but also helps conserve the environment, making it cleaner and greener. Scientists have come up with a new way to turn plastic waste into liquid fuel. It uses less energy than previous methods, and produces a higher quality end product. All around the globe companies and individuals are starting to produce fuel from waste plastic.

The pyrolysis process is an advanced conversion technology that has the ability to produce a clean, high-calorific value fuel from a wide variety of biomass and waste streams. It is the thermo-chemical decomposition of organic material at elevated temperatures in the absence of oxygen. The pyrolysis provides various operational, environmental and economical advantages. Under pressure and heat, the long chain polymers of hydrogen, oxygen, and carbon decompose into short-chain petroleum hydrocarbons with a ceiling length of around 18 carbons. Hydrocarbon molecules from the basic materials are split under the impact of the catalytic (carbon material) convertor inside the reactor at 70–240 °C. The reduction of process temperature takes place from 500–600 °C to 240 °C. The higher yield of liquid fuel of about 98 % was achieved.

The process of converting plastic into fuel involves catalytic degradation of waste plastic into fuel range hydrocarbon i.e. petrol, diesel and kerosene etc.

A catalytic cracking process in which waste plastic were cracked at very high temperature, the resulting gases were condensed to recover liquid fuels.

Flow Chart of Converting Plastic into Fuel:



The detailed plastic to fuel conversion process can be described as follows:

- first of all, waste plastics can be put into the pyrolysis reactor directly.

- secondly, heat the reactor by burning the fuel materials such as coal, or wood, or natural gas, oil. The pyrolysis reactor will be slowly heated, when the temperature reaches around 250 degrees, the oil gas will be generated.

- thirdly, oil gas will go into cooling system to be liquid oil. The gas which can not be liquefied under normal pressure will go back to combustion system. It will replace the fuel material to burn the reactor, which is energy saving and environment friendly.

- fourthly, when the oil production is completed, the temperature of pyrolysis reactor will be down. When the temperature falls down to 40 degrees, the carbon black can be discharged automatically.

- lastly, the hot smoke produced from the reactor can achieve national emission standard after being processed by the advanced dedusting system.

The technique breaks down polyethylene - the most abundant plastic in the world, used to make everything from plastic film and food packaging, to water bottles and shopping bags. Around 100 million tonnes of the stuff is produced every year. 95 percent of plastic is thrown out after being used just once, and 8 million tonnes of plastic - or one garbage truck-full every minute - ends up in our oceans each year. According to the report of World Economic Forum (WEF):"If no action is taken, this is expected to increase to two per minute by 2030 and four per minute by 2050." "In a business-as-usual scenario, the ocean is expected to contain 1 tonne of plastic for every 3 tonnes of fish by 2025, and by 2050, more plastics than fish."

The solution is fairly simple - we need to turn plastic waste into a commodity that people can actually use, and given all the hydrogen and carbon that makes up polyethylene, liquid hydrocarbon fuel is the obvious choice. What’s been holding us back from the dream of recyclable plastics is that even though polyethylene is made from fossil fuel, converting it back to its base parts has been a massive challenge, because of how stable plastic is as a chemical compound.

In summary, any sort of effort aimed at saving the environment is very important and matters a lot. Since its inception during the environmental revolution in the late 1960s, plastic recycling is one of the most encouraged solid waste management programs in the world. Prior to the push to use of plastic containers by manufacturers, products were packaged in glass, metal and paper. Therefore, in

order to keep our environment clean, reduce landfills, provide a sustainable supply of plastics to manufacturers, it is important to recycle plastics.

References

1. J. Aguado, D. P. Serrano, J. M. Escola, Fuels from waste plastics by thermal and catalytic processes: A review. Ind. Eng. Chem. Res. 47, (2008).
2. www.wastetireoil.com/
3. https://insteading.com › Environment
4. https://www.quora.com/What-is-the-process-followed-in-the-...

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OPTIMIZATION OF CUTTING TOOL LIFE PARAMETERS

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In a metal cutting operation, a tool deforms the workpiece material and causes it to shear away in the form of chips. The deformation process requires considerable energy, and the tool undergoes various loads. These loads lead eventually to tool wear, and sometimes to its failure. Thus, for an efficient processing, it is necessary to find a balance between the energy to remove the metal, and the ability of the tool to withstand the loads reliably. Correct selection of cutting parameters, tool geometry, materials used, and other factors make it possible to achieve a productive and cost-effective process of cutting metal.

Mechanical loads in turning operations are stable, while during milling they are dynamic, constantly changing from small to high and back, so the load on the tool is even greater. The types of loads and ways to reduce them are under consideration.

Loads that affect the cutting tool can be divided into four categories: mechanical, thermal, chemical and tribological (loads caused by friction and resistance). The four categories of load do not operate independently but rather interact and influence the sum of their effects.

Mechanical pressure accelerates tool wear and breakage. Intermittent cutting produces shock loads, which can cause damage of the chip. Heat loads arise from the fact that the deformable material of the workpiece produces heat, which leads to a temperature rise in the range of 800-1000 degrees Celsius, and, as a result, tool deformation and blunting. The combination of heat and pressure also facilitates a chemical reaction between the materials of the tool and the workpiece, diffuse wear occurs and the chemical composition changes along with the physical and chemical properties of the tool surface. Friction between the tool and the chip generates abrasion and erosion wear, a result of what are called tribological loads.

The ability of the tool to withstand the load is determined by its service life and predictability. For maximum tool life and process security, machining loads must be lower over a certain amount of time than the tool’s load-bearing capacity.

Key contributors to that capacity include the tool's cutting geometry and cutting material and coating.

In search of efficiency and cost reduction, operators are trying to reduce the the time spent on machine setup, tool and workpiece handling, as well as other various idle times.

When selecting the machining modes, it is necessary to take into account the dependence of all parameters: cutting speed, feed rate and depth of cut as well as the fact that the resistance of the tool depends on the cutting speed in a nonlinear way.

As studies show, the turning points in the wear curve are determined by the nature and degree of prevailing wear, as well as by the characteristics of the material being treated. The cutting force is not equivalent to the mechanical load on the tool. When calculating the mutual influence of the parameters on each other, the following should be taken into account.

The doubling of the cutting depth doubles the cutting forces as well as the length of the cutting edge in the cut. This leads to the fact that the load remains unchanged per unit length of the cutting edge.

Increasing the feeding speed increases the cutting force. Since a large feed increases the thickness of the chips, and not the length of the tool in a section, the load on the cutting edge is seriously increased.

With an increase in the cutting speed, the cutting force as a whole remains the same, and the power consumption increases.

Too high cutting speed can reduce process reliability by creating uncontrolled chips, extreme tool wear and vibration, which can damage the tool.

As the speed increases, the rate of change in the wear-resistant characteristics of the tool first decreases, then increases and again decreases. Such a nonlinear connection is explained by the change in the intensity of adherence of particles of rubbing surfaces (adhesion wear) and then by the transition of adhesive wear to diffusion bonding.

A high feed rate and depth of cut, combined with low or medium cutting speeds, can offer the best potential for safe and reliable processing.

To reduce the impact of heat, various methods are used. One of them is an increase in the cutting speed with a reduction in the contact area between the teeth of the mill and the workpiece. On the other hand, the reduction in speed leads to a decrease in heat generation, and if necessary, it is thus possible to lower the temperature.

Another way to lower the temperature is to feed the cutting fluid. At the same time, wear of the tool is reduced not only by cooling, but also by reducing friction. However, under conditions of high temperatures and pressure, often the coolant does not have a significant effect.

Various methods of monitoring tool wear can be distinguished. There exist direct methods with a direct measurement of wear parameters, and indirect, which allow using different sensors to determine the degree of wear in production conditions. A blunt tool increases the cutting forces and degrades the processing quality, which ultimately increases wear even more. The operators must determine

the point of wear when the re-sharpening is maximally cost-effective, or the tool must be replaced.

It is impossible to avoid tool wear completely. However, by selecting optimal processing parameters, it is possible to achieve maximum duration of its operation and predictability, and as a result, economic efficiency in general.

References

1. Рыжкин А. А. Режущий инструмент : учебное пособие. Ростов н/Д, 2009. 405 с.

2. Фельдштейн Е. Э. Режущий инструмент. Эксплуатация : учебное пособие. Минск ; М., 2012. 256 с.

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THE PROCESSES OCCURRING DURING THE AUTOCLAVE TREATMENT OF SILICATE MATERIALS

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When a lime-sand mortar is hardened in air at ordinary temperatures, the rate of chemical interaction between lime and sand is very small and practically does not cause a significant increase in strength. If, however, lime-sand silicate products are treated with steam at elevated pressure (9 atm) at a corresponding temperature (174.5 C), the chemical interaction between lime and silica sand occurs in the autoclave, forming calcium hydrosilicates, and the rate of this reaction compared to the flowing at ordinary temperature (average about 20 C) increases many times. As a result, the formation of calcium hydrosilicates in an autoclave mainly determines strength, durability and other properties of lime-sand products [3, 72].

$$Ca(OH)_2 + SiO_2 + nH_2O \rightarrow Ca(OH)_2 * SiO_2 * nH_2O$$

The presence of air in the autoclave reduces the temperature of the hydrothermal treatment at the same pressure. Therefore, it is advisable to remove air through the valves in the first period of steam intake. Positive results are obtained by evacuating the autoclave before steam injection. With the release of steam, the temperature of the products drops and the water contained in them evaporates. As a result, the concentration of the lime mortar located in the pores and on the surface of the brick changes, which causes precipitation of Ca $(OH)_2$ crystals from the solution. The purpose of steam in the process of water-heat treatment is to contribute to the preservation of the aqueous medium in the steamed material at a high temperature, without which it is impossible the interaction of lime, silica and water. In the absence of steam, the water would evaporate, the products would dry out, and the formation of calcium hydrosilicate stopped [1, 186].

Under the usual regime of water-heat treatment, adopted at lime-sand products plants (for example, silicate bricks), where unmilled sand is used, not all of the lime is usually bound to calcium hydrosilicate. The rest of the lime in the process of autoclaving is transferred from the amorphous state to the crystalline state, which significantly increases the adhesive force between the lime and sand grains. Along with this, the lime remaining after steaming, when interacting with carbon dioxide, is carbonized, which also increases the strength of the products. However, this reaction takes place only in the presence of moisture and mainly in the surface layers of the products. The effect of carbon dioxide on crystalline calcium hydrosilicates is not accompanied by a decrease in strength and other harmful effects, as when carbon dioxide is exposed to amorphous calcium hydrosilicate in hardening lime-pozzolanic cement. Thus, the grains of sand in such products are bound to the monolith by hydrosilicate and calcium hydroxide when interacting with calcium carbonate. However, calcium hydrosilicate is of primary importance.

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

With the introduction of part of the sand in a hammer form, all the lime is practically bound into calcium hydrosilicates. Free lime in products is not detected. In dense lime-sand products, solidified with the most common mode of autoclave treatment (9 atm, 8 h). In the beginning, hydrosilicate C_2SH (A) arises, which then goes to CSH (B). The increase in the duration of autoclaving leads to the formation of tobermorite $C_4S_5H_5$. In products hardening at a higher temperature (pressure) or for a longer time, xonotlite C_6S_6H appears. In cellular products, the transformations proceed faster and the final product, in addition to the above-mentioned hydrosilicates, $C_4S_6H_5$ hydrolyte may also appear. Of the more than 20 currently known calcium hydrosilicates, C_2S, CSH, and C_2SH_2 are of practical importance in real conditions of temperature-humidity steaming and the ratio of mixture components for silicate bricks, in some cases tobermorite ($C_5S_6H_{5-6}$) and very rarely xonotlite (C_6S_6H).

$$2Ca(OH)_2 + SiO_2 + H_2O \rightarrow C_2SH\ (A)\ //\ C_2SH\ (A) + SiO_2 + H_2O \rightarrow 2CSH$$

It should be noted that less basic hydrosilicates have greater strength. They are obtained when $Ca(OH)_2$ basically has already reacted, but dicalcium hydrosilicate is present in the material in the presence of unrelated lime.

A.V. Volzhensky suggested that calcium hydrosilicates are formed in aqueous solution. Silica is hydrated and goes into solution in the form of H_2SiO_3. Calcium ions as soon as silicic acid appears, preventing it from diffusing deep into the solution, form with it hydrosilicates, which mainly fall on the surface of grains of sand [2, 353-354].

$$SiO_2 + H_2O \rightarrow H_2SiO_3\ //\ Ca(OH)_2 + H_2SiO_3 \rightarrow CSH + H_2O$$

I. A. Khint believes that the initial components in the process of autoclave treatment interact with each other in the solid phase. He believes that the molecules of lime and silica mutually diffuse into each other; such diffusion is possible due to the fact that the reacting components are surrounded by water, the molecules of which have significant polarity [5, 14].

Most researchers believe that during autoclave hardening, lime and silica interact by dissolving the components in the liquid phase and their subsequent chemical interaction in solution. At a given temperature of hydrothermal treatment, each hydrosilicate itself can be stable only in a certain concentration range of the surrounding solution. A change in the composition of the liquid phase leads to the transformation of a previously stable hydrosilicate into another, stable in the liquid phase of a changed composition. Such a transformation occurs due to the dissolution of the initial hydrosilicate and the crystallization of a new one, which differs from the initial one either by chemical composition, or by a crystalline structure, or both. At normal temperatures, the solubility of lime is significantly higher than the solubility of silica. With increasing temperature, the solubility of lime decreases, and the solubility of silica increases.

The different nature of the change in the solubility of $Ca(OH)_2$ and silica with increasing temperature leads to the interaction starting in a relatively lime-rich solution, in which the lime-rich silica phase is stable, for example C_2SH (A). This phase is formed at the first stage of processing in samples of any initial composition and exists until $Ca(OH)_2$ completely binds, that is, until the solution is saturated with lime. After binding of free lime into hydrosilicate, the concentration of SiO_2 in the liquid phase begins to grow as a result of the dissolution of free silica. The increase in the concentration of SiO_2 continues as long as the lime-rich phase remains stable. At a certain concentration of SiO_2 in the solution, the transition of the lime-rich phase to the less basic hydrosilicate begins, which is stable under new conditions. A similar process is repeated until the formation of a solid phase that is stable in a saturated solution of SiO_2 or in a solution, the concentration of which is due to the inherent solubility of the tumors (in the case of complete binding of the initial components) [4, 113].

References

1. Боженов П. И. Технология автоклавных материалов / П. И. Боженов. – М.: Стройиздат, 1978. – 367 с.
2. Волженский А.В. Минеральные вяжущие вещества / Волженский А. В. — М.: Стройиздат, 1979. — 476 с.
3. Кудеярова Н.П. Вяжущие автоклавного твердения. Учебное пособие. Белгород 2007. 131 с.
4. Пащенко, А.А. Энергосберегающие и безотходные технологии получения вяжущих веществ / А.А. Пащенко, Е.А. Мясникова, Ю.Р. Евсютин. -Киев: Вища школа, 1990. 223 с.
5. Хинт И.А. Об основных проблемах механической активации. Материалы 5-го симпозиума по механоэмиссии и механохимии твёрдых тел. Таллин, 1975, т.1, с. 12-23.

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ELECTRIC CARS – TRANSPORT OF THE FUTURE

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People have been using a car with an internal combustion engine for over a hundred years. But modern scientists say, that in 50 years oil will end on Earth. It is a problem, and we need a car that works on a different principle.

Electric motor has many advantages. This kind of engine does not spoil the environment and much more profitable for people because of high gasoline prices.

And if it becomes fashionable, people will forget about the classic version of the car. Internal combustion engine has 1500 elements, and the electrical engine has only two components. This ensures its simplicity and reliability.

In Ukraine, only two percent of all cars are electric ones. To advance to Norway position, the global leader in phasing out petrol- and gas-fueled cars, Ukraine has a lot of catching up to do. Most new cars sold in Norway are now electric or hybrid. The benefits of electric cars are still debated. They run cleaner, reducing pollution, and don't directly use fossil fuels. However, most electricity is still produced by burning fossil fuels such as coal. But as renewables produce more electricity, the benefits of electric cars are expected to rise. Globally, Bloomberg's Electric Vehicle Outlook forecasts that electric vehicles will account for 54 percent of new car sales by 2040.

In the car market of Ukraine electric cars have appeared recently, since 2012 (the first 10 units), but during the next 5 years, the number of registered ones annually increased by 37.5 times and for the 1st of January, 2018 it has already numbered 5688 cars. The rapid increase in the number of registered electric vehicles started from 2016, when the import duty on electric cars was canceled at the legislative level. The number of registered electric cars in Ukraine increased by 11 times in 2016–2017. During these two years the share of electric cars in total sales doubled and reached 4.6% in 2017. Today the coverage of the territory of Ukraine by electric charging stations is about 20%. However, the rate of expansion of number of electric charging stations even only for 2017 is impressive, namely, the fourfold increase.

Expansion of the Ukrainian market of electric cars is constrained by the unregulated status of electric charging stations, as well as services related to servicing and operation of electric vehicles. First of all, the issue of classification of the activity of providing services for charging the battery of electric cars should be solved. It is possible to resolve the issue, if one distinguishes a separate activity in one of the Classification of Economic Activities (CEA) sections.

The current version of the Classification of Economic Activities contains an activity related exclusively to vehicle maintenance (section G, division 45, group 2), which does not include service for charging a car battery. The solution of the issue is the introduction of a new type of activity: "Services for charging batteries". As a result it will allow creating favorable conditions for the development of the market for servicing and operation of electric vehicles.

One of the most popular electric vehicle manufacturers is Tesla Motors. Tesla cars are a combination of quality, safety and economy.

Launched in 2008, the Roadster unveiled Tesla's cutting-edge battery technology and electric powertrain. From there, Tesla designed the world's first ever premium all-electric sedan from the ground up – Model S – which has become the best car in its class in every category. Combining safety, performance, and efficiency, Model S has reset the world's expectations for the car of the 21st century with the longest range of any electric vehicle, over-the-air software updates that make it better over time, and a record 0-60 mph acceleration time of 2.28 seconds as measured by Motor Trend. In 2015, Tesla expanded its product line with Model X, the safest, quickest and most capable sport utility vehicle in history that holds 5-star safety ratings across every category from the National Highway Traffic Safety Administration. Completing CEO Elon Musk's "Secret Master Plan," in 2016, Tesla introduced Model 3, a low-priced, high-volume electric vehicle that began production in 2017. Soon after, Tesla unveiled the safest, most comfortable truck ever – Tesla Semi – which is designed to save owners at least $200,000 over a million miles based on fuel costs alone.

Battery is the weak point of the electric car. They do not work well in the cold and have a short service life, but Tesla does not stand still.

To create an entire sustainable energy ecosystem, Tesla also manufactures a unique set of energy solutions, Powerwall, Powerpack and Solar Roof, enabling homeowners, businesses, and utilities to manage renewable energy generation, storage, and consumption.

The biggest problem is batteries: their work and disposal. The Lithium batteries that power EVs are difficult to dispose of and harmful to the environment. They contain toxic metals, namely nickel, lead and copper, as well as toxic and flammable electrolytes containing $LiClO_4$, $LiBF_4$, and $LiPF_6$. Exposure to these materials during the battery production phase is strictly regulated by US federal law, but the legislation on their disposal is inconsistent internationally. They present a serious human hazard, especially in areas that lack the infrastructure for solid waste collection and recycling, both in the US and abroad. There is an additional threat: even discharged EV batteries can deliver powerful shocks, or present a serious fire hazard, if mishandled.

Recycling EV batteries is, as a whole, expensive, yet feasible. Electric cars are just beginning to develop rapidly. And they have all chances to replace the classic cars.

References

1. Honchar A. Statistical Analysys of the Electric Car Market Development in Ukrane. Problems and Solutions. Kyiv, 2018. 45 p.

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EXPLOITATION OF ELECTRIC VEHICLES IN THE US

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Electric vehicles are much more efficient than petrol or diesel vehicles, and provide owners with significant savings when operating - from several hundred to several thousand dollars a year, depending on the type of vehicle. If you compare the costs of electricity consumption from the network and refueling at the gas station, electric vehicles also cost less for maintenance and repairs. But the money saved, including a federal tax credit of $ 7,500 for the first year of purchase, does not compensate for the terrible depreciation of electric vehicles.

Fuel consumption (electricity) remains one of the most attractive performance of electric vehicles. With an average US power cost of 12.6 cents per 1 kWh, electric vehicles cost the owner an average of 3.68 cents per mile in average for the market at 10.26 cents per mile and 5.59 cents in hybrids (Ford Fusion, Honda Accord , Hyundai Sonata, Toyota Prius and Toyota RAV4).

For comparison: the cost of fuel for one of the most popular types of vehicles for the local market – full size pickups (Chevrolet Silverado, Ford F-150, Nissan Titan, Ram 1500 and Toyota Tundra) – cost the owner an average of 13.88 cents per mile.

Strong side of electric vehicles are low maintenance, repair and tires costs: 6.55 cents per mile, less than the average market indicator – 7.91 cents per mile, and hybrids – 6.99 cents and pickups – 8.33 cents.

It is recommended to buy used electric vehicles or take new ones in leasing. “Although the initial cost of electric vehicles can be high, low fuel costs and maintenance make them an extremely affordable choice in the long run.” The second or third owner of electric vehicles will really save, although most of the older electric vehicles have less stock than the new models. Leasing can be saved in California, Oregon and other states where leasing agreements are subsidized, and you can often find an electric car with a monthly payment of less than $ 200.

In conditions of low temperatures the norm of a loss of a charge of a battery, even not in the most severe winter are considered to be 30-40% of their total volume. However, these numbers relate to untrained motorists who, due to the new specifics of an electric vehicle, simply do not rationally approach the issue of energy conservation.

The following measures are recommended for the rational energy consumption of the traction battery in the winter.

Garage storage of electric car is the best way. Parking in the garage significantly saves energy to warm up the car before the start of operation. Even in a not warm garage the temperature is a few degrees higher than outside, so the battery life will be less. The best option is a heating garage, the high temperature which will allow faster charging the electric car and compensate for the heat of charging time and material consumption of energy.

In winter, the electric vehicles not only reduce the stock, but also reduce the speed of charging. Therefore, when there is a possibility, it is necessary to connect

the electric car to the network until the next operation. Even if the battery has reached its second battery full volume, turning off the power of the vehicle is required.

Modern electric vehicles offer the possibility of remote communication through mobile applications. In the cold season, it is recommended that the boiler be switched on remotely while the car is connected to the mains.

Using friction brakes is an extra waste of energy, so in the winter it is necessary to use as much as possible recuperative braking, which slows down the motion without using the brakes. The rational use of the recuperation function increases the supply of electric vehicles by 10-15%.

It is worth noting that among all the countries where electric vehicles are rapidly moving to success there is a common feature – the state-run policy of supporting environmentally friendly modes of transport, which manifests itself both in providing material assistance in the purchase of vehicles (subsidies) and in the development of accessible infrastructure, is developing dynamically for their service.

Thus, the observation of European markets confirms that state policy is an indispensable condition for the development of the electromotive sector. This is all the more evident on the example of the Denmark's market, where since the abandonment of the state policy of development of electric vehicles, the number of registrations has decreased by 45.5% compared with 2016 and amounted to only 751 newly sold electric vehicles.

References

1. Your driving costs. How much are you really paying to drive? Your-Driving-Costs-Brochure URL: http://exchange.aaa.com/wp-content/uploads/2017/08/17-0013

2. Electric vehicles are costly for the first owners. URL: https://www.vedomosti.ru/auto/articles/2017/09/05/732352-elektromobili-dorogo.

3. Ivanov S. A. Didmanidze O.M., Glibin E.A. Tendencies and the development of modern electromobiles. Moscow, 2006. 76 p.

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GAS SEPARATION USING POLYMER MEMBRANES

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Based on the concept of sustainable development people around the world are more and more concerned about environmental issues. This is especially the case for air and water quality. In particular, the former is of interest for any living being. To this end, several processes have been developed for air purification/gas separation such as cryogenic distillation, adsorption, absorption and membrane technology. The latter is getting more and more interest because of its high efficiency, low power consumption, easy control, simple maintenance and low

investment cost compared to the other conventional separation processes. Today, membrane technology can be applied in several industrial fields requiring gas separation/purification such as: oxygen enrichment from air (O2 / N2), hydrogen separation from a synthesis gas (H2 /CH4 or H2 /CO2), hydrogen recovery in ammonia plants (H2 /N2 or H2 /CH4), methane purification from biogas or natural gas (CO2 /CH4) and CO2 capture in general (CO2 /N2).

Separation membranes can be made from ceramics, metals and polymers. The latter is of interest because they are less costly and less fragile but suffer from the famous permeability-selectivity trade-off known as the Robeson upper bounds [2]. For this reason different approaches are still under investigation to overcome this limitation and maximize the full potential of polymer membranes for gas separation. Unfortunately, there is no universal system that will work for any gas separation. For example, it has been reported that Ultem (polyetherimide) can perform best for H2 /N2 , H2 / CH4 and O2 /N2 separation, while Matrimid (polyimide) would be better for CO2 /N2 and CO2 /CH4 . Nevertheless, Ultrason (polyethersulfone) would be best for O2 enrichment. But these conclusions might be dependent on the operating conditions like pressure and temperature, as well as the inlet gas composition.

To improve the polymer membrane efficiency, several methods/techniques have been proposed. Although a great deal of work has been done on synthesis (development of new polymers/copolymers), one simple way to control the permselectivity of available polymers is to modify the membrane structure. Some examples are presented in the next paragraphs.

One of the most investigated structure is the production of mixed matrix membranes (MMM). This is done by adding functionalized nanoparticles into the polymer. This strategy opens the door to a wide range of particles (zeolites or metal organic frameworks), but several problems like optimum concentration, good dispersion, interfacial adhesion and pore blockage still need to be fully resolved. Another way to improve the membrane performance is to use a multilayer structure. In this case, each layer has a specific task to control the chemical, mechanical and physical properties of the system depending on the gases and conditions. For example, a thin polydimethylsiloxane (PDMS) layer was used to control the permselectivity which was coated on a low-cost foamed polyethylene (PE) layer mainly acting as a mechanical support [1]. An easy way to modify the properties of polymer is via additives. These low molecular weight components can modify the matrix chemical, mechanical and physical properties, as well as the interactions between all the components including the diffusing gases. This was shown to be the case by adding aromatic carboxylic acids into Pebax (poly(ether-b-amide)) [3].

Membrane cost is still a limiting criterion for gas separation. To reduce the membranes cost, continuous processes must be used with commercial commodity polymers. For example, polyethylene was proposed to produce a foamed structure via extrusion. With optimized processing conditions, it was possible to control the porous structure in terms of cell size, density and geometry, as well as the open-cell content to get a complete control of the resulting membrane permselectivities. Although the membrane itself can be optimized, the module design and

configuration must also be investigated in more details. For example, the type of membrane (flat, hollow fiber or spiral) must be selected. Also, optimization of the complete separation process must be investigated to improve on the separation performance while taking into account the overall costs. This can be done using the concept of stage-cut.

Finally, the membrane production should be better controlled. For example, a clear relation between the rheological properties of the materials (multiphase and multicomponent solutions or melts) must be determined to get a better control on the final membrane structure (active layer thickness, porosity, orientation, crystallinity, etc.). Although some works are available on the shear rheology of these systems, their elongational behavior is still to be investigated.

Polymer membranes are very interesting for gas separation applications because they can be low cost, easy to process, flexible and low density. Since no single polymer can perform all the tasks required, this is why material selection and structural design must be done, not only on the membrane itself, but also on the modules used for industrial applications. Several solutions have been proposed to improve membrane performance, but the optimum may be obtained only by a combination of several of them (synergistic effects). So, it is expected that important development will occur in the future and this can be done via experimental investigations to supply data for numerical models (validation).

References

1. Мембранное разделение газовых смесей. *ENCE GmbH*. URL: http://energy-units.ru/prochee-oborudovanie/membrannoe-razdelenie-gazovyh-smesej/.

2. Robeson L. M. The upper bound revisited. Journal of Membrane Science. Macungie, 2008. Vol 320 (1). P. 390–400.

3. https://www.sciencedirect.com/science/article/pii/S0376738800851212

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ROAD TESTS OF RENAULT KANGOO

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The article is devoted to improving the technical state of Renault Kangoo 1.5 dci (Continental VancoContact 2 195/65 R1595T tyres) by developing a simple methodology for checking the traction and speed characteristics of a vehicle by acceleration time.

Theoretical and experimental methods have been used in the research. The expected results involve obtaining a number of parameters, such as drag coefficient and total traffic coefficient.

In the work the generalization and development of scientific fundamentals of the actual and important scientific and technical task for the development of scientific and methodical apparatus for assessing the quality of Renault Kangoo is

made, which forms the basis for the development of mathematical models and methods of evaluation and quality assurance during the exploitation phase.

One of the main tasks is to develop practical recommendations for drivers of Renault Kangoo, which can help them to use this motor vehicle to the best advantage.

Our experiment took place at the beginning of the Kharkiv-Dnipro highway, and we conducted several test runs in this section of the road in order to improve the method of recording the results and complete our planned experiment in full.

At first, we made several passes using different gears and operating modes of the engine. After that, we started processing the data from the video recorders in order to determine the technical condition and to find out the drag coefficient in two different ways: with vehicle mass reduction and without.

The obtained speed dependences on acceleration time under loading are presented in Figure 1 and Figure 2. We have made a few passes: the first one was with a fully loaded car, and the second one – only with a driver.

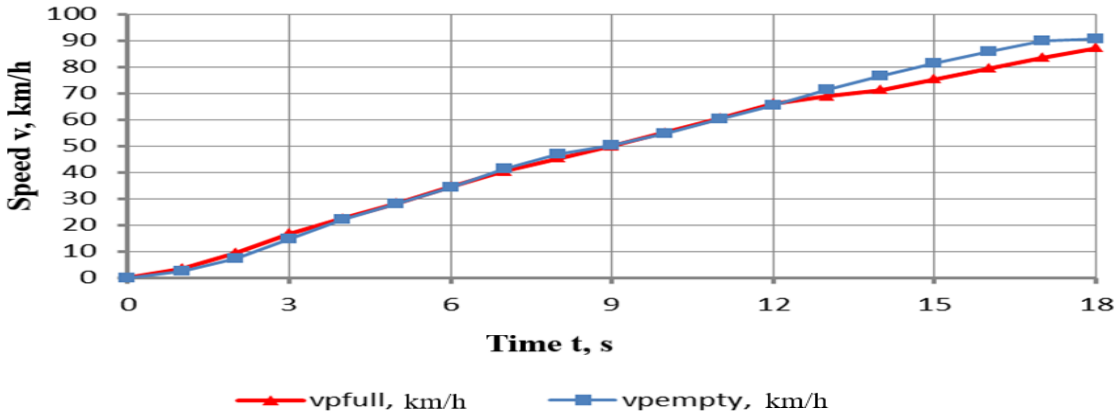

Figure 1. – The dependence of speed on the acceleration time using the 3 gear under loading

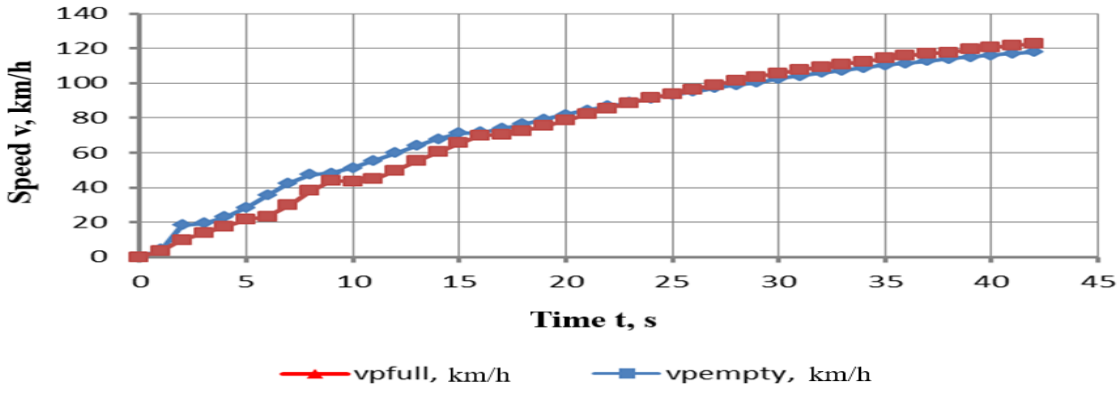

Figure 2. – The dependence of speed on acceleration time using the 4 gear under loading

These results allowed us to calculate the drag coefficient without considering and taking into account the reduced masses. The following formulas have been used:

$$C_x = \frac{6 \cdot m \cdot \left(j_1 - j_2 \right)}{F \cdot \left(v_1^2 - v_2^2 \right)} = 0,7414 \quad (1),$$

$$C_x = \frac{7.2 \cdot \beta \cdot m \cdot \left(j_1 - j_2 \cdot K_v \right)}{F \cdot \rho \cdot \left(v_1^2 - v_2^2 \cdot K_v \right)} = 0,7455 \quad (2)$$

The results are given in the table:

Table 1.

Speed ranges, *km/h*	116–94	89.1–60.1
Average speed	v1, *km/h*	v2, *km/h*
	105	71
Slowing down time, *s*	7	12.7
Slowing down, *km/s²*	j1	j2
	3.14285714	1.81818182
Cx1	0.7414	
Ψ	0.0195	
Kv	0.8356	
Cx2	0.7455	
Ψ1	0.018	

According to the results, the vehicle is in good working order and it does not require repair, the calculation of the engine power corresponds to the manufacturing standards.

References

1. Евграфов А. Н. Аэродинамика автомобиля. М., 2010. 356 с.
2. Рабинович Э. Х., Волков В. П., Белогуров Е. А., Никитин Д. В. Измерение аэродинамического сопротивления движению автомобиля дорожным методом. *Метрологія та вимірювальна техніка.* Харків, 2012. С. 390–393.

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COMMON PROBLEMS IN WIRE WELDING

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Welding typically is the most critical and scrutinized process in fabricated items, weldments, and pieces of equipment. The integrity of any finished product requiring welding is only as good as the welds joining together the different components and materials. Because of this critical nature, all quality assurance inspections and requirements revolve around the welding operation.

As with any fabrication process, there is a right way and wrong way to weld. And even when done correctly, it's important to be aware of the other factors that can sabotage the job.

One type of welding that often is performed is solid-wire welding. The advantages of this type of welding are that it produces a very clean weld and it is better suited for thin metal. A solid wire does not puddle and flow as needed to fill a joint consistently, making it unsuitable for thicker metals. It is also harder to apply a weld joint accurately as it tends to stick to one side of the joint more than the other. If solid wire must be used on thicker material, you may need to use multiple weld passes and then gouge or grind out previous weld passes until the weld joint is fully fused.

Another type of welding is flux-cored welding, in which a hollow wire is filled with flux. The advantages of this process is that it is better suited for thick metal, it puddles and flows into weld joints consistently and accurately, is more forgiving, fuses equally, and provides good joint penetration.

The disadvantages are that the flux-cored wire puddles and runs out too flat and quickly when this method is used for thinner metals. The flux burns, leaving a charred discoloration on the weld that requires extensive brushing and cleaning to remove. If you have to use flux-cored wire on thin material, be sure to use welding tabs at the beginning and end of the weld joint to create "dams," which will help keep the weld from flowing out of the joint.

Regardless of the material grades being welded or whether you are joining similar or dissimilar metals, if you follow proper procedures, you shouldn't have a problem making a quality weld. The best way to achieve good welds is to develop a thorough welding plan for the specific project. Start at the beginning and follow the necessary steps one by one until complete.

First, study the plans and drawings to identify all the types of welds, material grades being joined, and the joint preparation required. Second, produce sample weld coupons that mimic the welds you will need. You can then send these coupons to a lab for bend/break testing either through a third-party certified welding inspector (CWI) or an in-house CWI. Last, create the procedure qualification report (PQR) and welding procedure specification (WPS) for each type of weld required on the project. The PQR and WPS determine the parameters of the welding that needs to be done, such as amps, volts, travel speed, electrode, metal thickness, material type being joined, and the weld joint configuration.

It only takes one wrong move to put the quality of the weld in jeopardy. Some examples are using the wrong filler metal for the materials being joined; not performing pre- or postheat processes; using the wrong shielding gas; running the wire at the wrong speed; using the amps or voltage outside the proper range; not applying the proper joint preparation; and even something as simple as having a fan blowing toward the weld station that can blow away the shielding gas. These factors all can result in a bad weld. If solid wire must be used on thick material, you may need to use multiple weld passes and then gouge or grind out previous weld passes until the weld joint is fully fused.

Everything on the weld may look good visually even if you use the wrong filler metal or electrode. However, problems can arise later in the product's life when it is in use. During the stress of operation, vibration, and hot and cold expansion and contraction of the metal and welds, the wrong filler metal may have less or more expansion than the metals it joined together. This difference could cause the welds to break, leading to product failure and physical or financial damage to the end user.

Properly certifying welders is a requirement for controlling weld quality. A welder qualification is similar to the weld procedure qualification (WPQ) in which test coupons are welded together. The coupon undergoes a bend/break test, and upon satisfactory results, the welder is granted a certification once he or she has passed.

Also, calibrating welding machines properly is an important factor in controlling quality. Over time welding machines tend to lose their calibration and performance. When this occurs, consult a calibration expert who can test the machines periodically to make sure the performance output matches the settings entered into the machine. A properly calibrated welding machine is a necessity to get the proper performance.

Finally, ensure the wire that you are using is in good condition. There are quality procedures that you need to follow when purchasing and storing new and used welding wire spools. Moisture and cool weather can damage the weld wire, whereas rust and other contaminants can damage the quality and integrity of the filler metal. Because of this, store welding wire in a temperature-controlled storage cabinet when it's not being used.

The best way to achieve good welds is to develop a thorough welding plan for the specific project. Start at the beginning and follow the necessary steps one by one until complete.

References

1. Навроцкий А. Л. Работы по металлу. Сварка, пайка, клепка: практическое руководство. М., 2004. 416 с.

2. Овчинников В. В. Основы теории сварки и резки металлов. М., 2011. 248 с.

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HOW TO TIG WELD ALUMINUM

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Manufacturing products with aluminum can help extend part life, reduce weight, and deliver greater integrity in cold temperatures, making the material well-suited for applications such as truck and trailer manufacturing, cryogenic piping, and boat components.

However, welding aluminum presents some challenges, from controlling heat input to dealing with the oxide layer. Gas tungsten arc welding (GTAW) has traditionally been considered the go-to process for welding aluminum because of the high weld integrity and aesthetic appearance the process provides.

Achieving high-quality welds – and getting the coveted stacked-dimes appearance – when welding aluminum with GTAW takes practice and skill. It's also helpful to follow some key best practices.

While GTAW is a slow process and not typically used in high-production manufacturing, it is often a good choice in aluminum welding applications where productivity isn't as important as quality and appearance.

During aluminum welding with the gas metal arc welding (GMAW) process, filler metal is fed into the puddle as soon as the welder squeezes the gun trigger. These "cold starts" can result in lack of fusion and insufficient penetration.

With GTAW, you control when the filler metal is added and are able to establish the puddle and ensure proper penetration before adding filler metal. Keep in mind that having more control over this variable adds another layer of complexity and operator skill compared to other processes such as GMAW.

Proper heat input is a critical factor in successfully welding aluminum with GTAW. Because aluminum is so conductive, the heat of the weld puddle can be pulled away quickly. This characteristic requires putting in a lot of heat to establish the weld puddle. However, this heat must be controlled to prevent a runaway puddle or burn-through.

Heat in welding is a function of amperage and voltage, which means the higher the arc voltage, the more power going into the part. Although welding with a longer arc increases arc voltage, which in turn produces more heat, it also heats a much larger area of the material. This can cause a runaway puddle that grows quickly. To prevent this, use a shorter arc length to help localize the heat to a small area [2].

Another step that contributes to making a good aluminum weld is setting the proper balance control. When you are welding in AC polarity, the weld has an electrode-negative (EN) cycle and an electrode-positive (EP) portion of the cycle. EN is often considered the welding side of the AC waveform, while EP is where the cleaning or oxide removal occurs. On modern welding equipment, the balance control feature allows you to adjust the ratio between the two in response to what you're seeing in the weld puddle.

While older equipment had a truly balanced 50-50 ratio of EN and EP, many modern GTAW power sources have a factory preset balance control of 75 percent EN to 25 percent EP. If small black flecks appear in the puddle during welding – often referred to as “peppering” – your balance control is not adjusted properly. Turning the balance control down so there is less EN and more EP helps remove more oxide during welding and should reduce the peppering.

Adjusting the balance control does not replace the need for proper material prep and cleaning when welding aluminum.

Another factor that makes weld placement easier is the AC output frequency. This also can be set and adjusted on modern welding power sources. AC output frequency shouldn’t be confused with high-frequency arc starting, which only comes into play for arc starting.

The output frequency references how many times per second the power source switches polarity. Older GTAW power sources are 60 hertz, which is determined by the input power, but modern equipment has a factory preset of 120-Hz output frequency. The higher the AC output frequency, the more stable the arc becomes. This results in a tighter, narrower arc column that provides more directional control, allowing you to more easily weld in tight spaces and weld precisely without the arc wandering.

Turning down the AC output frequency to 80 or 90 Hz provides a wider arc cone, which can be helpful when welding an outside corner joint.

Use an output frequency of 150 to 250 Hz on thin materials that require accurate weld placement to prevent heating up a large area or burning through. For welding thick materials, a low AC frequency of 80 to 120 Hz is typically well-suited for materials 3⁄8 in. and thicker and will help you to achieve a wider weld bead profile [1, 265-266].

Adding more filler metal is one technique you can use to achieve the stacked-dimes look when welding aluminum with GTAW. Because filler metal is a solid being consumed into a molten liquid, it requires energy to change the material state – like putting ice cubes into a glass of hot water. The ice cubes melt but also cool the liquid. The same idea applies to adding filler metal during GTAW. Adding more filler rod causes a cooling effect on the back side of the weld puddle that helps produce the stacked-dimes appearance of the finished weld. Adding more filler metal with each dab produces a more pronounced appearance, whereas adding less filler metal with each dab produces a weld with a fairly smooth appearance.

References

1. Зусин В. Я., Серенко В. А. Сварка и наплавка алюминия и его сплавов. Мариуполь, 2004. 468 с.

2. Фролов В. В. Дуговая сварка алюминия : справочно-учебное пособие. Харьков, 2003. 65 с.

Ilinskykh S. S.

THE ROLE OF VIDEO SURVEILLANCE DEVICES AND DETERMINING THE SPEED OF VEHICLES IN IMPROVING ROAD SAFETY

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The modern car is by nature a device of increased danger. Taking into account the social significance of the car and its potential danger during operation, the manufacturers equip their cars with means, promote its safe operation. Passive safety of the car must ensure the survival and minimization of the number of injuries in the passenger car, hit the road accident.

In principle, the cameras are divided into three types: radar, video capture and laser, and by installation method - on stationary and mobile. Radar complexes can be easily distinguished by the presence of a radar sensor and a nearby cell directly to the camera itself. These devices work in two stages: measuring speed and fixing the violation. At first, the camera "fires" the roadway with the Doppler beam, which is capable of measuring speed at a distance of about a kilometer in cars moving in the counter and in passing directions. The coverage radius is a maximum of two lanes in one and two lanes on the reverse side of the road or four lanes in one direction. Having measured the speed of the radar, the camera enters the case directly, which photographs the state registration mark of the car and recognizes it with a special program. In most cases, such cameras are equipped with infrared spotlights to illuminate numbers in poor visibility and at night.

Radar cameras are not corrupt: about 32% of their testimony is false. Many parameters influence this: from pure weather to situational. For example, a cell may form on a cell, under whose weight its "angle of attack" slightly changes. Or in the stream there is a "chess" or a motorcyclist, which are intensively rebuilt from a row in a row. In the latter case, the radar measures the speed of the perpetrator, and the camera photographs a completely filled motorist.

The main purpose of camera installation, as well as any means of the Police, should be the following - to improve traffic safety, reduce the number of violations. The penalty is just a consequence of a violation that should ideally be avoided. Warning plaque in this section disciplines drivers even if it does not have a genuine camera, but a gun. In reality, the traffic police does not seek to warn traffic participants as much as possible about video fixation, often the cameras are masked, because of which disappears the original content of their installation. The hidden camera is suitable in this case only to fine the maximum number of offenders. However, extracted in violation of the lawful procedure of evidence become legally null and void, if they are considered in an impartial tribunal. Why do video cameras really need video violations PDAs.

There is a serious problem of road safety in the world now. In car accidents, more than 500,000 people per year die in the world, and several million are injured, injured and injured.

One of the most important problems in transport is traffic safety. The life and health of passengers and the preservation of material values depend on the correct and timely solution. Improving road safety is becoming an increasingly important

problem, whose successful solution is possible only by joint efforts of roadmakers, motorists, traffic police (GAI) with the involvement of specialists in a number of other sectors of the national economy.

There is a serious problem of road safety in the world now. In car accidents, more than 500,000 people per year die in the world, and several million are injured, injured and injured.

The result of an increase in the traffic flow is the reduction of the efficiency of the use of dynamic traffic flow. Decreasing the speed of the traffic flow through the simple near the intersection leads to increased noise. Increase gas pollution and over-consumption of fuel and lubricants. The problem of movement in modern cities is becoming an important urban planning task, the correctness of which depends on the level of urban amenities, the direction of their further development, the nature and form of resettlement of residents.

Accidents are caused by various causes and the study of them is very important for the development of measures to improve traffic safety. It was found that the dimensions of accidents and injuries are in direct proportion to the population, the number of vehicles, the size of the transport network, the state of roads, their equipment and amenities, technical condition of vehicles.

So, at the moment, scientists are actively working on the system of recognition of automobile numbers and persons. In other words, the strongest optics will photograph the car number, the person sitting at the wheel, check the data obtained with their own base - the vector masks of each driver of the Earth will be entered into a single computer network - and automatically print the regulations with the simultaneous sending of fine by mail. Already, the similarities of such complexes exist, but to date they give too many errors.

References

1. https://www.drive2.ru/b/456168683740332463/
2. https://kolesa.kz/content/articles/2017/10/kak-kamery-sergek-lovyat-za-prevyshenie-skorosti/
3. http://www.averba.com.ua/avtoadvokat-dnepropetrovsk/gai.html
4. https://fastmb.ru/autonews/autonews_rus/713-dlya-chego-realno-nuzhny-kamery-videofiksacii-narusheniy-pdd.html
5. http://article.autoua.net/144-policiya-i-avtofiksaciya-narushenij-pdd-kakie-izme.html
6. http://cardiagram.com.ua/kogda-voditeli-nachnut-poluchat-pisma-schastya-6550.html

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CARSHARING: A MODERN SOLUTION TO THE PROBLEM OF TRAFFIC CONGESTION

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Carsharing allows you not to spend money on the purchase and maintenance of your own car, but to fully satisfy your need for movement around the city. According to experts, residents of megacities are less and less in need of their own car with the growing popularity of carsharing systems, as well as other types of rental vehicles. Usually, in order to use the cars of the car sharing company, it is necessary to conclude an agreement once, in which the main nuances of providing services, rights and obligations of the parties are stated. After that, a new carsharing user gets the right to use any free vehicle of this service at any time. Technically, access to the car can be gained with:

1. Physical access card (HID, Mifare, EM-marine, etc.). For example, the German car2go service uses an ordinary driver's license with an RFID tag for this purpose.

2. Online booking of free cars through the browser. This method provides most carsharing services.

3. Car booking via smartphone app. In addition to the carsharing operators' own applications, independent developer aggregators are also available.

In the case of booking, the user is usually given 20 minutes to get to the selected car, during which a fee is not charged. After this period, the fee begins to be charged at the rate. In the article "Research: carsharing will make cities cleaner and more comfortable", experts predict that carsharing will be the basis of future transport.

The model of carsharing is designed to quickly and conveniently satisfy the traditional human need to move from one place to another, and also allows you to save your own money by reducing the cost of sole ownership of a car.

Carsharing has freed the streets. One car in the public domain replaces 8-20 private cars. In terms of the occupied parking space, that is 36-99 meters. Supporters of car sharing point out that land freed from parking spaces can be used for the development of public space, bicycle lanes and other ideas that will make the city more environmentally friendly and comfortable.

Many companies around the world offer carsharing services, which differ from ordinary short-term hired cars in a number of ways. First, the points - of - issue cars work around the clock, seven days a week. Usually there are several of them in a city, so you can take a car at one point and leave it at another, where the courier of the company or the next user will take the car.

The level of motorization in our country is higher than in the capital of Turkey. The average Ukrainian figure is 148 cars per 1000 people. In Kiev, this figure is 213 cars per 1000 inhabitants [3].

The interest in launching carsharing in Kiev was once announced by the American car rental company, Sixt, based on the successful operation of Sixt and BMW in Germany. There, the cost per minute was 0.31 euros, and the cost per hour was 18.6 euros. However, for Ukraine it was too high a tariff, and the company's specialists recognized the threat of car theft in our country to be too high. Therefore, they abandoned the intention – they said that the risks were higher than the potential profit.

In June 2017, in Odessa, they launched the first car sharing service in Ukraine – MobileCar electric vehicles with per-minute payment. To use the

service, MobileCar allowed drivers aged at least 25 years old, and with at least 3 years' driving experience. To register, just download the MobileCar application in GooglePlay (Android OS) or AppStore (iOS) and confirm your passport data. After that, the service specialists contact the client and ask them to sign a written contract at the company's office [2].

In the installed application, the nearest available electric cars are displayed (at the moment they are several Nissan Leafs), which can be remotely booked. As soon as the client gets to the car, they will be able to open the door with the help of a proprietary application, as well as assess the appearance and internal state, and check the set of documents.

You can complete the rental at any place allowed by the traffic rules, after making sure that the doors of the electric vehicle are closed, the ignition is turned off, and the gearbox is in the "P" position. You can close the car through the mobile application. The minimum required amount on the balance sheet must be at least 300 UAH. The main advantages of the service in MobileCar are the "feed" speed and lower price as compared to calling a taxi, the environmental friendliness of an electric vehicle that does not pollute the environment, as well as an advantage over public transport [1].

After some time, EkoCarsharing was launched in Kharkov - a project of AvtoEnterprise with electric cars, with the same carsharing services as in the Odessa company. The amount of the deposit is 5,000 UAH, which covers insurance with maximum damage to the car by the driver.

References

1. The term from Wikipedia is https://ru.wikipedia.org/wiki/Carstering (12/12/2018).

2. The article "Research: car sharing will make cities cleaner and more comfortable" - https://ecotechnica.com.ua/transport/1253-issledovanie-karshering-sdelaet-goroda-chishche-i-komfortnee.html (12/12/18).

3. Information from the MobileCar service site - https://mobilecar.com.ua/ (12/12/18).

Ivanchenko D. O.

ANALYSIS OF THE CHARACTERISTICS OF TRANSPORTATION OF PERISHABLE FOOD PRODUCTS AND REQUIREMENTS FOR DRIVERS AND VEHICLES OPERATING IN INTERNATIONAL TRAFFIC

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In the world economy transport plays a special role. The efficiency, quality and development of foreign economic relations of any country depend on transport working. Well-formed and developed transport system for each state is an important factor in its independence and socio-economic formation.

The state of the country's economy and the degree of development of transport are interdependent, and the higher the development of the transport system, the higher the development of the economy of the country, respectively. Automobile transport is spread throughout Ukraine; it is maneuverable, fast and mobile, so it is the most efficient mode of transport in today's market conditions.

International transportation is the transportation of goods between several countries. This kind of transportation has special requirements for drivers and vehicles operating in international traffic. In addition, it demands compliance with the requirements for transportation of goods, especially perishable.

Perishable goods are goods which, when transported by vehicles, need protection (cooling, heating) from the influence of high or low temperatures. Depending on the origin, the perishable goods are divided into the following groups: 1. herbal products; 2. animal products; 3. recycling products.

Especially perishable products are products in which, at violation of temperature modes and timing of implementation, a particularly favorable environment for the reproduction of microorganisms, is created which can cause damage to products and lead to acute intestinal diseases and food poisonings.

The especially perishable products include meat, fish, vegetable semis, milk, dairy products, cream confectionery, blood products and offal products. Perishable goods required to be transported at certain temperatures are transported by isothermal vehicles, refrigerated vehicles or heated vehicles. Liquid perishable foods such as milk, wine, kvass, beer, are transported by tanks equipped with the necessary technological equipment for reloading operations. For liquid products delivered at considerable distances the tanks with thermo insulation are used.

The bodies of vehicles for transportation of perishable products must comply with the sanitary and hygienic requirements specified in the sanitary rules and norms for food trade enterprises, public catering, food markets, etc. Vehicles used for transporting food must be clean with hygienic inner covering of the body, which is subject to sanitization, which consists of measures of prophylactic disinfection. The sanitary treatment of vehicles is carried out before every transportation of perishable food products [1, 113–115].

A certificate issued by the sanitary treatment establishments must certify the sanitary treatment of the vehicle.

Vehicles used for the transportation of perishable goods in international traffic must be equipped with devices for the constant objective control of temperature variations within the body during transportation of goods.

When choosing a vehicle for transportation of perishable goods, you must consider the following factors: a) name, type, category, variety; b) time of transportation, external temperatures; c) deadline for the sale of products, recommended transportation temperature. The consignor determines the method of transporting perishable goods (with cooling, heating), the type of vehicle (refrigerated, isothermal, covered) or container (universal or refrigerated) [1, 115–120].

According to the requirements for drivers, it was established that the minimum age of the driver of a vehicle that carries out international transportation of goods should be: for motor vehicles the permissible maximum weight of which

does not exceed 7,5 tons, not less than 18 years, for other motor vehicles – not less than 21 years.

Drivers, who additionally have a document on special training in accordance with the procedure established by the central body of executive power in the field of road safety, are admitted to international transportation of heavy, large and dangerous cargoes. Drivers of motor vehicles in the implementation of international road transport are obliged to adhere to the provisions on working hours and rest periods of drivers of motor vehicles in accordance with the order of the Ministry of Transport and Communications N 340 (z0811-10) 07.06.2010.

Drivers must have permission, registration sheets of work and rest schedules for the current week and the last day of the previous week, during which the drivers were driving the vehicle and other documents required by international agreements for the international carriage of goods [2, 56–58].

According to the requirements for vehicles for the international carriage of passengers and goods, motor vehicles with a certificate of conformity, a license card, registration and distinguishing marks of Ukraine are allowed.

The design and technical condition of motor vehicles used for international transportation must comply with the requirements of the legislation of Ukraine and a foreign state, a permit to travel through the territory received by the owner of the vehicle.

In addition, the car should be marked with an identification mark of the state (for Ukraine – an oval sticker with Latin letters UA).

References

1. Костюченко Л. М., Докіль Л. П., Кучинський Ю. Ф. Міжнародні автомобільні перевезення Київ. 2010, 208 с.

2. Столярський О. В. Правове регулювання міжнародних перевезень Київ. 2012, 318 с.

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SYSTEMS OF CONDITIONING OF COMPRESSOR TYPE

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Road transport is one of the most important spheres of entrepreneurial activity, as in the process of managing, each firm needs the transportation of materials, raw materials, finished products, while they use their own vehicles or use the services of motor transport enterprises.

The cars are equipped with a compressed air conditioning system. Units of the heater and the heat exchanger of the evaporator of the air conditioner are arranged in one unit. The air conditioning system controls are located on the panel, in common with the heater control units.

There are two main types of automotive air conditioning systems. The difference between the two air conditioning systems is determined by the type of device in which the coolant pressure is reduced: this may be either an expansion valve or an expanding tube.

The air conditioning system with expansion valve has five main elements:

– compressor (driven by the engine);

– condenser (located on the front of the car, in front of the radiator of the cooling system);

– filter / dehumidifier (located in the engine compartment);

– expansion valve (usually embedded in the evaporator);

– evaporator (located in the cabin with elements of the heating system on the front panel).

The air conditioning system with the expansion tube has five main elements:

– compressor (driven by the engine);

– condenser (located on the front of the car, in front of the radiator of the cooling system);

– expansion tube (located in the main or evaporator);

– evaporator (located in the cabin with elements of the heating system on the front panel);

– battery (located in the engine compartment).

To cool the air, a refrigerant is used.

Freon is an excellent coolant used in automotive air conditioning systems. The system itself consists of a freon refrigerating machine, the separate segments of which are connected by freon cables. Unlike domestic refrigerators, automobile air conditioners are cut-in connections with additional rubber gaskets. The compressor works by mechanical drive. Sealing provides several packing seals. At the same time it is impossible to guarantee the absence of leakage of the refrigerant – it begins to slowly evaporate even through the smallest cracks in the sealing elements. For this reason, automotive air conditioners need to be charged periodically.

Here's what you need to know about refrigerants:

– freon (coolant) is a colorless, odorless gas or liquid. In terms of chemical properties, freons are inert; however, in the event of large leaks seriously harm the environment. When heated to high temperatures, they become very strong poisons. The volume poured into the freon system depends on the car model and is always indicated in the technical passport;

– car air conditioner is a complex fresco cooler, the elements of which are connected by special freon wires. The weakest elements of it are sealers – it quickly wears out due to temperature, vibration, and direct mechanical influences, contact with other auto-chemicals;

– some percentage of freon is attributed to the lubricant. The manufacturer adds oil to the refrigerant because it reduces wear and tear and sealants. And it is for this reason that the air conditioner should be switched on for 10-15 minutes from time to time so that the lubricant covers a thin layer of the internal air cavity;

– the frequency of refueling of the car air conditioner freon depends on the age of the car. As a rule, a new refrigerator should be heated in 2-3 years of operation, and after 7 years the procedure should become annual.

Specialists recommend removing freon, when the car is subject to strong heating in any work. As a result of heating, the refrigerant expands, which entails a rupture of the individual elements of the air conditioner (normally only the sealers break down).

Today, only 2 types of automobile refrigerant are common:

– R12. It can boast of excellent refrigerant productivity, low power consumption. The lock is in its composition. Namely, in some percentage of chlorine, which negatively affects the environment. Studies have shown that prolonged use of this coolant in auto-conditioners has negatively affected the state of the ozone layer of the Earth. The so-called greenhouse activity (GWP) of these freon is very high;

– R134a. According to thermodynamic characteristics, it is close to the 12th freon, but still 10-15% worse than its cold performance and in liquid state is more fluid. However, it does not contain clap. The GWP coolant is 1430. Today it is often used in refrigeration equipment. In automobile air conditioners, its application twenty years ago was difficult: it required a serious technical adaptation of the main system node, namely, the compressor.

Depending on the purpose of the facility, the necessary air condition conditions, which are the most important for the specific conditions of use, are selected.

References

1. Нимич Г. В. Современные системы вентиляции и кондиционирования воздуха. Киев, 2003. 630 с.

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COOLING REGIME INFLUENCE ON CLINKER PROPERTIES

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Clinker cooling is directly linked to the clinker quality which is the main factor affecting cement quality. Mostly clinker cooling regime is determined by effectiveness of the clinker cooler: it regulates technological zones' distribution in the kiln, therefore clinker granulometry also depends on cooler effectiveness. In terms of increasing the heat recuperation, the amount of cooling air is often decreased to its technological minimum. Thus more energy could be used repeatedly which would decrease fuel costs. Also it is proven that fuel burning intensity and physical and chemical processes kinetics depend on temperature and enthalpy of the secondary air [1].

But there's still no consistent patterns that would connect clinker cooling regime and its chemical composition. It's still the subject of the future research. This is mostly because of the inconsistency of the clinker composition.

However, there's a general rule that increasing the speed of clinker cooling would lead to its partial destructurisation, which makes clinker with higher relative grindability because of increased relative quantity of defects in unformed crystal structures [2].

In order to find out the links between clinker properties and cooling regime were made a series of experiments with laboratory made clinker. The purpose of those experiments was comparison between specimens of clinker made from one raw mix consisting of chalk, two different types of clay and iron additive.

For the research were chosen three types of laboratory clinker cooling:

1. Slow Air Cooling

This method required clinker made in laboratory kiln at temperature of 1450 °C to be cooled in the kiln to the temperature of 1200 °C during 20 minutes. Then it was taken out and then cooled by the air of laboratory compartment (20 °C) until the cooling process stopped.

2. Fast Air Cooling

This method required clinker made in laboratory kiln at temperature of 1450 °C to be cooled in the kiln to be cooled by the air of laboratory compartment (20 °C) with a fan until the cooling process stopped.

3. Water Cooling

This method required clinker made in laboratory kiln at temperature of 1450 °C to be cooled in the kiln to be put in cold water for 2-3 seconds. After that clinker was cooled by laboratory air with a fan.

Thus from different methods used three different types of clinker were obtained. Compressive strength of the cements of standard composition and their relative grindability and crystallographic structure of the specimens were compared and the data was analysed in the process.

Relative grindability was measured by the period of time that was used to get the target specific surface of cements (4000 cm^2/g) in standard laboratory mills. According to the results of the analysis, grindability of the specimens increases with the increasing of the cooling speed (from methods 1 to 3 respectively). This could be the sign of increase of quantity of deformed crystal structures made by fast cooling.

This hypothesis was also proven by the results of microstructure analysis. The discovered structures have shown that crystal sizes of alite (C_3S silicate, which is considered as main mineral of the clinker composition) were decreasing in order of increasing the cooling speed (methods 1-3).

However, the compressive strength test results have shown that cement based on a clinker with water cooling was the least durable one. This may be the consequence of the case where the clinker minerals structure was too deformed to form stable hydrosilicate matrix but this needs further investigation.

The common correlations between clinker cooling speed and its relative grindability could be used to calculate economic profit of making more destabilized clinker structure. As for now, we can say that aluminate content in the raw mix

gives most obvious picture of influence on clinker structure forming during the cooling phase. According to the research [1], the optimum content of C_3A is 7,5%. This value could be used in theoretical raw mix calculations as maximum if the clinker structure forming is difficult.

References

1. Новоселов А.Г. Интенсификация процесса обжига цементного клинкера путем повышения эффективности работы холодильника – Белгород, 2013 г. – 19 с.
2. Новоселов А.Г., Классен В.К. Влияние режима охлаждения на активность клинкера с различным содержанием C_3A – «Современные проблемы науки и образования». – 2012 г. – №6.

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THE CHOICE OF PARAMETERS OF BROWN'S GAS ELECTROLYZER FOR THE FUEL SYSTEM OF A GASOLINE ENGINE

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Modern vehicles running on carbon-hydrogen fuels (gasoline, diesel) consume a lot of fuel and emit many harmful substances into the surrounding atmosphere.

Therefore, the search for alternative types of fuel is a highly topical issue at the moment. One of the directions is arranging generation of hydrogen directly in the engine compartment with its subsequent use as a traditional fuel additive. Nowadays, there is an increasing interest in the use of hydrogen in various directions. Here is why we have devoted our research to this issue.

Brown's Gas got the name from Yule Brown, a gifted Bulgarian professor and inventor living in Australia. He was one of the first to note the extraordinary properties of HHO, and to disassociate it cheaply from water. He was also one of the first to use it to power an automobile's internal combustion engine, and to also market it as a welding gas (and one of the first to experience the aura of suppression surrounding this alternative energy). Professor Brown discovered that using relatively small amounts of carefully tuned pulsed electricity across submersed plate electrodes acting as Capacitors can break the atomic bonds of water into HHO thousands of times more efficiently than the old methods of "brute force" high-Amperage systems.

Brown's gas is a mixture of monatomic and diatomic hydrogen and oxygen and a special form of water called Electrically Expanded Water (EEW) or Santilli Magnecules. The simplest way to make Brown's Gas is to use an electrolyzer, which uses electricity to split water into its elements of hydrogen and oxygen. At the instant that the water splits, the hydrogen and oxygen are in their mon-atomic state, this is H for hydrogen and O for oxygen. Brown's Gas has the following properties:

– It does not pollute the environment (there is no hydrocarbon in the gas composition).

– Complete combustion of the gas. The components are shifted to a chemically equivalent ratio of → H (hydrogen): 2 volumes, O (oxygen): 1 volume.

– Implosion, which is characterized by non-explosive nature of burning.

– Cost effectiveness. When burning Oxy Hydrogen (HHO), heat energy is released more than 3 times efficiently.

– Thermonuclear reaction: during the combustion, the hydrogen atom H and the O atom penetrate the atomic nucleus of the heated zone.

Due to the intensification of combustion the following conditions can be achieved:

– 10-15% increase in power.

– Environmentally friendly exhaust.

– Reduction in fuel consumption of up to 20%

– 80% reduction of CO2 emissions

The influence of hydrogen on the quality of combustion is shown in Figure 1.

It is clear that when using Brown's gas, the mixture burns almost completely and instantaneously, this fact allows improving engine power and reducing fuel consumption (less fuel will be needlessly wasted). So, the choice is obvious.

The addition of hydrogen provides a symmetrical distribution of the flame front in the combustion chamber, and due to high rate of combustion, the fuel efficiency increases.

A testing bench has been developed. One of its main parts is the electrolyzer itself – it is a device, which decomposes water into hydrogen and oxygen (so-called hydrogen generator). It is also used as a tank and a filter, where after electrolysis, Brown's gas is separated from water droplets.

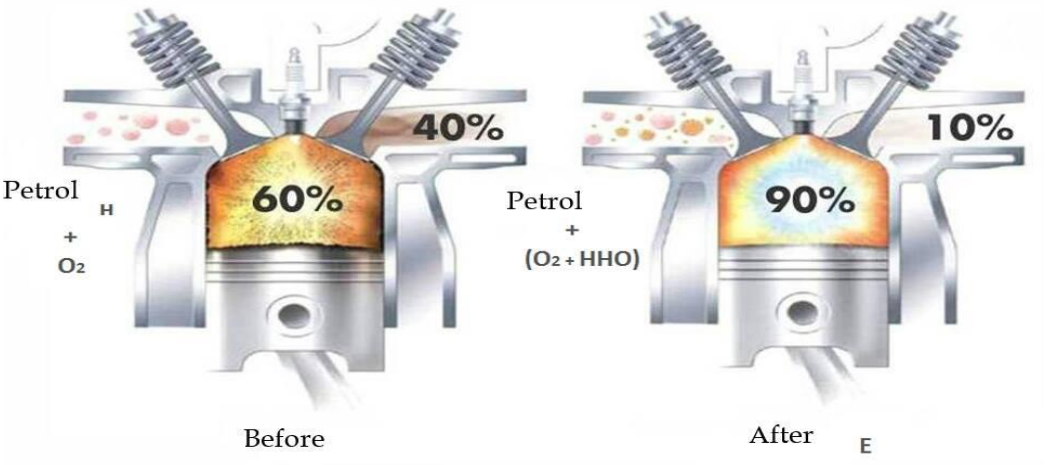

Figure 1. – The combustion procedures of a regular gasoline mixture and a mixture with Brown's gas

All these components are very important parts of the testing bench and they ensure proper operation. All of them are produced in Ukraine under a German license and are easily accessible to us.

Bench test procedure using chassis dynamometer (motor vehicle – KIA Magentis) has been conducted. Since this motor vehicle is a newer one, some of the electronics can't be used for the testing (mainly MAP and MAF sensors are not suitable for this purpose), but these problems have been solved and the experiment has been successfully carried out.

The following results have been achieved: Modern combustion analysis of gasoline-hydrogen fuel in the engine cylinders has been made. The testing bench for generating Brown's hydrogen has been developed. Process equipment for experimental testing of a motor vehicle including a standard Brown's hydrogen generator has been set up. Bench tests of a motor vehicle with an engine running on a gasoline-gas mixture have been carried out.

References

1. Водород как топливо. URL: http://sintezgaz.org.ua/1_artieles/113/vodorodnoe-toplivo

2. История появления вспомогательной топливной системы с использование газа Брауна. URL: http://dsto.ucos.ru/publ/generator_gara_brauna/istoria_gazabrauna_nno/9-1-0-32

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PROBLEMS OF THE INTERLAYER COHESION OF ASPHALT CONCRETE LAYERS

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At the moment there are numerous studies on interlayer cohesion of various materials. Their purpose is to evaluate the behavior of the materials at the interfaces, such as gas-liquid, gas-solid, liquid-liquid, liquid-solid, and solid-solid. It is done in order to discover the useful properties of such behavior and to use them in industrial spheres as well as for deeper academic studies.

Asphalt concrete represents a very complex structure not only from the view of molecular composition, but also from the view of the interface composition. The following article is concerned with the interaction of coating layers of asphalt concrete in the presence of a cohesive material between them, such as bitumen or emulsion.

Let's consider a simple model of such systems interaction. In the lower coating layer and in the upper one we present asphalt concrete of the first quality class based on road oil bitumen type B. We place a layer of penetration bitumen of 60/ to conduct a real test exactly in a solid-liquid-solid interface as the access is blocked by the upper layer of concrete. In this case one may separate the very upper asphalt concrete layer, but for this purpose it is needed special laboratory instruments.

To solve this problem the scientists invented a theoretical approach with empiric consequences. They suggested equations which allow measuring the properties not in the solid-liquid-solid, but in the liquid-solid interface. Via such parameters as density, contact angle of wetting and other physical and mechanical properties, it was managed to achieve the measurement of adjoining materials[1].

For considering the practical utility of such researches, let's turn more deeply to the problems of these phenomena. The reason of interface interaction's increased research is first of all the fact that there is no real rationing of material expense per unit area when building road surfaces. In Ukraine there isn't any normative document on this issue, thus there is no one who could ensure the operational life of a road, no one from the projector to the technical and designer supervision. It causes the problem of gluing materials expense, hence the problems of their price; another type of problems is represented by the accurate selection of such types of materials molecular composition, that is the percentage of the additions in it, which is as well connected with the price.

Of course, such problems can be solved by complex evaluation of the road surface at the stage of control when building, by selection of core samples and testing them in laboratories. The negative effect of such method is the damage of the surface. There are methods of wave and resonance evaluation of the state of the road surface, but these methods are under active development and improvement in virtue of the complexity of the generation of wave oscillation equations of the wave advance and decline in the body of the road surface.

That's exactly why the theoretical justifications of the gluing materials' behavior between the layers of asphalt concrete coating are becoming increasingly urgent. Really, if one knows the laws of liquid material's behavior within the solid body, the laws of thermal expansion, as well as probabilistic pore bridging characteristics of the material in solid layers, one may highly likely predict its behavior in any environment conditions and predict the necessary composition and quantity of the material on this basis.

Nevertheless, the foreign engineers invented and developed new methods allowing to determine the adhesion level in the interlayer space. The Leutner method is one of such methods.

This method consists in taking a borehole sample from the pavement. This borehole sample should be cut out by special fixture rotating the saws on circular contour and together persuading them down. Then the sample should be taken to the laboratory where it should be put inside the other unit which determines lateral resistance by breaking off the upper layer from the bottom layer because of applying normal and tangent direction of the force to pavement's upper layer [2]. The tests give us a vision of hardness level of connection between asphalt pavement layers, however testing cannot describe the current process because it involves only tangent direction of the force and does not include the breakout force.

If we could analyze any methods of determining the adhesion level from Europe, America and other countries all of them seem to be the same because all of them have the Leutner method as the base method with various modifications and additions. For example let's look to the works of scientists from Illinois (IL) [3, 4].

Ukraine also has the procedure of asphalt layers bounding force estimation [5]. This procedure consists in heating the sample to the temperature according to standard value, then the sample should be put in testing unit NTU-Z4-1, and when the unit starts working, it presses out upper pavements layers. The fixing arrow indicates the force value which causes the break-up of the sample.

Such method avoids any inaccuracy in Leutner method, but also it has a weak point - it doesn't involve tensile stress.

In conclusion, I would like to mention the progressive success of western countries and of this university in this direction. There are articles and normative documents on the layers' tests on rupture, compression and other physical processes, but there are no documents that consider the thermal effect on the materials and their complex behavior on the phase boundaries.

References

1. Углова Е.В., Тиратурян А.Н. Новый подход к оценке межслойного сцепления в нежёстких дорожных одеждах.,2010. 35с.
2. Randy C.West, Jingna Zhang, Jason Moore. Evaluation of bond strength between pavement layers. NCAT Report 05-08
3. Illinois center for transportation. Best practices for implementation of tack coat: part 1, laboratory study.
4. Illinois center for transportation. Tack Coat Optimization for HMA Overlays. laboratory testing.
5. СОУ 45.2-00018112-046:2009 Асфальтобетон дорожній. Методика оцінки зчеплення між асфальтобетонними шарами при зсуві.

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LANE CAPACITY

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The most important criterion characterizing the functioning of communication lines is their throughput. In the theory of design of roads and works on the organization of the movement, the term road capacity is used. The simplest definition of this concept is that the capacity of a road is the maximum possible number of cars that can pass through a section of a road per unit of time.

However, it should be noted that, considering the movement of cars and assessing the limits of the possible intensity of flow, we characterize essentially not the road, but the complex VADS. This is due to the fact that the characteristics of the vehicle and the driver may have no less effect on the throughput than the parameters of the road. For example, research in the United States has shown that if you completely replace a human driver with an automatic car control system, the lane capacity may increase by 2 times. The state of the environment C can have a great influence on its actual value. Actual throughput especially falls in heavy rain, fog, heavy snowfall and icy conditions.

In some cases, the definition should be supplemented with the fulfillment of the condition for ensuring a given message speed. This is most important for high-speed roads, where safety conditions must be ensured at specified high-speed modes. So, if for a normal city highway, the normal speed of a traffic flow is 50–60 km / h (corresponding to the road's carrying capacity), then for a speed highway, the desired speed may be 100–140 km / h. This requires a reduction in throughput rate [2, 84].

For simplicity, homogeneous traffic flows (columnar movement), i.e. the capacity of one lane, should be considered as initial. However, so far in the works of domestic and foreign scientists and in official publications there is no unified approach to the methods of calculation and full-scale determination of throughput.

The following modifications of the concept of throughput can be called: theoretical, nominal, normal, effective, proper, practical, actual, etc. Such a variety of terms is not accidental. It reflects a different methodological approach to the definition of this criterion, as well as a large number of factors influencing the throughput indicator in real traffic conditions. Naturally, therefore, depending on the number of factors taken into account and the accuracy of assessing the influence of each of them for the same means of communication, significantly different throughput values are obtained.

There are two fundamentally different estimates of throughput: on the stretch and on the crossroads in the same level. In the first case, the transport stream with sufficient intensity can be considered continuous. A characteristic feature of the second assessment is the periodic flow breaks for the passage of cars in the intersecting directions, due to traffic light regulation [1, 267].

Returning to the marked variety of modifications and pursuing the goal of a simpler and clearer classification, we can divide the concept of throughput into three: the calculated Rp, the actual Rf and the standard Rn.

Estimated throughput is determined theoretically by using various calculation formulas. For this, mathematical models of traffic flow and empirical formulas can be used, based on a synthesis of research data briefly discussed earlier.

Determination of the actual capacity is possible only on existing roads and in the prevailing traffic conditions. These data are of particularly great practical importance, since they make it possible to realistically assess the carrying capacity while ensuring a certain level of speed and traffic safety. However, obtaining objective data on security requires quite a long time. Actual throughput can also be called practical. The objectivity of determining the actual throughput depends on the soundness of the methodology, the thoroughness of the research and the processing of the results. Given the value of data characterizing throughput, the researcher should pay particular attention to the choice of the observation site, the sufficiency of the volume of regulated information and the accuracy of measuring the speed of cars in the stream.

Experience shows that in dense traffic conditions, drivers tend to reduce the distance to extremely dangerous limits. As a result, so-called "chain" collisions occur, in which dozens of cars sometimes get involved [3, 266].

The simplest is the use of regulatory capacity, which is specified in official regulatory documents, for example, in the Building codes and regulations. It

should, however, be borne in mind that this does not take into account the whole complex of factors and conditions that characterize a stretch of road. Therefore, its values for many specific conditions are underestimated, and for some overestimated. In addition, developers of regulatory data often seek to provide a reserve and underestimate the throughput rate.

References

1.Balabanov I. G. Financial management. - M .: Finance and Statistics, 2008. 379 p.

2. Bulgakov I. N. High speed driving. - M .: Phoenix, 2007. 129p.

3. Tereshina N. P. Economy of transport. - M .: INFRA-M, 2008. 370p.

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PARTICAL SAFETY FACTORS OF ACCIDENTS ON THE ROADS

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The accident rate in Ukraine is one of the important problems of modern society. The Road Safety Authority is constantly creating new measures to address conflict situations. According to statistics, every year the number of accidents is growing. B.V. Babkov has established 3 ways to identify dangerous road sections in the process of designing the methods of accident rate and safety factors, as well as the principles of correcting the route in the process of reconstruction and major repairs.

Also, based on the materials of the conducted surveys of roads and the implementation of experimental works by B. V. Babkov and his students, a number of valuable recommendations have made:

- development of ways to identify dangerous sections of the road in the process of designing methods of accident rates and safety factors, as well as the principles of track correction during reconstruction and overhaul;
- road design for mixed bus and trolleybus traffic;
- taking into account the influence of visibility in the plan and longitudinal profile of roads on the modes and safety of traffic and the requirements for curves in the plan and longitudinal profile of the conditions of visibility at night, in the light of headlights;
- substantiation of the parameters of ring crossings at the same level, contributed to their wider application on the roads of the USSR, the development of new types of intersections at the same level;
- design of sewer intersections in one level, assessment of their capacity and relative safety.

For the method of accident rates on the basis of the processing of numerous statistical data on the accident, the particular accident rates are determined. These coefficients obtained by V. F. Babkov by collecting numerous data on road traffic

accidents around the world and processing them according to a single methodology. It lies in the fact that all the information about the accident was divided into groups. In each group got an accident with a common main cause. For example, reducing the width of the roadway makes it difficult to drive a car, leads to an increase in accidents, etc. The coefficient of accident rate is a product of partial coefficients that take into account the influence of individual elements of the plan and profile,

$$K_{ав} = \prod_{i=1}^{20} K_i$$

where - private rate – the ratio of the number of accidents on the stretch of road with different elements of plan

This coefficient is calculated in tabular form for each stretch of road, which changes at least one parameter that influences the traffic safety. The calculation results are presented in the form of a table. It immediately shows the places of increased danger, which can also be determined taking into account the influence of the seasons of the year, and the degree of danger is determined by the indicators have given in the Table 1.

In the projects of improvement of roads at capital repairs in the conditions of hilly relief it is necessary to provide reorganization of sites with accident rates more than 25-40. On mountain roads from the position of traffic safety can be considered acceptable areas with the values of the final accident rate of less than 35 and more than 350. However, it should be borne in mind that at its values of more than 350 traffic speeds and road capacity are significantly reduced.

Table 1. Value of accident rates

$K_{ит}$	Conditions of movement
≤10	not dangerous
10-20	less dangerous
20-30	dangerous
40≥	very dangerous

At values of the final coefficients of accident rate close to the maximum admissible, it is recommended:

- to make the marking of the carriageway forbidding overtaking with departure on a strip of oncoming traffic at accident rates more than 10-20;

- to establish signs of prohibition of overtaking and restriction of speed at accident rates more than 20-40.

B. V. Babkov established the value of partial coefficients in the form of ranges. Therefore, the representatives of the Police Department and even an outside expert can offer different meanings. So, we decided to deal with this issue and chose the method of Cluster analysis. We decided to find more accurate values using a Dendrogram.

References

1. Babkov B. V. Design of roads: part 1: studies. For UNIVERSITIES with a degree in «car, roads" and "bridges and tunnels" / B. V. Babkov, O. V. Andreev. M: Transport, 1979. P. 339-367.

2. Babkov B. V. Design of roads: part 2: studies. For UNIVERSITIES with a degree “in car, roads” and "bridges and tunnels" / B. V. Babkov, O. V. Andreev. M: Transport, 1979. 407 p.

Kulyk M. M.

HOW TO GET RID OF TRAFFIC JAMS ON THE ROAD? SOLVING THE PROBLEM OF URBAN CONGESTION

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In recent years in modern large cities of Ukraine a lot of special attention on the roads is attached to solving the problem of urban congestion. Daily traffic jams steal our time, increase emissions of exhaust gases (waste gases) into the urban atmosphere, which in the meantime affects the human body and the urban environment, reduce the quality of our lives and increase our money spending. Getting into a congestion, we abuse our authorities for roads, the organization of traffic, signs and from all this we get the human factor so-called "aggressive behavior", but from this nobody gets better [1]. So, how can Ukraine get rid of these hours of traffic jams on the road?

Many experts have expressed their opinion that there will always be traffic jams, but despite this, in fact, the solution to this problem is still possible. It is believed that the more roads are built, the faster traffic grows, which in turn all actions to increase the capacity of the road network nullifies. Unfortunately, not everything is as simple as it seems, the traffic jam is associated with many reasons why it is not possible to do it. Therefore, to solve the problem of traffic jams, technology and a sound approach to the problem are needed [3, 4].

In large cities, the authorities are taking various methods and actions to increase the capacity of roads [1]. Many strategies to solve traffic problems are approved for many years and are not adjusted for a long time, despite the fact that the road situation can change dramatically very often. Therefore, many measures to reduce the number of traffic jams on the road leads to a short-term effect. However, there are many possible solutions that can be done today to alleviate the situation on the roads of large cities.

Consider the different methods in order, and the first method is Autonomous vehicles.

Often the culprits of traffic jams are the drivers themselves because of their wrong actions on the road or because of an accident. For example, if the driver is driving too slow on the high-speed lanes, it slows down the entire traffic flow. Also, when rebuilding, many drivers often break the rules of the road, moving to another lane without turning on the turn signal, which causes other drivers to brake sharply, causing a chain reaction to reduce high-speed traffic on the road. Often

drivers in the same number are not inferior to each other on the road, or drive a car too aggressively, which naturally leads to a violation of the bandwidth of the road.

If cars with automatic driving will get its mass distribution in large cities, it will increase the capacity of roads, as the electronics driving the car will not allow traffic violations, will not allow the car to go too slowly or aggressively rebuilt. Autopilot will reduce the character of individual driving, make all the maneuvers of the car smooth and predictable.

Cars with Autonomous driving completely remove the human factor. This will increase the safety of the car and minimize traffic violations [5].

The next solution may be active traffic monitoring. When you drive on the highway in any major modern city, usually an intelligent traffic control system keeps track of you, using a variety of sensors. Of course, the system does not monitor every car, but in General the average speed of the flow of cars on the road. Based on the average speed, traffic lights work at intersections to more effectively allow traffic flows through traffic lights.

Also, the traffic tracking system can generate certain information messages for drivers, which are displayed on special screens installed on the roads. This is especially useful in the morning and evening rush hour, when there is the busiest traffic. On such screens can be displayed information about traffic jams, average speed at the intersection of streets, etc.. Drivers saw the message, can decide on the detour hampered plots in front, which will reduce the load on the road.

Also, this system is able to warn about the accident ahead. This allows you to warn drivers about the danger on the road, which will reduce the risk of re-hitting the car.

The third method is intelligent road marking. At the moment, this technology is still under development, but, nevertheless, we hope that it will be implemented in many cities around the world (including Ukraine). The technology is an interactive road marking, which is able to transmit a hazard warning to the driver. It is worth noting that the warning information is collected and transmitted to each car individually. So markings on the road can inform the driver of an accident, turns, signs, settlements and the state of the road surface. If the vehicle is equipped with the function of projecting the image on the windshield, such tips coming from the interactive road markings will be projected directly in front of the driver on the windshield.

There is also a well-known coordination of traffic lights "green" wave-it is important, where introduced one-way traffic with a minimum number of intersections. In fact, this system is already used in many large cities of Ukraine and other countries. So the traffic lights are adjusted in such a way as to provide a "green" wave of movement. Also, with the help of motion sensors, which are installed along the entire length of the street, the average speed is monitored. Taking into account the intensity of the traffic flow, traffic lights automatically change the mode of operation. Including on a parallel one-way street to the other side, all traffic lights are also synchronized to ensure a uniform flow of traffic that prevents the formation of traffic jams.

According to some reports, this setting of traffic lights can increase the average speed by 20 percent, reducing travel time from 20 to 30 percent [3,4,5].

There are several methods to solve problems such as:

- reverse lanes;
- smooth exits and exits on the highway;
- correct layout;
- toll lanes.

Despite all the technological solutions to get rid of traffic jams the best solution is public transport. This is recognized by the authorities of all major cities in the world. The development of public transport in cities, of course, facilitates the road situation. If you think it won't help, it won't. Think that on average a small city bus can carry 50-70 people. Imagine that all these people have cars, but refused them to travel to work. This is a huge number of cars that in rush hour will not drive on the roads of the city.

The leadership of all major cities in developed countries has been developing public transport for many years and promoting the benefits and benefits of its use.

If you develop a decent network of public transport, which will be able to get to work faster, people sooner or later refuse to travel to work during rush hour in their cars [2].

References

1. Справочник по безопасности дорожного движения / Под ред. проф. В.В. Сильянова. – Осло – Москва – Хельсинки, 2001. – 773 с.
2. Шештокас В.В. Город и транспорт / В.В. Шештокас. – М.: Стройиздат, 1984. – 176с.
3. ДБН Б.2.2-12:2018 Планування і забудова територій -
4. ДБН В.2.3-5-2018 Вулиці та дороги населених пунктів
5. ДСТУ 3587-97 Безпека дорожнього руху. Автомобільні дороги, вулиці, залізничні переїзди. Вимоги до експлуатаційного стану.

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ALTERNATIVE FUELS AND THEIR IMPACT ON OPERATING CHARACTERISTICS OF MOTOR VEHICLES

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Road transport is one of the most dynamic and rapidly developing modes of transport. In the near future, the development of road transport will continue to register high growth rates and fuel consumption will increase. Whereas oil deposits are declining. There is a current global need for alternative and renewable energy sources. The solution of this task requires considerable labour and material expenditures. Significant volume of fuel consumption by motor vehicles is associated with high energy intensity of road transport: it is 12 – 14 times greater than that of river transport, and 17 – 20 times greater than that of railway one. The report presents an analysis of the prospects for the use of alcohol gasoline in road transport.

The most common alternative fuels for automobiles are compressed natural gas, liquefied petroleum gas, and hydrogen. But when using water, there is a big explosion hazard. Therefore, hydrogen has not found wide application. Nowadays, the most promising direction is the use of alcohols as a fuel. Widespread use of alcohols is observed in the United States and Brazil. Ethanol is widely used in France, Germany and Spain.

In all countries, gasoline that contains alcohol is indicated by “E” numbers, which describe the percentage of ethanol fuel in the mixture. For example, E5, E7, E10 can be poured into any car.

Ethanol has a high octane number and it is very easily manufactured and processed using a technique that is similar to producing alcohol. Ethanol is obtained from wood waste and sugar cane. It provides high engine efficiency and low emissions. Ethanol is a very renewable resource, which is especially popular in warm countries.

In Ukraine you can find alcohol-containing gasoline at various gas stations under the following names: A-95E Premium +, Hepard95, Innovative E95, EXTRA A-95, etc. In Ukraine the law does not require indicating the percentage of ethanol the fuel contains.

Experts say that it is important that bioethanol contains no more than 0.2% of water, as it seriously affects the quality of the fuel, especially during the winter. Ethanol is very hydroscopic and there is a theoretical risk that the engine can split the mixture into gasoline and water-alcohol mixtures. And as a result, the following problems might be observed: excessive fuel consumption, detonation, ignition failure. Ethanol is an excellent solvent and oxidizing agent, here is why ethanol in gasoline can damage gaskets and other plastic parts of the car. To avoid this, stainless steel should be used. One of the most important performance indicators of ethanol is corrosiveness. Ethanol is a strong solvent and it can erode rubber and plastic parts of the fuel system. In order to avoid this, it is necessary to use a special additive, which can increase acid pH.

To obtain objective information on the consumption of blended fuel, the tests have been carried out on a VAZ-2115 vehicle using standard A-95 gasoline and alternative motor fuel INNOVATIVE E-95 with 35% of ethanol. USB digital oscilloscope Autoscope II and a computer with the appropriate software have been used as equipment. The oscilloscope is designed to pick up analog signals from the vehicle sensors and convert them to digital ones. The signals have been picked up from the speed sensor, injectors and air flow sensor. All readings have been recorded in real time on a computer and processed with the appropriate software.

The experiment has been performed as follows: The car in 4th gear accelerated to a speed of 40 km/ h and moved along the straight road for 1 minute. To eliminate the influence of slope and road irregularities, the car moved along the route with the same speed in two directions. Then the average results of two measurements have been taken. These measurements have been performed at such speeds as 40, 50, 70, 90 and 120 km / h, which doesn’t failure to comply with traffic regulations for public roads. As mentioned above, these tests have been carried out using two types of fuel such as A-95 and alternative motor fuel INNOVATIVE E-95.

From the conducted research it is clear that with the use of alcohol gasoline the fuel consumption increases by 15-20% compared with the use of traditional fuel. Ethanol is cheaper than pure gasoline, which means that a fuel that contains ethanol is cheaper.

The energy content of ethanol is about 33% less than pure gasoline. The impact of fuel ethanol on vehicle fuel economy varies depending on the amount of denaturant that is added to the ethanol. The energy content of denaturant is about equal to the energy content of pure gasoline.

Ethanol is an excellent fuel for internal combustion engines. Ethanol burns faster, allows more efficient toque development, and gives a vehicle increased power. Compared to gasoline, ethanol has poor cold-start properties due to its high heat of vaporization. Gasoline requires less heat to vaporise than ethanol and is blended with ethanol to improve its cold-start properties.

References

1. Гомонай В. І., Богоста А. С., Лобко В. Ю., Тацькар А. Р. Етиловий спирт як екологічне паливо для двигунів внутрішнього згорання. *Наук. вісник Ужгород. ун-ту*. Ужгород, 2011. №1(25). С. 82 – 87.
2. Емельянов В. Е. Автомобильный бензин и другие виды топлива: свойства, ассортимент, применение. М., 2005. 207 с.
3. Міхненко Є. Високооктанова кисневмісна добавка до бензинів. *Харчова і переробна пром-сть*. Київ, 2002. № 6. С. 14 – 15.

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DURABILITY OF ASPHALT CONCRETE. INFLUENCE OF AGGRESSIVE ENVIRONMENT

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The importance of this research indicates that roads are widely used all over the world They. are used to implement freight and passenger transportation throughout the country and beyond. The quality and convenience of such transportation depend on the road construction material. The durability of road-making materials has an important impact, first of all, from the viewpoint of economics, therefore the research is carried out in order to find ways for ensuring asphalt concrete quality and increase of its service life, and impact of aggressive environment on the durability of asphalt concrete. The goal of this study is to identify the influence of temperatures of aggressive environment for the durability of asphalt concrete.

Asphalt concrete is used for building roadbeds and base course layers of main streets, for constructing wearing course of roads, for overpasses and hole repairs, platforms for parking of cars and trucks, interior squares and road, pavements. Most motorways are built with asphalt concrete, because it has

numerous advantages comparing with over covering of roadways. The main difference of asphalt concrete from one with mineral viscosity is its thermoplastisity that is softness and reduction of hardness to 0,8-1,0 MPa when the temperature rises to 50 degrees above zero in boiling weather , and increasing of hardness strength to 10,0 -15,00 MPa during negative temperature in winter.

The granulometric composition of the asphalt concrete mixture determines the interstice presence of the mineral part of asphalt concrete, which in its turn determines the amount of bitumen in the mixture and interrelationship with extra sponginess. Optimal extra sponginess interconnects with viscosity of ready substance and complex of performance requirements factors such as transport, atmospheric, climatic. For example, low viscosity of bitumen requires high sponginess of asphalt concrete, which ensures rapid evaporation of light fractions from bitumen and as a result increasing resistance of operating factors. The complex of operational factors also impact on the choice of bitumen brand.

It is necessary to use bitumen with a lower viscosity in a cold climate than in hot one. The movement of heavy vehicles dictates the necessity of using high-viscosity bitumen.

Durability is a general quality of a material which can be characterized by the lifetime of a structure or material, the number of cycles to be distracted during cyclic loading, the number of freezing and melting cycles. Durability depends on the quantity of the applied tension, the environment temperature. The main feature of road construction materials is extremely difficult conditions of performance requirements. Along with the quiescently operating and cyclic tension, they suffer from the harmful effects of aggressive environment such as fuel oil materials, water, different liquids, salts, and agricultural roads suffer from the influence of mechanical fluids.

In real conditions, roadway covering meets a cyclical impact of a load that increases constantly. The frequency of tension maybe different depending on the intensity of the movement. In laboratory conditions, convenient load states are selected and the number of cycles is recorded, which the material in construction can be held without breaking or reaching the dangerous level of destruction. There are two basic modes of loading such as constant load with the amplitude of cyclic tension and need in a material of constant deformation.

In spite of the diversity of load modes, the mechanism of destruction in both cases is basically the same. The main difference in destruction of the mechanism is not due to the nature of the load, but the state of the material, different degree of glassy (the state of bitumen and polymers depends on temperature) or the type of their structure (crystallization or coagulation).

It should be considered the mechanism of destruction of asphalt concrete on an example of static fatigability. It is important to remember that under the action of a constant load time (σ = const) in the body there develops a creep, which is accompanied by the accumulation of odd deformations. If not to load for a long time, the process of accumulation of deformations in the coagulation systems will result in destruction.

Deformation of real bodies cannot be shown as strait a simple straight line, and the flow of real coagulation systems never ends. After the section of elastic

deformation, the growth rate of deformation becomes extinct, regulates, and deformation is carried out at a constant speed (the section of lineal increase of deformation during some time), and after reaching the limit meaning of deformation it ends with complete destruction of the system. This corresponds to the state when all flexible bonds are destroyed and the removal of structural elements of the system is so great, and the intermolecular connections are so reduced that the destruction becomes completely irreversible.

In real conditions, when considering the durability of materials, it is impossible to stay within the range of mechanical approach. It is necessary to take into account the effect of environment. The strength of the influence of environment on the durability of materials depends on the conditions of diffusion of the circumstances to the part of the sample, the source of the wetting process, the type of interaction of the environment with components of asphalt concrete.

The main feature of the destruction of materials in aggressive environment is the relationship between the speed of destruction and the rate of expansion in the sample material. As tension increases, the lifetime of the sample declines and the contribution of the environment decreases until destruction. Besides, the environment, even with a brief -term effect load, can contribute to the destruction. And if to take into account that the conditions of influence of the environment on the roadway covering are not limited during some time, at that time the environment is always in the interstices of organic concrete, and the short-term load "stretches" the material and creates more facilities for the destructive action of the environment. Cyclical deformation helps to enclose the environment in interstices and cracks with each new tension and reinforces the process of destruction.

References

1. Zolotarev V.A. Ispytaniya dorozhno-stroitel'nykh materialov. Uchebnoye posobiye V.A. Zolotarev, V A. Kosmin. –KH .: KHNADU, 2011. -368 s.

2. Gun. R.B. Neftyanyye bitumy / R.B. Gun. - M .: Khimiya, 1976. - 512 s

3. Kostin V. I. Shchebenochno-mastichnyy asfal'tobeton dlya dorozhnykh pokrytiy, Uchebnoye posobiye V.I. Kostin. - Nizhniy Novgorod, 2009. - 67 s.

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INFLUENCE OF AGGRESSIVE FLUIDS ON THE LONGEVITY OF ASPHALT CONCRETE

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Modern road construction is a huge system that includes many components. Each component has its own meaning and its own role in construction process and it is completely necessary to pay attention to all of this components. All roads are started from a project. During the project developing engineers make decisions

related to geometric parameters, technological processes, used material and technical sources.

There are two types of automobile roads and highways with hard surface: bitumen and concrete surface. The object of this work is the operation of bitumen surface. Such material constitutes compressed mixture of materials. Each material has its own features, advantages and demerits. Therefore the operation of bitumen surfaces must be investigated, its strains must be detected in order to find a way of its enhancement. The practical meaning of this investigation involves the search of material contrariety to aggressive fluids and the increase of its service life.

Asphaltic concrete is a material obtained by compression of heated asphaltic mixture of gravel chippings, sand, bitumen and mineral dust of detected quantity prepared in special mixers. If bitumen is replaced by oil tar or polymer then the material is called oil-tar concrete or polymeric concrete.

The most of automobile roads have the pavement of asphaltic concrete because this material has a number of advantages of other matter. The main difference between asphalt concrete and mineral concretes consists in their thermoplasticity. Because of this feature such materials can handle dynamic stresses from the vehicles much longer than mineral concretes.

The fractional composition of asphalt concrete determines the percent of pore spaces in material mineral part which in its turn determines the need of bitumen material. Optimal residual pore volume is associated with the viscosity of adhesion media and the complex of operation externalities. There we have transport externalities, atmospheric externalities and climatic externalities. For example, if bitumen has low viscosity, there should be the high pore volume ensuring fast vaporation of light bitumen fractions leading to the increase of material resistance against operation externalities.

The structurization of hot asphaltic concrete is deems to be finished after its compression and cool-down. In case of using cool asphaltic concrete it’s necessary to wait for a few hours before putting the surface into the service. The main asphaltic concrete features are strength, water-resistance, wearing-resistance and shear-resistance. It must be said that defined features significantly depend on material temperature and the environment temperature.

The stone matrix asphaltic concrete is a monolithic material made qfcompressed and cooled stone matrix asphaltic mixture.

The stone matrix asphaltic mixture is a mix of minerals, materials (gravel chippings, sand and mineral dust), stabilizing part and bitumen material added with determined interrelation and mixed in heated state.

The longevity is a generalized material feature which constitutes the service life of material or structure before the breakage form cyclic stresses. The longevity can be measured by cycles of the constant stress application and also by freezing/defrosting cycles. The longevity depends on the intensity of applied load and on the environment temperature. The data obtained as a result of the following tests with the number of cyclic constant stresses can be used in drawing of typical dependence diagram.

It’s impossible to pay attention only to the mechanical factor during the longevity investigation if we want to approach the test to real operation conditions.

We should consider the influence of fluids contacting with our material in real life. The degree of fluid influence on asphaltic concrete longevity depends on fluid diffusion to material sample, on moistening process and on the reaction of material components on one or another fluid.

First of all, we need to prepare material samples of 5 kg of asphalt mixture. The first mixture component is the mineral part (gravel chippings, sand and mineral dust). The mixture of gravel chippings and sand and bitumen should be put in heating box for heating to operation temperature (170-180◦C). Heated mineral part should then be mixed with mineral dust.

The stone matrix asphaltic mixture sould contain bitumen of 5-7% of the whole mixture mass. However, it's necessary to determine more accurate percent of bitumen content for preparing of the most qualitative mixture. Accurate bitumen content percent can only be determined by a testing method. Bitumen running-off tests were performed during the sampling process.

If the bitumen amount added to the mixture is too small gravel chippings will not be covered by bitumen causing the reduction of material strength ability. If the bitumen amount added to the mixture is too large the part of this bitumen will not be used in covering the mineral part and will run off the mixture.

The longevity of the asphalt concrete sample will be determined by the method of residual deformation collection. Samples were put under constant static load. These conditions were provided by means of longevity measurement presser. The process of longevity measuring with the influence of aggressive fluids foresees prior containment of samples in such fluids during one hour.

The algorithm of the test performing is next:

1) sample should be put on two hard supports;
2) the stem transiting the load on the sample should be set in its middle;
3) the load should be hanged on the presser;
4) sample should be contained under the pressure until the breakage moment.

The time for breakage should be fixed. After a few of such tests we can draw an influence diagram that will show the dependence of material longevity on bitumen volume and the type of aggressive fluid.

References

1. Золотарев В.А. Испытания дорожно-строительных материалов. Учебное пособие/ В.А. Золотарев, В А. Космин. –Х.: ХНАДУ, 2011. -368 с.

2. Технічні вимоги: ДСТУ Б В.2.7-127:2016 Суміші асфальтобетонні та щебенево-мастикові. – [Чинний від 07.01.2016]. – К. : Мінрегіон України, 2016. – 26 с.(Національний стандарт України)

3. Волянський О. А. Технологія бетонних і залізобетонних конструкцій/ О.А. Волянський. – К. : Вища школа, 1991. -168 с.

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INCREASING DURABILITY OF PISTON RINGS USING STEEL-MOLYBDENUM COATING DEPOSITED BY GAS-THERMAL METHOD

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A significant increase in the reliability and durability of machine parts is one of the main problems of modern engineering.

This problem can be solved by developing new technologies of processing machine parts that are subject to friction and depreciation.

The well-known strengthening technologies have some disadvantages, namely: strengthening can cause changes in the micro-geometry of parts, surface distortion and internal stresses, it also affects the operability of the machine and requires special and expensive conditions.

This scientific research is devoted to investigating the structure and features of steel-molybdenum coated piston rings.

In the course of investigation the coatings are applied to the piston rings made of high-strength cast iron. The piston rings, which are to be covered with the steel-molybdenum coating have been arranged into groups of twenty. On the working surfaces of the piston ring groups, a special groove is made under the coating to increase the adhesion of the coating to the substrate.

The technological process of applying the steel-molybdenum coating to the piston ring groups includes the following stages: preliminary cleaning, bead blasting treatment, spraying.

The bead blasting treatment deals with cleaning the surface of the base coat as well as increasing the total area of the adhesion sections between the substrate and the coating.

Molybdenum and steel wires are fed at a certain speed. The coating is applied through an electric arc spray process. The molybdenum wire is connected to the positive terminal of the power source and the steel wire is connected to the negative terminal.

The temperature of the piston rings during the application of the steel-molybdenum coating is 150 ° C. The coating thickness is 0.8 mm. After the coating deposition process is completed, a mechanical treatment should be carried out.

The structure of the steel-molybdenum coating has been investigating using a metallographic microscope with magnifications of X100, X300.

The microstructure of the coating has typical characteristics of gas thermal coatings layered with uniformly spaced pores.

The industrial etching of the samples has been carried out using Murakami's reagent (10 g NaOH, 10 g $K_3Fe(CN)_3$, 10 ml H_2O), which is used to reveal the structure of Mo and other refractory materials.

The structure of the steel-molybdenum coating after etching is shown in Figure 1. The microstructure of the coating is a combination of molybdenum (dark etching areas) and steel (light non-etching areas).

The large-dispersed component of molybdenum appears with a larger increase in the structure of the coating, apparently, due to the high rates of crystallization during the coating process. Besides the two main phases, the other structural components are observed in the coating, which are the products of the interaction of steel and molybdenum wires with oxygen and nitrogen, as well as products of interaction between molybdenum and steel in the process of plasma spraying.

The pore size of the coating is 5 ... $10*10^{-6}$ m, which is optimal for piston ring group operating with significant force and temperature loads.

The porosity of the coating (up to 12 %) provides an increased oil consumption of the rings, which positively affect both running-in procedure of the sleeve-the piston ring pair and the operation of the piston ring group.

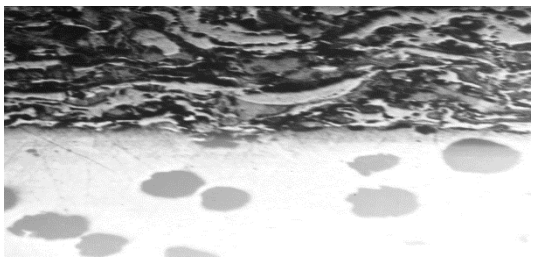

Fig. 1. The microstructure of steel-molybdenum coating after etching

The control of the adhesion strength of the steel-molybdenum coating to the substrate is carried out with a special device by twisting the piston ring group with simultaneous bending until the coating is peeled off. The angle of twist at which the coatings is peeled off is not less than 35°, which indicates a satisfactory adhesion of the coatings.

The results indicate that the steel-molybdenum coating is more wear-resistant than chrome plated one. The steel-molybdenum coating has a low coefficient of friction.

The investigation of the structure of the steel-molybdenum coating has shown that it has a heterophase structure. The porosity of steel-molybdenum coating provides an increased oil consumption of the rings. The coefficient of friction of the steel-molybdenum coating is 20% lower than that of the chrome plated coating for all the studied loads. The wear rate of the chrome ring is 2 times higher than that of the ring with a steel-molybdenum coating.

References

1. Антошин Е. В. Нанесение металлических и неметаллических покрытий посредством газотермического напыления. М., 2002. 147 с.

2. Катц Н. В. Металлизация распылением. М., 2006. 216 с.

3. Кудинов В. В. Теория и практика газотермического нанесения покрытий. М., 2000. 432 с.

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A HUMAN – RIDER OF MAN-MADE APOCALYPSE OR HIS VICTIM?

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About million years ago human started thinking to make his life easier. Life is developing and with it began to appear different technologies without which our existence not possible.

Technology – aggregate of facilities and receptions which help to create material values. Origin of development technologies is the first industrial revolution during which was transition from manual to machine work.

From origin of scientific and technological revolution to now, technologies reached a high level and have a big influence at our life. Thanks to high level of developing human has more time for favorites affairs. But infinite faith in that technologies have an infinite quantity of possibilities puts humanity in corner limiting in future prospects.

Using of modern devices, systems and all which refer to technosphere has advantages and significant disadvantages. So from here appear a lot of thoughts on the assessment of development modern technologies.

The use of modern devices, systems and all that belongs to the technosphere has both advantages and significant drawbacks. Therefore, from here pluralism appears in relation to the assessment of the development of modern technology and technology. One part of humanity believes that without the technosphere of human existence becomes impossible, very difficult and with the absence of any further development. The other - the development of technology leads to a large number of social problems: unemployment, disunity and high pressure on the human psyche. In addition to social problems, attention is needed to the problems associated with pollution of the atmosphere, soil and the ocean by waste from the disposal of various devices and machines. Therefore, the question now arises of the moral responsibility of engineers to humanity, because the moral neutrality of the technical activity over the years has long been lost.

The worldview of a modern person is controlled by two things: the world-wide system of integrated computer networks and television. Thanks to them, a person forms his attitude to the world, learns new information and is formed as a person.

In 1962, Joseph Lyclider published the work of the "Galactic Network", which resulted in the first concept of a computer network, whose model appeared in 1969. Today, the worldwide "web" is widespread in every country and has unlimited power over a person, creating information wars, or vice versa, helping to find a variety of information.

Today, the impact of social networks on the mental state of the person is of great importance and no one will bring Lyclider to account for being the pioneer of the Internet.

The German philosopher Alois Juning very aptly spoke about this, who believed that in the history of man, there was no such responsibility as now, for no man has ever had such, thanks to technology, power over all living on the planet. A

person can destroy all forms of life or cause very heavy damage. In fact, technology is becoming part of the evolution of mankind, which already leads to the solution of the question: does a person use technology, does the technique serve a person [2]?

In the 60s of the 20th century, in response to technological obsessions, environmental upheavals and protests came. The problem of pollution of the ecosphere is quite actual in 58 years, which means that there is no solution to the problem, even if there are a large number of reports by the scientists of the Roman Club that were aimed at the urgency of the threat to the entire planet.

And from here comes another problem: what period of time will suffice natural resources to ensure scientific progress? If you remove from the Earth everything that is there, the Earth itself will not remain. Already, there is a change in the climate, a lot of cataclysms caused by man-made human activity. Necessary measures and measures for the protection of nature are put forward only by some countries, while others ignore them. For example, a dump of ships in Bangladesh, where vessels instead of utilization, which requires a lot of money, are simply left at the landfill, which will pollute the countries closest to it and is a cemetery not only for maritime transport, but also for people who work there [2].

With so many problems from the outside there are problems inside the person. Depression begins, lack of desire for work, conversations, and the like. A man becomes a technogenic apocalypse on the surface only because he makes such a choice himself. This is followed by a succession of other, already psychological problems: a sense of uselessness and lack of perception of the world, emotional decline or crisis. Man has given more value to technology than to himself, his experiences and problems. Drawing on the work of S. I. Shcherbakova, one can conclude that the way of life in the conditions of socio-technological development of the world necessitates its constant socio-philosophical comprehension and correction, since such development, raising the standard of living, is accompanied by an increase in environmental threats. The degree of awareness of the contradictions of the global technogenic way of life depends on the possibility of sustainable development of future generations and the creation of comfortable conditions for their livelihoods [3].

The role of man in the world - the most important role. The role to be performed impeccably. Mankind needs to reflect on where our planet is rolling and what will happen to it in the coming years. Only a man is able to change the catastrophe of idyll, because man has power over the past, present and future.

References

1. https://ru.wikipedia.org/wiki/Техника

2. http://lifeglobe.net/entry/6245

3. Щербакова С. И. Социально – философское осмысление способа жизни в техногенном обществе. – Весник Вятского государственного университета. – №3. – 2018.

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COMMON-RAIL DIRECT FUEL INJECTION SYSTEM

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In modern world of automobiles such items as ecological requirements and fuel economy have a big importance. If we take to account these things in choosing of engine with a certain type of fuel, we can choose gas engine. However there is a relatively insecurity of exploitation, and necessity of refueling on gas station (in field it's dangerous and inappropriately). Also gas equipment has big sizes and weight (often spare wheel with normal size doesn't fit in a boot). But diesel motors have disadvantages too. In the end of 60s, engineer Robert Huber developed a prototype of the accumulate fuel system, then the technology was developed by Dr. Marco Ganser from the Swiss Technical High School Zurich. In the mid-1990s, Dr. Shohei Ito and Masahiko Miyaki of Denso Corporation developed the common rail system for commercial vehicles and implemented it in the ECD-U2 system, which was used on Hino Rising Ranger trucks. In 1995, they sold the technology to other manufacturers. Therefore, Denso is considered as a pioneer in adapting the common rail system for the necessities of the automotive industry. Therefore, Denso is considered as a pioneer in adapting the common rail system to the needs of the automotive industry. That system can be characterized by injection of fuel in cylinders under high pressure (up to 300 MPa).

So let's highlight the advantages and disadvantages of this system:

– injection under high pressure gives a decrease of fuel consumption (up to 15 percents in comparison with the traditional systems). Also this increases engine power almost on 40 percent;

– high pressure fuel pump has only one fuel line (simpler construction). Also in some pumps piston is switchable (one more way to reduce fuel consumption);

– lower noise of running engine due to better spraying;

– fewer vibrations. There used to be a lot of vibrations felt in traditional direct fuel diesel engines. Now those vibrations have been reduced with the common rail direct injection system;

– as result motor can run in wider range of loads. For understanding this thing we should remember feature of working traditional diesel fuel system, where amount of fuel depends on engine speed and angle of crankshaft (driving wheel of high pressure fuel pump shaft mechanically connected with a gear wheel of engine crankshaft);

– construction of one-channel high pressure fuel pump is simpler than construction of classic HPFP;

– better mileage. Since the common rail diesel engine provides more power, that means you will get better mileage on your fuel. As a result, your fuel economy will be better as well. This means less money spent on fuel when you're on the road;

– high quality requirements of fuel. It can be explained by expensive vehicle. Vehicles with a common rail diesel engine are going to be more expensive than those with the traditional diesel engine. If you're working for a company that

supplies you with the vehicle, then it is no sweat. But if it is a personal vehicle, then you may not want to spend the extra money;

– expensive parts. Since the common rail vehicles are more expensive, you can expect that replacement parts are going to be expensive as well;

– more maintenance. Common rail diesel engines will need more maintenance than a traditional diesel engine. Even if you do the maintenance yourself, it still takes more time, effort, and possibly expense.

And now let's observe the principle of its operation.

Solenoid or piezoelectric valves make possible fine electronic control over the fuel-injection time and quantity, and the higher pressure that the common rail technology makes available provides better fuel atomization. To lower engine noise, the engine's electronic control unit can inject a small amount of diesel just before the main injection event ('pilot' injection), thus reducing its explosiveness and vibration, as well as optimizing injection timing and quantity for variations in fuel quality, cold starting, and so on. Some advanced common-rail fuel systems perform as many as five injections per stroke.

In common-rail systems, a high-pressure pump stores a reservoir of fuel at high pressure – up to and above 2,000 bars (200 MPa; 29,000 psi). The term 'common rail' refers to the fact that all of the fuel injectors are supplied by a common fuel rail which is nothing more than a pressure accumulator where the fuel is stored at high pressure. This accumulator supplies multiple fuel injectors with high-pressure fuel. This simplifies the purpose of the high-pressure pump in that it only needs to maintain a target pressure (either mechanically or electronically controlled). The fuel injectors are typically ECU-controlled. When the fuel injectors are electrically activated, a hydraulic valve (consisting of a nozzle and plunger) is mechanically or hydraulically opened and fuel is sprayed into the cylinders at the desired pressure. Since the fuel pressure energy is stored remotely and the injectors are electrically actuated, the injection pressure at the start and end of injection is very near the pressure in the accumulator (rail), thus producing a square injection rate. If the accumulator, pump, and plumbing are sized properly, the injection pressure and rate will be the same for each of the multiple injection events.

Due to the high precision of the electronic control and the high injection pressure, the fuel in the engines occurs with high recoil. Because of this, fuel consumption and exhaust emissions are reduced. Common rail system leads to the development of diesel engines, because environmental standards for toxicity are rising and contributes to the further development of the fuel system.

References

1. Казедорф Ю. Системы впрыска дизельных двигателей. СПб, Москва, 2012. 320 с.

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PHYSICO-MECHANICAL PROPERTIES OF ASPHALT-POLYMER CONCRETE

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Traditional asphalt concrete with modern loads on the axle of vehicles and the intensity of traffic on the roads of higher categories cannot provide the durability of the upper layers of road coverings. The use of polygonal and crushed stone mastic asphalt concrete to some extent solved this problem ten or fifteen years ago. But the development of motor transport causes the need to intensify: the resistance of the coatings to the formation of irreversible deformations (shiftiness) at high temperatures; crack resistance at low negative temperatures; resistance against excitation, peeling and pouring under the influence of water; resistance to aging, tired strength.

Based on the main principle according to which the quality of asphalt concrete is determined mainly by the quality of bituminous binders, researchers and road users of many developed countries came to the conclusion that it is expedient to replace ordinary bitumen with bitumen modified by polymers. Beginning in the 1960's, this direction of bituminous technology developed rather intensively, but unsystematically: a wide variety of polymers (in the first stage of their waste production) was used and was looking for technologies to combine them with bitumen. Only at the end of the last century there were formulated the basic principles of obtaining bitumen, modified by polymers (BMP) [4, 135−136].

They are reduced to the following: the effective modifiers of bitumen are thermoelastoplastic polymers; replaced in various asphalt concrete of ordinary bitumen with bitumen. This addition of polymers increases their durability; in the aspect of providing the desired level of quality. BMP perspective is the direct introduction of polymers into bitumen; selection of components of the BMP which should take into account the ratio of parameters of its quality and value. Taking into account the importance of the issue for the development of the road sector in the EU countries (2005) and in Ukraine (2007) [1, 6−7] there were developed state standards for these binders. More than 10% of bitumen used in industrially developed countries contains polymeric additives.

To study the influence of the properties of bitumen, modified by polymers, on the physical and mechanical properties of asphalt concrete, asphalt polymers of ‘B’ type were investigated. The results of the tests show (Table 1) that asphalt polymer composites compared with asphalt concrete have higher strength values at temperatures of 20 ºC and 50 ºC, lowered by temperature sensitivity [2, 24−25]. The use of polymeric additives reduces compressive strength and tensile strength at 0 ºC, increases adhesion at displacement. At close values of average density and final porosity water saturation of asphalt concrete is higher than asphalt polymer concrete. So, the pore structure of asphalt polymer concrete has a greater number of closed pores contributing to higher frost resistance.

Asphalt concrete modified by bitumen polymers have high coefficients of water resistance, which is explained by good adhesion properties of bitumen-polymer binder. Also, in [3, 67−68] it is noted that at positive temperatures in the asphalt polymer concrete has higher modulus of elasticity. At the same time, at higher temperatures, higher deformation and cracking properties of the material are observed. All this will lead to an increase in the durability of the road pavement asphalt-polymer concrete.

Table1 –Physical and mechanical properties of asphalt concrete

Indicator	The value of the indicator for asphalt concrete on the binder		
	BND 90/130	BND 90/130 + DST	BND 90/130 + APP
Compressive strength, MPa at a temperature of 50 ºC 20 ºC 0 ºC	 1,3 3,1 10,8	 1,6 3,2 8,2	 1,8 4,7 9,4
Strength at split, MPa, at 0 ºC	5,72	4,27	5,08
Water resistance coefficient	0,89	0,96	1,0
Coefficient of long water resistance	0,76	0,81	0,93
Final porosity,%	2,97	2,69	2,55
Water saturation,%	2,76	1,79	1,76
Average density, kg / m3	2,35	2,36	2,37

The results of researches of physical and mechanical properties of asphalt concrete on bitumen modified by polymers are presented. It has been shown that polymer modification improves the properties of asphalt concrete, but due to the high cost of the modifier, an increase in the cooking temperature and an increase in the optimal amount of binder cost of asphalt polymer will significantly increase. Therefore, in each case, the use of this or that type of polymer and its amount is expedient to calculate the cost-effectiveness of its use due to the increased durability of asphalt polymer concrete coating.

References

1. Бітуми дорожні, модифіковані полімерами. Технічні умови. ДСТУ Б В.2.7-135:2014 – К, Мінрегіонбуд, 2007. 22 с.

2. Галдина В.Д. Влияние полимерных добавок на свойства битума и асфальтобетона / В.Д. Галдина. Вестник СибАДИ, вып. 2 (12). 2009. 32-35с.

3. Золотарев В.А. Свойства асфальтобетонов на основе битумов с большим содержанием полимера / В. А. Золотарев, А. С. Лапченко в кн. В. А. Золотарев. Битумы, модифицированные полимерами и добавками. Избранные труды. Том 2. Санкт-Петербург, 2013. 100-107с

4.Золотарев В.А. Особенности структуры и свойств битумов, модифицированных полимерами типа СБС. Харьков, Изд-во ХНАДУ, 2003. 211-228с.

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POLYMER COMPOSITES BASED ON EPOXY RESIN AND PLANT WASTES

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Introduction. The development of the modern building industry, agriculture and other industrial branches are hardly connected with polymer composition materials (composites) [1]. At last years the polymers with wood high dispersive materials attract more and more attention of the scientists and engineers [2-4]. The widening of production of such materials is due to the gradual decreasing of the natural purveyance and cheapness of the wood wastes. Besides of the composites with wood wastes are characterized with high technical characteristics and often are even better than the analogues made from poor woods. The purpose of our work is the obtaining of ecologically poor polymer composites filled with natural plant wastes, namely yucca.

Experimental. In our case we used the yucca - subtropical plants dry wastes dispersive fibers (<50 mcm), which have very thin needles face. Using of yucca wastes in composites is based on application namely of needle like structure of this plant [5]. The epoxy resin ED-20 with hardener polyethylene-polyamine as hardener is used in our composites. There were obtained the composites with different content of ingredients. The moulds used in our technology for formation of samples for physical- mechanical and other properties were selected in accordance with standards using fluoroplastic material. At the end of hardening (after 24 h) the samples were removed from moulds and are heat-treated in the thermostats during 2 h under 80 °C.

Results and discussion. The following characteristics of the obtained composites were testified: density, mechanical strengthening at pressing, softening temperature by special method and water-absorption. Obtained results are presented in the Table 1and Table 2.

Tables 1 and 2 data show that first of all the composites containing 40-50 wt% of the filler with middle sizes about 50 mcm are characterized with more high characteristics in comparison with analogues with more high dispersive fillers. This result may be ascribed to present of more long needles in first composites, than in second one. On the second stage we have preliminary modified the filler particles by 5 wt % of ethyl-silicate using the reaction of salinization. The end product of this reaction was investigated by use of FTIR. Obtained by this way modified filler was introduced to the epoxy resin, which was hardened in the regime described above. The technical characteristics of the composites with modified fillers are presented in the table 3.

Tab 1 - The technical characteristics of the composites based on epoxy resin and yucca dry wastes (average length of the filler particles is about 50 mcm)

N	Filler (wt%)	Density, g/cm^3	Strengthening at pressing, MPa	Softening temperature, °C	Water-absorption, %
1	40	0, 94	66,2	185	1,5
2	50	0,87	60,6	170	0,16
3	70	0,82	54,8	160	2,5

Table 2 - The technical characteristics of the composites based on epoxy resin and yukka dry wastes (average length of the filler particles is <50 mcm)

N	Filler (wt %)	Density, g/cm^3	Strengthening at pressing, MPa	Softening temperature, °C	Water-absorption, %
1	40	0,90	58,7	180	2,07
2	50	0,99	63,9	170	3,17
3	70	0,89	51,4	170	5,48

Table 3 - The technical characteristics of the composites based on epoxy resin and yukka dry wastes modified by ethyl-silicate

N	Filler (wt%)	Density, g/cm^3	Strengthening at pressing, MPa	Softening temperature, °C	Water-absorption, %
1	40	1,10	77,6	180	1,80
2	50	0,98	79,3	190	2,56
3	70	1,80	76,9	170	3,90

In accordance with the table 3 data the strengthening of the composites containing the modified filler is rather high than for analogues containing unmodified same filler. This parameter depends on the content of the filler. By more high values of strengthening are characterized the composites containing 40-50wt% of the modified filler. These composites are characterized with high softening temperature (i.e. high thermal stability). It is clear that improving of technical characteristics of composites with modified fillers is due to molecules of ethyl-silicate, which are displaced on the surface of needle like yukka fillers and active influenced on the hardening reactions in the composites in result of which the interactions reactions between filler particles and epoxy-molecules enhance and

the compatibility of composite components increases. Namely the last fact is responsible in the increasing of waterproofing of the composites. It is well known fact that after increasing of the dispersive filler concentration the water absorption of polymer composites enhances. The experimental data shows that because of the modifier action the increasing of the water-absorption in composites at increasing of the filler concentration is slower than in case of analogues without unmodified filler.

Conclusions. Application of dry wastes of the plant yukka as fillers in the composites based on epoxy resin leads in general to obtaining of material with high light weight, low water absorption and good mechanical and thermo stable properties. For example, the composites containing 40-50wt% of yukka are characterized with following parameters: strengthening (at pressure) 60-66 MPa, thermal stability 170-185 °C, water-absorption 0,16-1,5 %. Introduction to the composites of the same filler particles modified by ethyl- silicate improves some properties of the composites in comparison with analogous containing the same, but unmodified filler to some extent (especially strengthening up to 77 MPa). Improving of the technical characteristics of composites containing modified by ethyl-silicate filler in comparison with analogous materials with unmodified one is due to enhancing of the ingredients compatibility and increasing of interaction between them.

References

1. Chemistry and Chemical Technology / J. Aneli, O. Mukbaniani, E. Markarashvili, G. Zaikov, E. Klodzinska. - 7 (2), 141-145, 2013.
2. Wood - Polymer composites / Ed. by K. O. Niska and M. Sain. - Tokio, 2012.
3. Klesov A. Wood - plastic composites / A. Klesov // J. Wiley& sons, 2007. - 698 p.
4. Clemons, C. D. Wood-plastic composites in USA / C. D. Clemons // Forest product Journal, 2002. - 52 (6).
5. Aneli J., Shamanauri L., Aneli J. (junior). Polymer conmposite. Georgian Patent. P6127, 2014. Tbilisi, Georgia.

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THE INTELLIGENT WINTER ROAD MAINTENANCE MANAGEMENT

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An important part of the maintenance activities of the road administrators is winter road maintenance which is necessary to enable road transport during winter. Delay of possible intervention could directly threat the safety or the flow of traffic. On the other hand, any unnecessary interventions are of significant costs. For this reason, these interventions should be optimized at a time and place when it is convenient.

The effective management of winter road maintenance is only possible on the basis of relevant information about current and future road weather and surface conditions on specific road sections. Such information together with information about movements and performed maintenance of each vehicle in real-time create the basis for support of winter maintenance decision process and for efficient fleet management. The result of the intelligent winter road maintenance is thus effective winter maintenance with cost saving as well as increased safety on the roads, increased flow of traffic and decreased environmental negative impacts in winter time.

The aim of the intelligent winter road maintenance management is to give the dispatcher and driver spreaders a set of intelligent tools that will help them optimize their work.

The main task of a dispatcher is to manage maintenance – continuously monitoring development of weather and road weather conditions, deciding on deploying maintenance crews in certain parts of the given region and determining appropriate technology and intensity of maintenance (e.g. technology used, amount of spreading).

The dispatcher is also responsible for keeping records during maintenance keeping the so-called winter maintenance diary and record performed procedures. Here it is important to have an appropriate software tools for the dispatcher that will facilitate these activities in order to devote maximum time to maintenance management.

The driver is equally important, because he is responsible for quality of the actual performance of maintenance in the field. To achieve high quality and efficiency of winter maintenance it is necessary to have relevant data about the weather and road surface conditions. They can be obtained from various sources.

The most important source of real time meteorological and pavement data are road weather stations ensuring automatic data collection and transmission. They are essential tools for remote monitoring of weather conditions on the roads. Generally there are two basic types of locations for the RWS: representative and critical. Stations in the representative location can provide perspective of the situation, which can be applied to a relatively larger part of the area (road network). Stations in the critical location are used mainly for early detection of adverse weather conditions in the region (generally they are set up at the coldest points of the roads and bridges).

The RWS are equipped with variable set of sensors for measuring of meteorological date (air temperature, relative humidity, wind speed and direction, precipitation, visibility, remote sensors and others). They are also equipped with road sensors connected to the station for measuring road conditions (e.g. road surface temperature, road surface status - dry, wet, moist, snow, ice; water layer thickness, freezing point, salt concentration, friction and others). Traditionally, road sensors are embedded in the pavement (typically two pavement sensors in a location).

There are promoted contactless sensors, which are just “looking” on the road surface as a camera, located on the side of the road. A novelty of the last year is a Swedish provenance weather camera that scans the road surface and classifies its

status in the two-dimensional perspective. It is a revolutionary advancement. Some road weather stations are equipped with overview camera for visual monitoring of road status and actual weather (add-on night vision). The RWS also provide early warnings about dangerous situation on the road (such as frost, ice, mist, wet or snow-covered surface) and allow direct control of connected variable message signs (VMS) warning drivers of impending danger. In some cases, installed defrosting sprays may be activated, when it is necessary. Static RWS are standing isolated only in selected locations on the road network and there are no data between them. A maintenance vehicles and inspection personal vehicles with additional meteorological sensors thus actually become the mobile road weather stations. The dispatcher needs software support for proper and effective management of winter maintenance.

Road weather information system (RWIS) is a software tool which collects all relevant available data which can be used by dispatchers to support decision making in winter road maintenance management. More convenient are web systems which allow internet access from anywhere, possibly even from a mobile device. Another important source for RWF model should be GPS data from the spreaders about performed maintenance in the recent past. The model itself predicts the meteorological weather developments and can predict the emergence of ice on the selected road section.

References

1. TP 10/2008, Intelligent transport systems and transport technological devices. MDPT, SR, Bratislava 11/2008.

2. TP 09/2008 Devices, infrastructure and systems of road communications technological equipment. MDPT, SR, Bratislava 11/2008.

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ANALYSIS OF EXISTING CONTROL SYSTEM OF LOCAL AUTOMOBILE ROADS

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Good road condition means good economic condition because each dollar approximately means plus $2.5 to GNP.

Upon modern road construction reformation conditions, especially general roads decentralization. The problem of operation maintenance control and repair work planning on local roads. National system SUSP (surface condition control system) «functions» on national roads. Speaking about other roads, situation requires the integration of efficient local road network condition control system.

Chronologic development of control systems in USSR is started from explaining differential service ranges of road dressing and surfaces considering vehicle density, traffic concentration and climatic conditions. Such system has a strain. It did not consider current operational state of individual road sections

leading to improper involve of maintenance measures to take, The problem of surface state assession, repair works volume prediction and economic explanation of reasonability of measures was solved by National Institute DerzhDorNII. The research basis is pack of data collected from 1965 to 1969 on roads with advanced surfaces.

Prediction of operation state changes during the operation cycle was proposed by S.S. Kizima [2]. Repair work planning system was developed basing on surface evennes changes during the operation. However, Kizkma's system did not include gradual operarion state changes. In foreign countrys, such systems were significantly developed in 70s of XX century And were called (Pavement Management System – PMS), nowadays we can name the most efficient ones: HDM –4 (France), PCI (USA), ABDD «DOROGA» (Russian Federation and countrys from the Customs Union), WLPPM (United Kingdom) [3,1]. From XX century the methods of automation and robotic application are developing, the problem of neural network integration in difficult control processes becomes actual. If you reference to national programs, now Ukraine moves in direction of decentralization and integration of single geoinfoarmtional system of national automobile roads which will combine SUSP, Electronic road passport, automatic bridge control systems and other automation programs. It's obvious that this direction will increase the efficiency of national costs use, their proper distribution, all this will lead the roads to better technical condition.

Today, existing national system SUSP created in 2001 for national roads (46.985 km) should be functioning only with full pack of data in 2018.

- Administrative data
- Vehicle density
- Geometrical parameters of major elements
- Road dressing
- Axis and profile
- Breakage of road dressing surface;
- Road dressing surface evenness
- Road dressing strengh
- Automobile wheel cohesion with dressing surface;
- Financing level.

However, use of such system for local roads (123 thous. Km) cannot always be proper considering limited financing sources and significant cost for collecting full pack of data, requirements of high-qualified personnel in local road departments. Basing on the analysis of working systems of local road control, it's necessary to perform a disassembly of control system for local road network.

References

1. Кизима С.С., Андрєєв С.І. Оптимізація планування робіт по ремонту нежорстких дорожніх одягів. Автомобільні дороги і дорожнє будівництво. Вип. 41. – Київ, Будівельник. 1987. 29 – 35с.

2. Прусенко Е.Д., Демишкан В.Ф. Основные направления совершствования методов управления состоянием автомобильных дорог. *Сб. науч.* трудов XJ.Харьков. Знание, 1998.39-47с.

3. Закордонець Ф.С., Андрєєв С.І., Павлюк Д.О., Кизима С.С. Про деякі аспекти застосування моделі HDM в Україні. Автошляховик України, К.1999, № 2. 40 – 41с.

4. Посилання за електронним джерелом http://www.ukrgeo.ua/data/info_reform.docx

5. Інструкція до формування банків даних для системи за результатами натурних обстежень автомобільних доріг (СУСП). Київ. 2001.

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HYBRID CAR PROBLEMS

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To analyze the problem, we first derive the definition of a hybrid car. A hybrid car is a car that uses more than one energy source to drive the drive wheels, most often it is an internal combustion engine paired with an electric motor. Depending on the make and model, there are different wiring diagrams for power units to each other and driving wheels such as serial where the internal combustion engine is connected only to an electric motor and performs a generator function, parallel to where the internal combustion engine and electric motor are connected to the drive of the driving wheels by means of a differential and can work both together and separately, depending on the mode of operation and series-parallel where the engine and electric motor are connected both in series and in parallel, depending on the mode of operation of the power plant.

After a brief introduction to the topic, we will proceed to the analysis of the problems that the driver may encounter when buying or operating a hybrid car. The very first problem arises before buying a hybrid car, the price of such cars is much higher than cars that have the same technical characteristics as a hybrid car. A hybrid car is a more environmentally friendly and economical car with a traditional engine, but not every car enthusiast is willing to overpay the original cost of the car. In the more developed countries of the world, the state helps when buying electric vehicles and hybrid cars with cash payments for purchases or gives various types of benefits for drivers. It sounds good, but Ukraine is not included in the list of these countries, therefore hybrid cars are not frequent guests on our roads.

After buying a hybrid, their owners face the problem of maintenance. Repair of this car is more expensive due to the more complex design of the power plant. There is also a difficulty in finding a service station that can work with this type of car because of the small number of these cars. Not all stations have a desire to train staff for such work. In addition to the engine, you need to service a high-voltage battery, which service is performed exclusively by a specialist in high-voltage technology. This also requires the purchase of an expensive tool for maintenance and repair of hybrids.

In winter, a hybrid car does not suffer as much as an electric car; even without a heated garage, the driver will not have any particular difficulty in starting the engine as the engine starts with a separate battery like in a car with traditional internal combustion engines.

Then, with a long service life, a problem with a high-voltage battery is brewing, they have a limited resource and its replacement is expensive, hence the problem with buying and selling a used car. The buyer may not know about the existence of this problem, and buying a high-voltage battery soon after buying a "new" car will not please him much.

The above problems, such as the cost of the car, the cost of maintenance and the cost of replacing the high-voltage battery, mainly rest on the client's solvency, but do not forget about the advantages of hybrids.

The main advantage of the hybrid mentioned in the drawbacks, namely, saving on fuel, thanks to the energy recovery system during braking and the ability to turn off the engine in start-stop mode, thereby preventing the engine from operating at low loads, at which engine are not efficient and have high fuel consumption "Corks" in large cities are not uncommon and in these cases the hybrid shows its tangible efficiency.

The next no less important fact is the increased ecology of hybrids, especially when the requirements for a car regarding its environmental friendliness become tougher at the legislative level every year. In most European countries, if a car does not meet environmental standards, it is open for recycling. Thanks to a more rational use of fuel, carbon dioxide emissions are reduced, perhaps when most drivers switch to hybrids and electric mob, then society will feel a significant difference.

Hybrids also have an advantage in the reserve of the car without refueling and are not inferior in traction-speed characteristics of cars with a traditional engine, every year the model range of hybrid cars and electric cars is replenished and their number is rapidly gaining momentum.

From the above factors we can conclude that the hybrid is a more modern car in all respects and the future behind them, the only problem is the solvency of drivers, which every year becomes less relevant as with the development of technology and the expansion of infrastructure hybrids become more affordable.

References

1. Синергетичний автомобіль. Теорія і практика / О.В. Бажинов, О.П. Смирнов, С.А. Сєріков, В.Я. Двадненко. Харків, 2011. 236 с.

2. Гібридні автомобілі / О.В. Бажинов, О.П. Смирнов, С.А. Сєріков (та ін.). Харків, 2008. 327 с.

3. Car Reviews [Электронный ресурс]. – Режим доступа: http://www.edmunds.com/chevrolet/volt/2011/comparison-test.html.

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BITUMEN EMULSIONS IN ROAD CONSTRUCTION

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Bituminous road emulsion is an artificial building material that has wide application in road construction. It is a homogeneous high flow fluid. It is produced by mixing bitumen with an aqueous solution of emulsifier. Bitumen emulsion helps to reduce the amount of binder from 20-40 %. Thanks to the use of BE in the composition, it is possible to extend the road-building season. In the preparation of EB, two types of cation-and anion-active emulsifiers are used. Due to the dissociation of the polar surfactant group, the phase fraction (bitumen drop) acquires an electric charge (with an anionic emulsifier - negative, with a cationic - positive). One disadvantage is the high price of surfactants, which is why manufacturers often resort to finding cheaper ways to obtain a substance that performs this function. The most high-quality emulsions are produced using colloid mills (average droplet diameter of 3-4 μm), lower-quality emulsions are obtained with mechanical stirring at a speed of 1500 min^{-1} and emulsification time of 10-40 min (average diameter of 12-18 μm), even coarser emulsion they are produced by bubbling and using the AD-2 acoustic disperser (average diameter over 50 microns). The production of emulsions is carried out using many joint units and aggregates of an asphalt concrete plant using special equipment.

As an example, take a hot and cold mix of asphalt concrete. A lot of energy goes to heat the sand and aggregate, due to the fact that these materials are wet from contact with water (rain) or moist air. Partly at the factories, materials are stored in open form, which leads to filling with water. The amount of water depends on the porosity and size of the aggregate; the water content varies for the aggregate from 0-6 % to 10 % for sand. Reducing energy consumption can be achieved on the basis of the choice of aggregate, sand and their heat capacity. The percentage of water in the material increases the energy consumption of the asphalt plant by ~ 13-15 %, depending on the specific heat capacity of the aggregate. The disadvantage of hot mix is low air temperature, weather conditions, time of year and geographic location. These factors affect the laying of asphalt mix. In this case, a bitumen emulsion is used, which replaces the process of heating bitumen and aggregate, thereby saving time and energy for the preparation of the mixture. Cold mixtures can be applied in unfavorable weather conditions. The mixture can be transported over long distances, there is no limit in laying time on the road. Cold mixture can be obtained both at the work site and at the asphalt plant without heating the mixture. For work with this mixture used construction equipment as well as for the hot mixture (asphalt paver and others). The cost of construction with an emulsion can be cheaper by about 5-6 % compared to conventional bitumen [1, 1-6]. The enterprise of road facilities must ensure the implementation of measures to protect the environment and the rational use of natural resources. One of the main production processes in the road sector is the production of bitumen emulsions. In order to maintain environmentally safe conditions during

their production, the following measures must be taken: - the use of emulsifiers, which have a sanitary certificate and are recommended for use:

- the use of emulsifiers, which have a sanitary certificate and are recommended for use;

- Sealing the components and connections of the bitumen preparation unit and its correct operation to reduce hydrocarbon emissions;

- provision of adjustment and adjustment of the heat generator to achieve greater completeness of fuel combustion and reduce emissions of hydrocarbons, carbon monoxide, soot, and the like;

- the use of sealed containers and pipelines (for example, plastic) for the storage and transfer of hydrochloric acid to reduce its loss due to evaporation;

- the use of closed containers for the preparation of an aqueous solution of emulsifier and mechanical mixers to prevent the emulsifier vapors and hydrochloric acid from entering the atmosphere;

- the use of special settling tanks for drainage of wash water and residues of an aqueous emulsifier solution;

- neutralization of water in the settling tank with alkali;

- embankment of the territory of an enterprise or a shop with protective shafts to prevent spreading of the emulsion in case of its accidental release;

- ensuring technological control over environmental safety during production [2, 1].

References

1. Hot Mix Vs Cold Mix : Economic Comparison : HINDUSTAN COLAS LTD, 2011. URL: http://www.osicltd.in/Content/images/PDF/Comparison_Cold_ Mix_Vs_Hot_Mix.pdf, 1-6 с.

2. Транспортна екологія : Екологічні вимоги до підприємств дорожнього господарства. URL: https://pidruchniki.com/92921/ekologiya/ekologichni_vimogi_pidpriyemstv_dorozhnogo_gospodarstva, 1 с.

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CONCEPT AND CLASSIFICATION OF STOCKS IN THE SUPPLY CHAIN

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Stocks are tangible resources (means of production, consumer items, other values) necessary to provide expanded reproduction, service to the intangible production sector and to meet the needs of the population stored in warehouses or elsewhere for the purpose of their subsequent use.

The notion of stock permeates all spheres of material production, as the material flow in the path of movement from the primary source of raw material to the final consumer can accumulate in the form of stocks in any area. And inventory management at each of the sites has its own specifics.

Despite the fact that holding stocks involves certain costs, entrepreneurs are forced to create them. [2, 114-129].

There are many classifications of stocks. In the scientific work of Y. Kricavsky and S. Kubiv on the theory of inventory management the following types are distinguished:

1. Place of production in the logistics chain: inventory of material resources; stocks of incomplete production; stocks of finished products; tare supplies; stockpile of return waste.

2. Activities based on basic logistics:

- stocks in supply – material resources that are in logistics chains from suppliers to the inventories of material resources of the producer, intended to provide production of finished goods;
- industrial stocks – stocks of material resources and work in progress, which came to consumers and were not processed, they are located in enterprises of all branches of the sphere of material production, intended for industrial consumption and allow to ensure the continuity of the production process;
- commodity (sales) stocks – stocks of finished goods, transport stocks, which are in the warehouses of finished products of the manufacturer and in the distribution network, designed to meet the demand of consumers (sales);
- aggregate inventory – it is the object of optimizing the logistics management from the position of total costs, and contain all the above types of stocks: stocks in supply, production stocks and inventories.

3. For involvement in integrated logistics activities:

- warehouse stocks – stocks of finished goods, which are located in warehouses of different types and levels of certain parts of the logistics system, both intra-firm and logistic intermediaries;
- transport stocks (stocks on the road, transit stocks) – stocks of material resources, work in progress or finished goods, which are in the process of transportation from one part of the logistics system to another or within a single link of the logistics system;
- supplies of goods processing – a specific stock, which is formed without a logistical storage operation (e.g., handling in one transport unit from one kind of transport to another, consolidation, sorting, etc.).

4. For functional purposes (for industrial and commercial stocks):

- current (regular) stocks – designed to ensure the continuity of the production and sales process between two regular supplies, generated in the event of uneven and regular supply due to inconsistencies in supply and one-time consumption;
- insurance (guarantee) stocks – intended for continuous supply of the consumer in the unforeseen circumstances: the variation in the frequency and magnitude of supply parties from the planned changes in the intensity of consumption, delays in deliveries on the road, failures in production and technological cycles, etc.;
- preparatory (buffer) reserves – this is a part of the production (commodity) stock, intended for the preparation of material resources and finished products for industrial or personal consumption;

- seasonal stocks – these are stocks of material resources and finished products that are created and maintained under the condition of apparent seasonal fluctuations in demand or the nature of production, transportation;

- stocks of promotion of finished products – these are formed and maintained in distributive channels for rapid reaction to the company's marketing policy of moving goods to the market;

- outdated (non-liquid) stocks – these are formed due to differences in logistics cycles in production and distribution with the life cycle of goods, as well as due to deterioration of the quality of goods during storage.

5. For belonging to a chain of logistics chain or logistic intermediaries the following stocks are distinguished: stocks from suppliers; stocks of consumers; stocks at resellers; stocks by intermediaries of physical distribution. [1, 316-345]

Classification of stocks of the enterprise on the basis of these features is rather conditional and is intended mainly for the structuring of data in the implementation of control.

References

1. Економіка логістичних систем : монографія / за наук. ред. Є. Крикавського та С. Кубіва. — Л. : Вид-во Над. ун-ту “Львівська політехніка”, 2008. 596 с.

2. Крикавський Є.В. Логістика. Основи теорії: Підручник – Львів: Національний університет «Львівська політехніка» (Інформаційно-видавничий центр «ІНТЕЛЕКТ+» Інституту післядипломної освіти), «Інтелект-Захід», 2004. 416 с.

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THE PROJECT OF THE CITY SERVICE STATION WITH A PRODUCTION COMPLEX OF MAINTENANCE AND REPAIR OF POWER SYSTEMS

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The main task of motor transport is the qualitative and timely satisfaction of the needs of the national economy and the population in transportation at the possible minimum costs of material and labour resources.

Together with the development of public road transport, the number of private cars is increasing every year. The increase of the fleet of cars also considerably outpaces the growth of RTE, which by virtue of this does not completely provide the need for repair services. Support of the fleet of these cars in a technically good condition requires further improvement and development of the production and technical base of auto maintenance services – service stations (SS), petrol stations (PS), parking lots and other enterprises.

Construction of new enterprises, expansion, reconstruction and technical re-equipment of existing enterprises of motor transport must meet the modern

requirements of scientific and technological progress and the conditions for the transition of the economy to market relations.

Therefore, in the diploma project, the tasks of making a technological calculation of the enterprise, planning and design solutions of the building were developed, a post for maintenance and repair of car power systems was made. During the work lambda regulation was investigated and its influence on the work of the car engine and the environment, protection of labour was also studied. The requirements of normative documents, ecological safety, maintenance of territories, etc. are given.

The diploma project also has a graphic part the general plan of the enterprise, the production building, the post of servicing power systems of the car, the automobile engines system of power, the structural scheme of the power systems of the car, the scheme of the lambda of regulation.

Due to the fierce competition and the increasing environmental standards, automakers are forced to constantly improve their cars. Engines equipped with a carburetor no longer provide the desired economy, eco-friendliness and power of the car. This is due to the inability to accurately adjust the carburetor in different modes.

Therefore, at the earliest opportunity, manufacturers introduced an electronic injection control system under the control of an 8-bit microprocessor with a frequency of 4 MHz in 1979. This happened 8 years after the appearance of the world's first 4-bit microprocessor 4004. At the moment, the engine management system was quite complex in terms of the number of sensors and actuators, complex mathematical models written in the form of a control block program.

The transition to a more precise control system became possible not only due to the appearance of the microprocessor. The experience of building automation systems at industrial enterprises accumulated for decades and was useful. At that moment there has long been a subject in the university, without which the automation of processes is unthinkable – The theory of automatic control (TAC). TAC is a science that allows you to calculate the level and speed of impact on a certain number of controls at once to get the predicted exact result in the allocated time. On the basis of TAC for industry the theory of management was created.

In this diploma project, a city-type medium-power service station was designed and developed. The place of development was chosen, the capacity of the enterprise, the number of posts and workers were calculated. The general plan of the territory of the enterprise, the industrial-administrative building and the post of servicing and repair of car power systems were designed. During the design, some engineering and technological solutions were chosen.

Characteristics of the post service of the power system of the car, the production unit and the technology of the organization of work are given.

Also the research on lambda regulation was conducted, which studied the ways to regulate emissions of exhaust gases into the air.

The work of an employee of an enterprise, rules and requirements of safety engineering were analyzed as well as the basic security measures at the enterprise.

Having performed an analysis of the quality assessment of technological decisions and comparing the obtained values with the reference ones, we can

conclude that the specific indicators of the number of production workers, the area of administrative-household facilities are below the reference. The conclusion is that during the design of the station the following basic parameters were laid down, which made it possible to use material and technical means more efficiently and economically (land, building area, labour resources).

References

1. Говорущенко М.Я., Варфаломєєв В.М., Волков В.П., Волошина Н.А. Проектне забезпечення формування виробничо-технічної бази підприємств автомобільного транспорту : навч. посіб. Київ, 2012. 115с.

2. Лудченко О.А. Технічне обслуговування і ремонт автомобілів: організація і управління : підручник. Київ, 2004. 478 с.

3. Лудченко О.А. Технічна експлуатація і обслуговування автомобілів: технологія : підручник. Київ, 2007. 527 с.

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RUNNING GEAR. SHOCK ABSORBER

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While most drivers have heard of a shock absorber, for short they are also called ‘shocks’ or sometimes ‘dampers’. Not many people realise what they do and also how safety critical they are. Like all moving parts of a car, a shock absorber can become worn over time. This results in its need to be replaced. Knowing when to replace the shock absorber it’s not always obvious. How long a shock absorber lasts depends on a huge number of variables: model of car, the mileage driven, and the type of road surfaces driven on. Depending on what quality of damper you fit, 4-5 years seem to be about the average life span of the shock absorber. Concerning that, a typical car might go through 3 or 4 sets of dampers in its lifetime. It’s reasonable to expect that you'll have to replace some at some point. Here’s our guide for identifying issues with your shocks.

The shock absorber controls unwanted movement of the car body. It does this by controlling the movement of the wheels. The springs themselves absorb bumps and changes in the road surfaces. While the damper then control/dampen the movement of the wheels after that. Without them the car wheels will bounce up and down uncontrollably every time you go over a bump. This is not only uncomfortable but also dangerous! These two things combined will result in the tyres losing touch with the ground. A selection of typical front and rear shock absorber designs. In effect, it’s the job of the shock absorber to keep the tyres in uniform contact with the road. The way they do this varies from car to car, but the principle is the same. In sportier models, the damping is ‘firmer’, which may feel a little less comfortable. This means that car body movements are more rigidly controlled.

Most modern cars use telescopic shocks that feature a piston and valve arrangement within an oil-filled tube. They call them hydraulic dampers and as the wheel rises, it shortens the shock. Oil is forced within the shock through small holes in the piston. This slows and controls the movement of the wheel as the spring oscillates. Some more sophisticated shocks have an extra gas chamber within this arrangement. There are also many different types of adaptive or electronically controlled damping systems. It's possible to alter the firmness of the damping can on the move to suit the road surface or the driver's preference.

As shock absorbers wear they become less effective. For example, the damping becomes less and less. As the effectiveness of shocks degrades it's not always easy for the average motorist to realise this. You can inspect them within the wheel arches for signs of leakage. Oil stains are a clear sign. You should replace the damper as short as possible. Not all worn shocks leak so don't rely on that method. Scalloped dips in the tyre is another thing to watch for on the tyres edges. Cupping in the technical name for this and though it other worn suspension parts can cause the damage or wear. It is most common with worn shocks.

The circled area on the shock shows dark discolouration where oil has leaked from the seal. That's about it for visual inspection. Next, you need to be aware of unusual noises in the suspension, especially over a rapid sequence of bumps. Audible signs or wear are a rapid, dull thumping sound. This noise is the sound of the tyre whacking up and down on the road. It's not the actual shock itself. Other noises to listen out for are knocks and rattles which could indicate shock bushes or other suspension bushes that are probably need to be replaced.

Longer braking distances are another way of identifying worn dampers. All those things are difficult to assess unless you're aware of your car dynamic abilities. You need to know what they are like and how they have changed. Saying that, if you think that the car isn't as good to drive, or isn't as secure on the road as it used to be, go along to a good mechanic to have the shocks tested. A quick and dirty DIY test is to simply push down hard on the wing of the car. Make sure that it goes quickly and see if it bounces. A working damper will compress, rebound and immediately settle. A damper that has completely failed is likely to bounce a couple of times before it settles again. This is more difficult to find out with modern McPherson strut suspension designs but is still worth a go.

While replacing shocks is not the most difficult maintenance job on a car, we'd recommend that it should be left to the experts unless you're a dab hand with the spanners and you have tools such as spring compressors to hand. Whether you're doing the job yourself or getting a professional to do it for you, insist on replacing the shocks in pairs, across either the rear or the front of a car. This ensures consistent levels of damping across the axle.

When fitting them, be aware that some shocks are specifically designed for just one side of the car. When ordering new shocks you should be aware that there could be different types that will physically fit your car. For example a Mitsubishi Lancer X , like our project car, came as a standard sedan with standard shocks. And there was a Lancer X EVO version with firmer sports shocks and a commercial version with heavy duty shocks all of which look virtually identical and will all fit,

but will all offer very different handling characteristics. So, it's important to look closely all the technical details when buying new shock absorbers.

And finally, although you can drive a car on worn shocks, it's not something you should scrimp on, as they are integral to everything the car does, especially braking and turning. On badly worn shocks, braking distances can increase; a car could 'skip' across the road mid-corner over bumps; or it may react in an unexpected manner during an emergency manoeuvre, so at the first sign of an issue, get them replaced.

References

1. Тур Е. Я. Устройство автомобиля: ходовая часть. Киев, Москва, 1985. 246 с.

2. Service manual Lancer X : Running gear, 2007. 145 p.

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STUDY OF INTERACTION OF A CAR WITH A STAND DURING THE DRAWBAR TEST

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Traction stands exist to recognize and calculate the performance of cars. Also, the traction stands are an integral part of the tuning studio. Most often, the traction stands are used on the sections of the state control of the technical condition of the car. These stands also help to find out how much power the car losts.

Stands of traction qualities (STQ) serve for complex diagnostics of the car on such basic parameters of its operational properties, as power and fuel efficiency. They allow to simulate in stationary conditions test load and speed modes of the car.

In this case, the following diagnostic parameters are most often used: power on driving wheels (wheel power); torque (or thrust) on the driving wheels; linear velocity on roller circle; specific fuel consumption; effective engine power; moment of resistance (resistance to rotation) of wheels and transmission; run time; time (or path) of acceleration; acceleration (deceleration) at in-run (rundown).

When testing cars on drum stands, such modes are used: maximum traction force or maximum torque, maximum speed, partial load of the engine, forced scroll of driving wheels and car transmission.

Traction stands have the following main functional components: rollers, load device (brakes), measuring system. According to the type of load devices there are two modes of diagnostics: speed and load. The speed mode is implemented on inertial stands in the process of accelerating the inertial system of the car-stand. Loading mode of diagnostics, characterized by constant speed and braking forces

on running drums at the time of diagnosis, can be performed only on the stands equipped with brake loading devices.

The greater the wheel power of a car, the less the path and time of dispersal of inertial masses in the established speed range.

Power stand of traction properties consists of a support-drive device, stationary remote control and display, a fan and airflow to the radiator, the device for removal of exhaust gases, remote stand, insurance devices, devices for testing stand. In addition, the stand can include fuel flow meter, stopwatch, recorder for recording a diagram of power and power that develops on driving wheels.

There are stands for cars, trucks and buses according to the type of diagnosed vehicles. The main indicators here are: realized traction power (power), speed and load on the axle. There are also universal stands, that are designed for several types of vehicles.

Depending on the type of loading device and other structural features of the traction qualities of the stand, it is possible to measure in full or in part the following diagnostic parameters:

– speed of the car;
– power wheel;
– torque or traction power on wheels;
– time of in-run (rundown);
– frequency of rotation of the crankshaft of the engine;
– fuel consumption;
– the power of mechanical losses in the transmission.

Typically, traction stands are equipped with an external fan to blow away the radiator in order to maintain the normal thermal mode of the engine to be checked by the vehicle in the absence of the incident airflow. The fan is mounted either on a trolley that is installed in front of the heater when the car stands on the stand, or in the ditch, at an angle. In the first case the preparatory-final time increases, in the second one the below access to a car becomes worse. Finally, the set of traction booth should include a system of exhaust gas discharge, which has a heat-resistant sleeve, which is worn on the exhaust pipe and is connected to the exhaust fan. If there is no such system or it is not efficient enough, it is very difficult to operate at the post, especially when testing diesel engines. Typically, along with the traction booth, a fuel flow meter and a motor-tester, which are assembled on a common rack set of devices for in-depth diagnostics of the engine. When checking a car on a traction booth the insurance pads (stops) are set under free driving wheels in the front to prevent the forward self-drive of the car during the test.

Traction stands are the most technological and the most necessary stands for testing modern cars. With the help of them, new cars that have just been developed and released are being tested. You need to know how much new technologies could reduce fuel consumption, toxic emissions and at the same time raise the specific power of the car. Every year traction stands are upgraded, more and more parameters can be measured with their help. The main problem is their price. They are very expensive due to the measurement technology, the volume of the stand itself and the high cost of the equipment used. In ideal conditions, traction stands must be presented at all car service stations, and everyone strives for this.

References

1. Говорущенко Н. Я. Роликовые стенды для проверки тормозных и тяговых свойств автомобилей (теория, расчет и конструирование). Харьков, 2009. 344 с.

2. Головных И. М. Моделирование процесса разгона автомобиля с гидромеханической трансмиссией на диагностическом стенде с беговыми барабанами. Вестник Иркутского государственного технического университета. Иркутск, 2010. № 5. С. 161–166.

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BASICS OF CAR AERODYNAMICS

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Why should we care about aerodynamics? Why does it matter? We need to use the energy as efficiently possible, losing as little to the air as we can. We want cars, which can not only save our money, but also throw less into the environment.

Aerodynamic design of cars is crucial as it directly affects the fuel economy and stability in motion .Therefore it is necessary to have a clear understanding of external aerodynamics of road vehicles.

So, when developing the new car specialists in the field of aerodynamics should solve the following tasks:

– optimization of the external shape of the body and geometry parameters as well as design and installation parameters to ensure minimum drag;

– improvement of aerodynamic characteristics defining performance indicators of aerodynamic stability and controllability;

– determination of the optimal zones and volumes of air intake and emission for engine cooling systems, ventilation, air-conditioning and refrigeration;

– determination and reduction of aerodynamic noise.

Moreover, the solution of one task often contradicts the fulfilment of another one. For example, reduction of the drag coefficient improves streamlining, but at the same time it worsens vehicle stability in side winds and gusts. Therefore, experts should seek a reasonable compromise.

One aspect of car design that plays a part in saving fuel is aerodynamic efficiency – in other words, making sure a car meets as little resistance as possible from the air it travels through. The more aerodynamically efficient it is, the less fuel it will use to travel along at any given speed. The faster the car moves, the more important it is to keep the air resistance – drag – to a minimum.

What determines the force of drag? Two parameters have a decisive influence on it: the aerodynamic drag coefficient Cd and the cross-sectional area of the car (mid-section). You can reduce the midsection by making the body lower and narrower, but it is unlikely that there will be many customers willing to buy a car like that. Therefore, the main direction of improving the aerodynamics of the car is to reduce the drag coefficient. The drag coefficient Cd is a dimensionless

quantity, which is determined experimentally. For modern cars, it lies in the range of 0.26 – 0.38. Currently, auto manufacturers are attempting to reduce the drag coefficient to the range of 0.3. This coefficient plays a key role for the design of hybrid cars. The most popular hybrid hatchback is Toyota Prius that has a drag coefficient of 0.26.

However, this Cd figure cannot be used by itself to calculate a car's aerodynamic drag because it does not take into account the car's frontal area. The frontal area is the car's total cross-section, or the total amount of space it occupies when viewed from the front. A full-size car and a scale model of the same thing would both have the same Cd figure, but the larger version would need a lot more power to propel it at speed because its frontal area is larger [2].

The cars with a stepped shape of the rear part such as sedans and coupes have the best indicators of streamlining. It can be simply explained. The stream of air coming off the roof immediately falls on the trunk lid, where it returns to normal and then finally breaks away from the edge. Side streams also fall on the trunk, which prevents harmful whirlwinds behind the car [3].

Not every device attached to a car's rear is a true wing, though. Spoilers are more common than wings on modern road cars, but they are quite different. The most important surface of a wing is the underside, where the greatest pressure difference is realized. Spoilers don't have an underside; they simply deflect airflow from its path and are used mainly as pop-up devices on road cars. This helps with stability at higher speeds by separating the airflow at the trunk lip [1].

The bottom of the car also affects its aerodynamics. The protruding parts of the suspension and exhaust system increase resistance. To reduce it, they try to smooth the bottom as much as possible or to cover everything that "sticks out" below the bumper. Sometimes a small front spoiler is installed. The spoiler reduces air flow under the car. But it is important to know when to stop. A large spoiler will significantly increase the resistance, but the car will be better "pressed" to the road.

For sports and racing cars described measures are ineffective. To keep such cars on the road, you need to create greater downward force. For this purpose a large front spoiler, side-skirts and antiwings are used. A race car has to fight the other cars but shouldn't have to fight the air. So the formula one designers used knowledge of aerodynamics to decrease the vehicles fight with the friction imposed by the surrounding air or drag. Also aerodynamics is used to create a shape that will create a strong downward force. Indy cars need this because at such high speeds the tires may not grip the roadway, or at its very worst the air pushing up on the bottom of the car will flip it over.

Modern aerodynamic design, as seen in such cars as Nissan GT-R Nismo, and McLaren MP4-12C, favours a low nose and a relatively high tail for good penetration through the air and stability.

Aerodynamics is one of the key enablers to deliver fuel economy targets.

Aerodynamics design process starts from earliest concept and continues up to and beyond production. Fuel economy is a top "reason to buy". Aerodynamics is a major factor in total vehicle energy consumption.

References

1. Евграфов А. Н. Формообразование автомобильного кузова : учебное пособие. М., 2001. 95 с.

2. Евграфов А. Н. Аэродинамика автомобиля. М., 2010. 356 с.

3. Скуда Д. В. Разрабока методов дизайн-проектирования легковых автомобилей : дис. … канд. техн. наук. Иж., 2005. 210 с.

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WIRE ELECTRO-DISCHARGE GRINDING FOR MICRO-MACHINING

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Machining miniature cylindrical parts are of great challenge because the pressure that tools or grinding wheels exert on parts such as the micro parts/electrodes can cause the parts to deflect, making it difficult to achieve the desired accuracy. In fact, in some cases it's impossible to machine such tiny parts using these conventional methods. Unlike traditional cutting and grinding processes, which rely on the force generated by a harder tool or abrasive materials to remove the softer work piece material, the electrical discharge machining (EDM) process utilizes electrical sparks or thermal energy to erode the unwanted material and generate the desired shape. EDM is capable of machining complex shapes in hard materials. The process includes an electrode and a workpiece, both submerged in dielectric fluid. Electrical current flows between the workpiece and electrode, repeatedly creating tiny plasma zones that instantaneously melt and remove the material. The electrode in EDM takes different forms. Wire EDM machines use a thin wire to cut. Ram EDM machines, or "die sinkers," use electrodes that are custom machined into 3D shapes. The EDM process produces a cavity in the part that is the opposite or female version of the "male" electrode form. Similar to the ram EDM machine is the small-hole EDM machine, or "hole popper." On this machine, the electrode is a cylinder used to machine a hole. One further improvement is to rotate parts in a spindle mounted on the table of a wire EDM unit and allow the wire to "grind" the parts to shape and size. This is advantageous for micro-machining applications where material is removed electrically via spark erosion, not mechanically. The chance for deflection is eliminated because work piece and wire never touch in addition, the wire EDM unit can be easily programmed to machine contoured round features, whereas grinding operations would require longer setup times and contoured wheels. WEDG employs a set of wire guides to confine the wire tension within the discharge area between the rod and the front edge of the wire and to minimize the wire vibration. One of the advantages of WEDG is its ability to machine choice of complex shapes such as tapered and stepped shapes at various sections.

At present an experimental setup of a submergible rotary axis for the WEDM is built to machine micro parts. With the help of the available experimental setup at PSG, experiments have been performed by machining a ϕ2.0 mm HSS rod to ϕ0.4 mm rod to analyze the process parameters of WEDG.

To produce Micro electrode of copper and brass material using wire electric discharge grinding (WEDG) with less than 40 microns of diameter and length of 20 mm (L/D=20/.4) as well as with an aspect ratio of 50 and optimize the machining parameters to get good surface finish some of them were inspected by Scanning Electron Microscope (SEM) and performing Micro machining on hard metals like Beryllium copper in Electric Discharge Machining.

Study of WEDG process parameters to produce components like micro electrode for micro machining on hard metals with an (L/D = 20/0.4) aspect ratio of 50 and above, round electrodes and micro tools on hard and difficult to machine materials (Copper, Carbide and Tool steel) which subsequently can be used for micro-EDM or micro-cutting applications.

To analyse the effect of process parameters (voltage, spark gap, speed and feed of wire) on MRR, Surface finish and aspect ratio of 50 with ϕ0.4 mm wire by using existing CNC Wire EDM (Mitsubishi) and develop mathematical models. To manufacture of micro components like Probe, Injection nozzle and electrodes, etc. To analyse the dimensional, form accuracy and surface finish of the micro electrode produced and optimize the process parameters. To analyse the micro machining capability of our micro electrodes on hard metals like beryllium copper and vanadium in EDM and optimize the process parameter to get better accuracy, surface finish and MRR while at micro machining. To study the effect of di-electric fluid and by adding suspensions in the fluid to investigate the quality of machining.

Wire Electric Discharge machining becomes an important nonconventional/nontraditional machining process due to its competency in machining of work pieces with complex geometry and hard stiffness. The development of new, advanced engineering materials and the need for precise and flexible prototypes and low-volume component production have made WEDM an important manufacturing process to meet such a demand. Unlike traditional cutting and grinding processes, which rely on the force generated by a harder tool or abrasive material to remove the softer work material, the WEDM process utilizes electrical sparks or thermal energy to erode the unwanted material and generate the desired shape. In WEDM process the material is removed by a series of discrete electrical discharges between the wire electrode and the work piece. The discharges, which are highly focused by the dielectric medium, cause rise in the local temperatures of the work piece near the point of introduction.

Once the process parameters are optimized then it is possible to go for taking consultancy or job work for manufacturing of micro components and micro machining in hard metals with the help of micro electrode according to the needs of the industry. Further research is needed in the same area on how the machining parameter affect the required MRR and the surface finish while performing micro machining on hard metals in Electric Discharge Machining and by adding emulsions or nano particles to the di-electric fluid in order to find an optimal ratio of additives for improved machining parameters and suggest the same for the users of WEDM.

References

1. Новое в электроэрозии – электроэрозионное точение. URL: http://galika.ru/wp-content/uploads/2013/03/Statya_EDM_Turning.pdf
2. Micro “Turning” Using Wire EDM. URL: https://www.mmsonline.com/articles/micro-quotturningquot-using-wire-edm.

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WELDING STAINLESS STEEL RIGHT

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Stainless steel continues to gain popularity in applications across the fabrication industry, mainly thanks to its corrosion resistance, strength, and toughness. Compared to mild steel, however, the material poses some welding challenges, especially for less experienced welders. Stainless steel can be three to five times more expensive than mild steel; any welding mistake can compound the overall costs for rework.

Choosing the right welding process is key. There is a give-and-take with every option, and no single process provides a perfect solution. To determine the best option, fabricators need to consider the upfront cost and characteristics of the filler metal, required productivity, equipment complexity, and operator skill set.

Stainless steel resists corrosion and maintains strength at extremely hot and cold service temperatures, hence its popularity in the piping and petrochemical industries. Stainless also has a low susceptibility to bacterial growth on its surface, making it well-suited for food-preparation and medical equipment.

Common stainless steels come in chromium-nickel or straight chromium grades. Compared to chromium-nickel stainless, straight chromium stainless grades and carbon steel have similarly low coefficients of linear expansion, which determines how materials expand and contract under temperature and pressure. Straight chromium grades also have a lower melting point than carbon steel but a higher melting point than chromium-nickel stainless. Still, compared to carbon steel, both straight chromium and chromium-nickel grades share high electrical resistance and low thermal conductivity.

In addition to welder skill and equipment availability, the application priorities – cost, productivity, and bead appearance, for example – influence which stainless steel welding process fabricators ultimately choose.

Shielded metal arc welding (SMAW) uses simple, portable equipment, which is why it’s a popular choice for maintenance and repair work. But SMAW, or stick welding, is less productive than other processes and can produce a lot of spatter, which increases time and cost for cleanup.

For fabricators who have not welded stainless steel before, SMAW is a good entry point. It uses no shielding gas, so to start welding, a welder needs only an SMAW-capable power source and stainless steel SMAW electrode.

The cost per pound for these electrodes is mid-range – less than flux-cored or metal-cored arc welding wires and slightly more than solid wires. Fabricators can purchase SMAW electrodes in small quantities, such as 6- or 8-pound packages,

which is helpful for small jobs and can keep costs down. Still, fabricators need to consider SMAW's stub loss and slag removal to determine if the process's low electrode costs still make it cost-effective overall.

A 309 or 312 SMAW electrode is a good choice for stick welding stainless steel, especially for maintenance or repair applications. It offers high cracking resistance and good strength, and typically can join stainless steel already in service, even if the specific material grade isn't known.

When productivity is a priority for stainless steel welding, wire feed processes offer efficiency and good bead appearance. Advancements in equipment and filler metal have made these processes easier to use, even for those newer to welding stainless steel.

Many fabricators perform gas metal arc welding (GMAW) of stainless steel with a solid wire. GMAW has moderate equipment complexity and operator skill requirements, and for stainless steel welding, it can be used in pulse or spray transfer mode.

Metal-cored arc welding, either with pulsed or standard spray methods, provides fast travel speeds that input less heat into the weld. This helps prevent warping and distortion when welding stainless steel.

Although metal-cored welding produces less spatter than other forms of wire welding, the price per pound for the stainless steel filler metal is the highest. When deciding on this filler metal and process, fabricators should weigh the upfront cost versus the productivity gains and the potential reduction in rework and cleanup.

Many fabricators have submerged arc welding (SAW) systems in place for welding carbon steel, but SAW also offers significant benefits for stainless steel, including greater productivity and extremely low spatter levels, which help save time and money on cleanup. SAW is well-suited for thick materials and large applications such as storage or liquid natural gas tanks. Though it's limited to the flat welding position, it can be performed by less-skilled operators. When using SAW on stainless steel, fabricators employ a neutral or nonalloying flux, which does not add alloys that could alter the chemistry of the completed weld.

As the use of stainless steel continues to grow, more companies will have to become familiar with welding the material. Cost may be the key consideration for some operations, while reducing downtime and improving productivity may be the keys for others. Each process and filler metal choice comes with trade-offs. While there is no such thing as the perfect welding process for stainless steel, keeping some key considerations in mind when selecting the process and filler metal can help ensure success and cost savings.

References

1. Моисеенко В. П. Материалы и их поведение при сварке. М., 2009. 304 с.

2. Шоршоров М. Х. Металловедение сварки стали и сплавов титана. М., 2012. 337 с.

3. Stainless Steels Welding Guide.
URL: http://m.lincolnelectric.com/assets/global/Products/Consumable_StainlessNickelandHighAlloy-BlueMax-BlueMaxMIG316LSi/c64000.pdf.

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GEOGRAPHIC INFORMATION SYSTEMS OF HIGHWAYS

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Today, in all spheres of human activity related to spatial objects, there are geo-information mapping systems (GIS). The area of tasks solved by GIS is quite diverse: information and reference systems, network analysis, management of infrastructure and its development, tracking traffic flows, monitoring of various man-made and natural phenomena. Also, these tasks include spatial analysis, modeling, exploration of the subsoil, design of linear and area objects, planning [1]. For these purposes, GIS is equipped with a fairly complex mathematical apparatus, as well as SQL query language. The most popular GIS, such as ArcGIS, AutoCAD Map, MapInfo Geomedia Professional have a wide range of tools for working with vector and raster data, databases, query generation. All of the above GIS have their own data format, and also have significant differences in the presentation and processing of graphic and textual information.

Traditionally, GIS is widely used to control linearly extended objects, including highways. In practice, there are two options for the formation of geo-information systems of auto-mobile roads, this is the creation of a GIS together with the appearance of an object and for already existing objects.

To obtain a single model of the entire road, the best practice is to use geographic information systems. It is completely unimportant how the information model of the automobile road was obtained (using a model to have passed all the way from design to operation, or as a separate project to model the already existing road), it should contain the entire data set inherent in BIM models. A road may consist of multiple BIM models of individual sections. The GIS of highways contains all components of the information model in accordance with PAS 1192 2: 2013 “Draft standard for information management in the capital construction phase using information modeling”: a geometric model of objects in three coordinates; attribute information; related documents [2]. An equally important aspect of BIM is the use of a common data environment (SOD) to implement collaboration. The organization of SOD is often not considered at all, focusing only on the BIM model itself, which is incorrect, since the UK’s first accepted BIM standard BS 1192: 2007 “British Standard. Co-production of architectural, engineering and design information - norms and rules "describes precisely the aspects of the organization of SOD [3].

The road GIS uses the MS SQL database server as a data warehouse. All GIS users get simultaneous access to the information model of roads; users can read and modify information (graphic, attribute and related documents) in accordance with

the assigned access rights; GIS stores the history of changes in all objects using the temporal mechanism - the model changes with the change of the road. Using the temporality, it is possible to compare the current state of the model with a model a year ago (or select any date of interest). Thus, it can be concluded that GIS is a multi-user common data environment containing a BIM-model of a highway [4]. Currently, work is underway to create a lightweight version of the GIS of highways based on web technologies.

The web solution is less resource intensive, faster and allows access to the GIS workstation from desktops, laptops, tablets or mobile devices from anywhere in the world where there is Internet access. The implementation and implementation of a web-based environment of shared data with the provision of access via the Internet takes us to a new level of information modeling.

Obviously, the geo-information system of highways contains a comprehensive BIM-model of the highway during the operation phase, as well as being a common data environment that ensures the joint work of all stakeholders in the process, while a web-oriented GIS allows for the highest level of maturity - IBIM. Progress does not stand still and the traditional range of tasks that can be solved using GIS is constantly expanding. In addition to the well-known functions associated with the operation of roads, which are successfully managed by many geographic information systems, such as: certification, preparation of linear graphs and reports, analytical functions related to diagnostics and accident centers, etc. The road builder's advanced tool already has a foundation for innovative trends. But GIS is not only a constantly updated traffic data base installed on servers, but also a software package for working with it.

When creating a GIS, the points of the departmental geodetic support network are laid, which are located mainly on artificial structures and are also part of the infrastructure. Land-based geodetic support network (VOGS) can be used by land surveyors, road-building equipment automated control systems, unmanned vehicles for more accurate positioning on the road. Thus, the GIS of highways is not only a web-based common data environment that implements the third level of maturity - IBIM, but also significantly expands the range of traditional tasks set before geo-information systems just a few years ago.

References

1. Скворцов А.В. [и др.]. Геоинформационные системы в дорожном хозяйстве. Справочная энциклопедия дорожника (СЭД). VI. М. ФГУП «Информавтодор», 2006. 372 с.

2. Баранник С.В. Обзор практических документов национального BIM-стандарта США NBIMS-US V3 // САПР и ГИС автомобильных дорог, 2017. № 1(8). 4–8с.

3. Баранник С.В. Обзор британских стандартов семейства PAS 1192 // САПР и ГИС автомобильных дорог, 2016. № 1(6). 24−27с.

4. Бойков В.Н., Баранник С.В., Кузовлев Е.Г. ГИС автомобильных дорог в контексте парадигмы информационного моделирования (BIM) // Дорожники, 2017. №3 (11). 66–69с.

5. Скворцов А.В., Сарычев Д.С. Жизненный цикл проектов автомобильных дорог в контексте информационного моделирования // САПР и ГИС автомобильных дорог, 2015. – № 1(4). – С. 4−14.

6. Скворцов А.В., Поспелов П.И., Котов А.А. Геоинформатика в дорожной отрасли. М.: МАДИ (ГТУ), 2005. – 250 с.

7. Король М.Г. BIM: Информационное моделирование — цифровой век строительной отрасли // Стройметалл, 2014. – № 39. – С. 26–30.

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THE ANALYSIS OF WAYS TO WIDEN BRIDGES

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Nowadays 24,447 bridges and over-bridge are used on the communication lines of Ukraine. The major part of this number, namely 16,306, is made up by highway bridges. Most of the bridges are reinforced-concrete.

A lot of bridges in Ukraine were designed and constructed according to the technical norms which were in effect till 1984. At present time they do not meet the technical conditions of the road traffic according to the sizes of the traffic way and the bearing capacity. About 1,500 road bridges on the roads of national standing have the traffic way size less than 8 m, that is, there are no safety strips on such bridges, while the bridges with size of 9 m in most cases do not meet the present standards and have to be expanded.

The possible methods of widening are the following: widening of pavements with the additional concreting of consoles or by applying the precast walkway slabs which allow increasing of the foot size; deposition of the pavement blocks or their removal, deposition of the pavement blocks with the additional concreting of consoles of the slabs (group A); installation of the solid-cast (precast with cast-in-place, cast) attachable slab, included in the joint exploitation with the main beams with the increased consoles (group B); the structural addition of beams of the superstructures to one or two sides (symmetrically or asymmetrically) with widening: а) of only bars (group C), б) of bars and tower bodies (group D), в) of the whole substructure, including the foundation part (group E); a combined method of the abovementioned (group F).

Schemes of the widening the reinforced concrete superstructures

The schemes of increasing the pedestrian size to expand the pavement capacity (group A) involve the replacement of the existing pavement blocks. The possible schemes of increasing the pedestrian size can be seen in Figure 1.

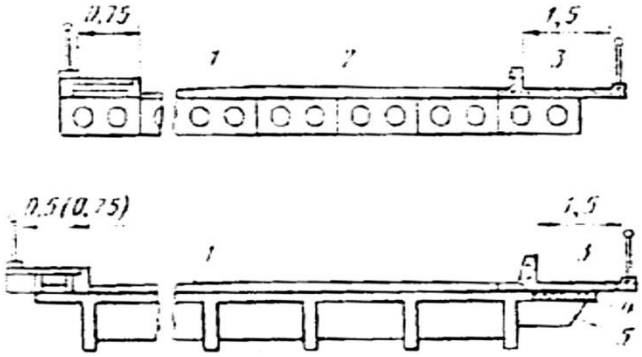

Figure 1. The schemes of increasing the width of pavements (group A):
1 – the existing superstructure; 2 – the surface of the deck; 3 – a new pavement block; 4 – a concrete section of the console slab; 5 – the stiffening rib under the console slab; 6 – the supporting block under the console slab

Widening due to the solid attachable slab (group B), which does not require adding the beams, is applied as the rule when increasing the size by for 1,0–3,0 m in the superstructures up to 18 m, and in some cases even more. At the same time the removal of all elements of the bridge deck (pavements, surfaces, etc.) and ensuring of the joint work of the slab with the exploited superstructures are provided. The possible schemes of widening according to group B are given in Figure 2.

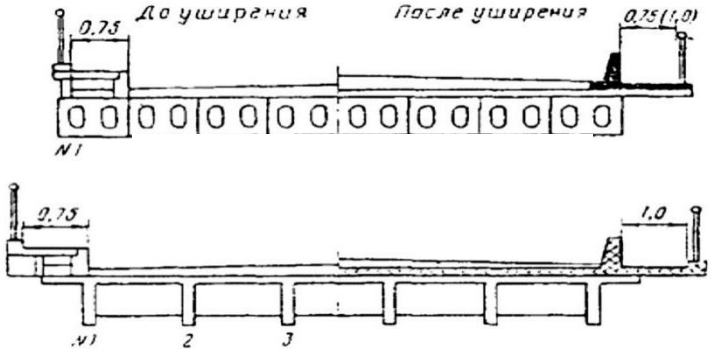

Figure 2. Schemes of widening due to the solid attachable slab

The schemes of widening with the help of the ribbed attachable slab (precast or precast with cast-in-place) which do not require the supports widening, are used when increasing the size mainly by 2–5 m (in some cases with a good technical-economic substantiation – even by more) in the bridges with the pans up to 18 m and with the superstructures of both split and non-split systems.

When widening the joint work of the attachable slab with the existing beams is provided. The use of a flat slab in the cast version is inadmissible.

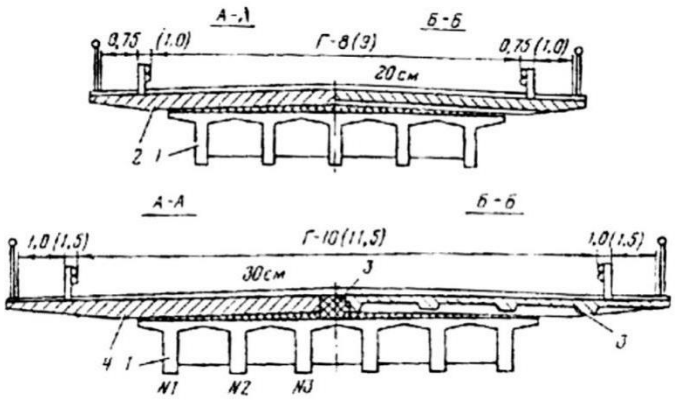

Figure 3 The schemes of widening the cast and (a) and precast with cast-in-place (b, a) attachable slab:
1 – the existing superstructure; 2 – precast ribbed attachable slab; 3 – the monolithic splined weld (sections A-A – on the cross joint, B-B – on the attachable slab.

Widening the bridges with the symmetrical addition of beams (slabs) of the superstructures and with the development of only a cross-beam (group C) provides for the addition of one beam on each side (symmetrical widening) and can be used when increasing the size from 1,5 to 2,5 м (Figure 4). In this case, the attached elements are combined with the existing construction on the traffic way slab or on the slab and the wall of the beam (slab), which in most cases facilitates the work of old blocks in the superstructure.

The bridges widening with the symmetrical adding of beams (slabs) of the superstructures and with the development of only a tower body (group D) involves the addition of one or two beams on each side and can be used when increasing the size by 2-3.5 m. In this case, the widening is carried out according to the schemes similar to those given for group C (Figure 5).

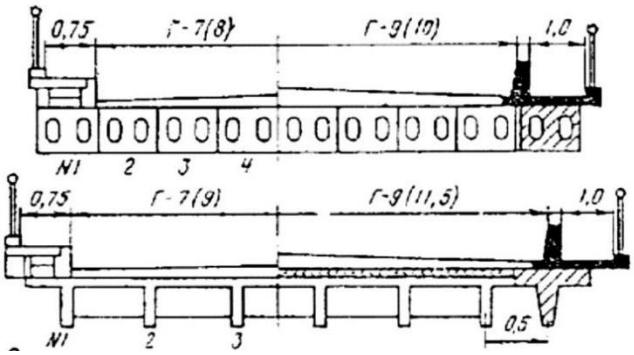

Figure 4. The schemes for increasing the size with adding one beam on each side of the superstructure

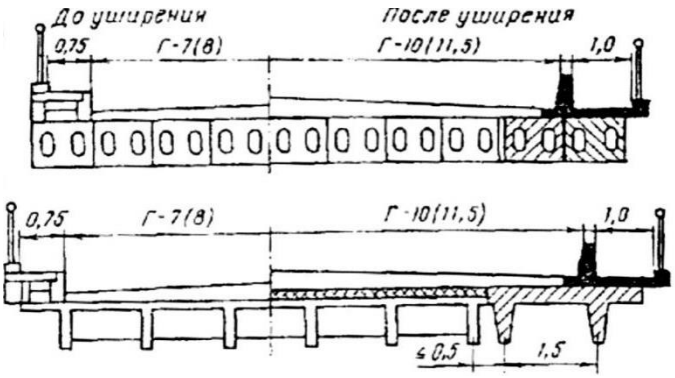

Figure 5 The schemes for increasing the size with adding the beams of superstructures that require the tower body widening (Group C, D)

Widening the bridges with widening the foundation of supports through the installation of new supports (Group E) can be two-sided (symmetrical or asymmetrical) or one-sided depending on the position of the road axis after the reconstruction and the possibilities of the contractor. In this case the schemes of widening the superstructures can be based on the schemes shown in Figure 5, but with the bigger number of the added beams. The one-sided widening is used, as a rule, in those cases which require the insignificant increase of the bridge capacity or do not require it at all. The one-sided widening is most effective in the combination with other methods of strengthening and widening as in this case, along with the simplification of the technology, it leads to the increase in the bridge capacity.

The combined methods of widening (Group F) represent a combination of the abovementioned methods and schemes which clarify them (see Figures 1–5). The most effective are the schemes of the combined methods of the superstructures widening which allow simultaneous essential increase of the bridge capacity (Figures 6 and 7), applicable to the bridges with the initial size G-7+2X0.75 m.

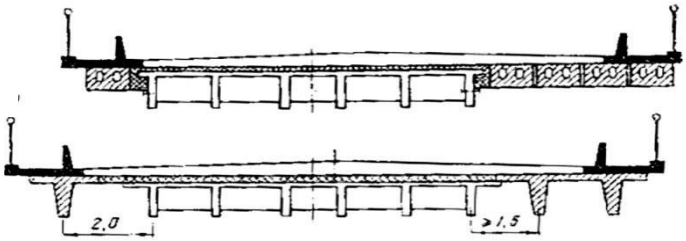

Figure 6. The schemes of the combined methods for widening the cast diaphragm superstructures

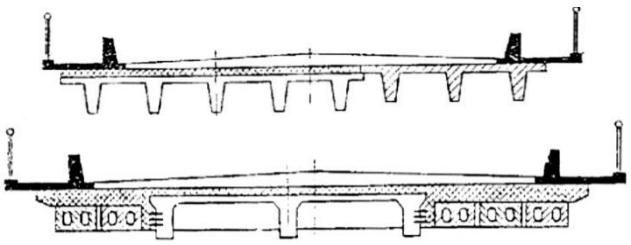

Figure 7. The schemes of the combined methods for widening the cast non-diaphragm and monolithic diaphragm superstructures

Consequently, when choosing the schemes of widening superstructures you should take into consideration the fact that with the significant widening (more than 2 m to one side) there is a danger of lowering the height of the under clearance. For such constructions one should consider only those schemes of broadening in which the mark of the bottom of the added constructions with a cross slope of 2% meets the requirements. It is advisable to use the attachable slab, additional low-height beams and cored slabs.

References

1. Инструкция по уширению автодорожных мостов и путепроводов. ВСН 51-88. М.:Транспорт, 1990. 128 с.

2. Страхова Н. Є., Голубєв В. О., Ковальов П. М. Експлуатація і реконструкція мостів / За ред. А. І. Лантуха-Лященка. К., 2002. 408 с.

AUTOMOBILE TRANSPORT

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ANALYSIS OF BATTERY PACKS OF HYBRID VEHICLES

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The aim of research is to analyze the types of batteries that are used in hybrid cars. The subject of investigation is electrochemical properties of car batteries. Research methods are as follows: analysis, classification, comparison and generalization.

In order to correctly evaluate traction batteries, we formulate basic criteria that are inherent in them: battery life, the number of charge-discharge cycles, specific energy consumption, battery change settings depending on the temperature of operation and maximum discharge current.

We will consider the types of batteries that are used in vehicles: nickel-cadmium, nickel-metal hydride, lithium-ion, lithium-polymer and lithium iron phosphate.

A nickel-cadmium battery (Ni-Cd) is a chemical power source in which the cathode is nickel oxide hydrate Ni $(OH)_2$ with graphite powder, electrolytes are potassium hydroxide KOH 1.19-1.21 density with the addition of lithium hydroxide LiOH, the anode is cadmium oxide hydrate Cd $(OH)_2$ or metal cadmium Cd. The temperature of operation is from minus 50º C to 40º C. The maximum discharge current is 10 A/ A x hr. The number of charge-discharge cycles is 900. Specific energy consumption is 65 Wxhr/ kg [1].

A nickel-metal hydride battery (Ni-MH) is also a chemical power source that has the anode with a metal hydride hydrogen electrode (usually nickel-hydride or nickel-lanthanum lithium), electrolytes are potassium hydroxide, the cathode is nickel oxide. The temperature of operation is minus 60º C to 55º C. The maximum discharge current is 10 A/ A x hr. The number of charge-discharge cycles is 500. Specific energy consumption is 72 W x hr / kg.

A lithium-ion battery (Li-ion) consists of electrodes (a cathode material on aluminum foil and anode material on a copper foil) separated by an electrolyte with porous separators. Lithium-ion batteries differ according to the type of cathode material. A lithium-ion battery has a positively charged lithium ion that is able to be implemented in the crystal lattice of other materials. Currently, mass production of lithium-ion batteries uses three classes of cathode materials. First, lithium kobaltate Li-Co-O_2 and solid solutions are based on isostructural nikelato lithium. Second, lithium-manganese-oxide based material with a spinel structure $LiMn_2O_4$ is one of the most prominent compounds. Finally, lithium ferro-phosphate Li-Fe-PO_4. The temperature of operation is minus 20º C to 60º C [2]. The maximum discharge current is 65 A / A x hr. The number of charge-discharge cycles is 600. Specific energy consumption is 240 W x hr / kg.

A lithium-polymer battery (Li-pol, Li-polymer, Li-Po, LIP, Li-poly) is the improved design of a lithium ion battery and it uses electrolyte polymer material.

The temperature of operation is minus 20º C to 40º C. The maximum discharge current is 10 A / A x hr. The number of charge-discharge cycles is 500. Specific energy consumption is 300 W x h / kg.

A lithium iron phosphate battery (Li-Fe-PO_4, LFP) is a type of lithium-ion battery that is capable of charging and discharging at high speeds compared to other types of batteries. The battery uses Li-Fe-PO_4 as the cathode [3]. The temperature of operation is minus 30º C to 55º C. The maximum discharge current is 60 A / A x hr. The number of charge-discharge cycles is 2000. Specific energy consumption is 140 W x hr / kg.

Thus, the batteries under consideration have their advantages and disadvantages. The most appropriate battery to use in cars is a lithium battery having high energy and a number of charge-discharge cycles. At the same time there are two major drawbacks – high cost and falling capacity when operating at low temperature, which is typical for climatic zones in Ukraine. Taking into consideration the parameters of quality, lithium-iron-phosphate batteries are superior to others because of a large number of charge-discharge cycles. The remaining two types of lithium batteries are approximately on par with nickel-cadmium and nickel-metal hydride batteries. The cost of cell components is not taken into account during the assessment of the parameters of batteries though it is the key factor in the production of chemical power sources.

References

1. Nickel-cadmium accumulator [Electronic resource]. Mode of access: https://ru.wikipedia.org/wiki/Nickel-cadmium_accumulator (Date of appeal: 12/10/2018).

2. Bahotskiy V. S. Chemical sources conductors / V. S. Bahotskiy, A. M. Skudin. – M. : Energoizdat, 1981. – 360 p.

3. Rakov V. A. Operation and maintenance of cars with hybrid power plants: monograph / V. A. Rakov. – Vologda : VoNU, 2014. – 143 p.

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STEPPER MOTOR MODELING

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This work is carried out in an environment of mathematical modeling MatLab-Simulink. The use of the stepper motor(SM) block is shown in Fig. 1.

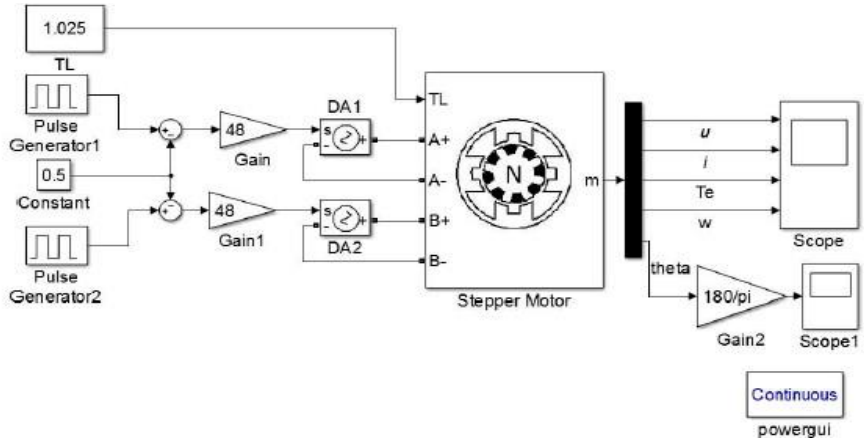
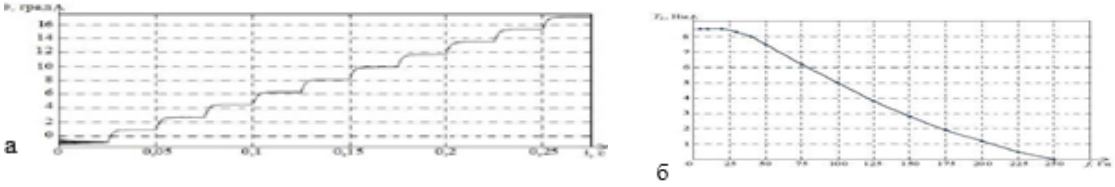


Figure 1. – Diagram Simulink – model with the stepper motor

Through the medium of mathematical modeling MatLab-Simulink, dependent angular step from the time of the mechanical characteristics of the SM and graphics transients M (t) and ω (t) (Figure 2), and the dependence of angular frequency from time θ (t)may be got from the of (Figure 3).



a *– the dependence of the angular pitch of time;*

b *– the mechanical characteristics of the SM*

Figure 2 – Transients

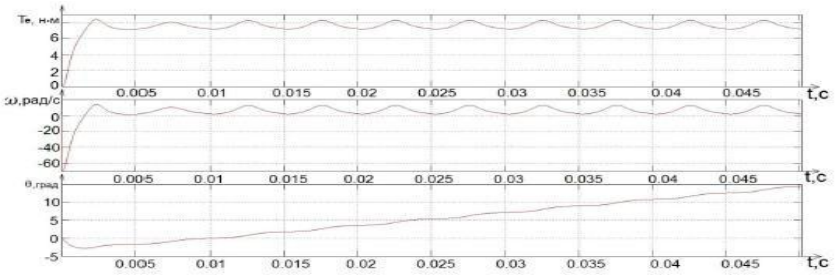


Figure 3. – Transients - M (t) ω (t), the angular characteristic θ (t)

The same mathematical model SM can be considered as a mode of fragmentation step. In the simulation mode full step management features SM are as follows (Figure 4).

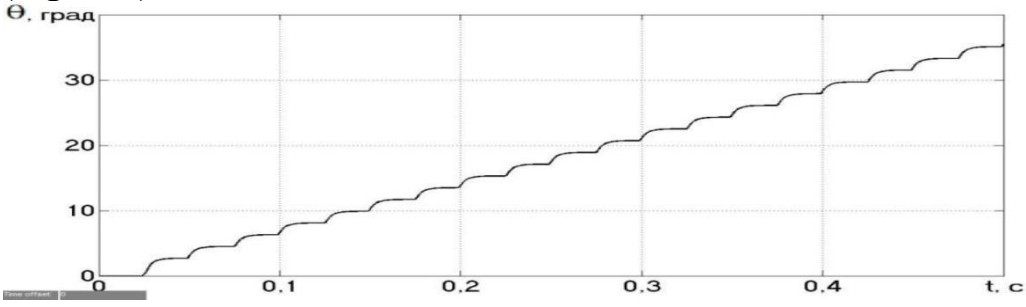


Figure 4. – Dependence angle rotor position in the step-by-step mode

In the step-by-step mode of the stepper motor (step angle S = 1,8˚) control signals are shaped on Figure 5. From Figure 5.6 It is shown that due to the shift of control signal by a quarter of a period every time two phases increase the electromagnetic torque of the engine. Working similarly, control signals can be shifted by a half of a period.

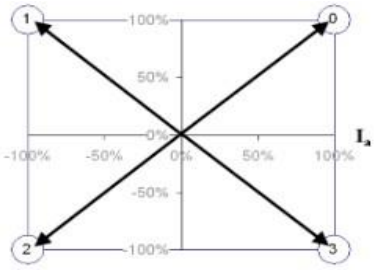


Figure 5. – Diagram of currents in phases at the semi-step mode

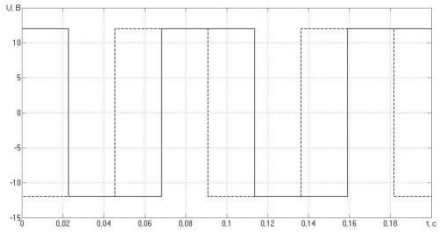


Figure 6. – Control mode signals at the full step mode

When considering the splitting step 2 SM (step by step) characteristics will be as follows (Figure 7).

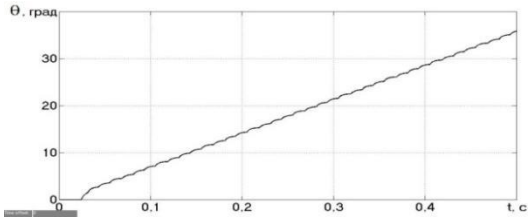


Figure 7. – Dependence of an angle of rotation of the rotor from the time in the semi-step mode

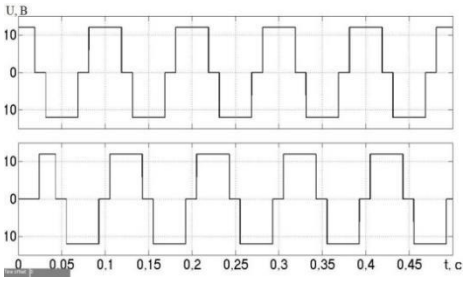


Figure 8. – Control mode signals at the semi-step mode

Implementing the semi-step mode (step angle S = 0,9˚) control signals by adding levels are modified (Figure 8).

References

1. Интегрированное интеллектуальное управление и диагностика мехатронных станочных систем / В.Ц. Зориктуев, А.Г. Лютов, Ю. А. Никитин // Мехатроника, автоматизация, управление. 2005. № 8. С. 26-30.

2. Сидоров А.С. Мониторинг и прогнозирование износа режущего инструмента в мехатронных станочных системах: дисс. канд. техн. наук. - Уфа, 2007.- 201 С.

3. Дискретный электропривод с шаговыми двигателями [под редакцией М.Г. Чиликина]. -Москва: Энергия, 1971. 624 с.

4. Денисов В.А., Жуков А.В. Исследование динамической модели электромеханической части системы компенсации износа режущего инструмента // Вектор науки ТГУ, 2011. №3(17). С.56-59.

Bulava I. V.

THE ENERGETIC SPECIFICATIONS OF ELECTRICS CARS

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As electric cars are widely common nowadays, their potential consumers and researchers are interested in their operational properties.

Competitiveness of the electric car is basically determined by its traction and speedy characteristics and energetic efficiency.

The difference between the traction, speedy and energetic characteristics of the car with an electric motor is determined by the features of energetic specifications.

Special techniques are developed for the assessment of energetic specification of electric cars and their comparison with energetic characteristics of common cars. Energetic specifications of the electric car are important of its working properties.

Energetics specifications consist of consumed energy and mileage.

Consumed energy is estimated by the following indicators:

- energy consumption when driving;
- energy consumption per path;
- specific energy of the battery.

These indicators generally depend on the design of the electric car and its traction drive.

The influence of the design of the electric car on energy consumption is determined by its weigh mass, body shape, specification of tyes and so on. The electric consumption of the electric car directly depends on the design and traction drive parameters.

There are three groups of traction drive parameters of the electric car:

- energetic (battery parameters);
- power (electrical motor parameters);
- mechanical (transmission parameters).

Different types of electric motors are used on the electric cars:

- DC motor;
- valve motor;
- asynchronous motor.

Each of these motors has got its advantages and disadvantages. The valve motor is the most economical among other motors.

Mechanical parameters of traction drive are determined by the transmission parameters. It is necessary to pick up the parameters in order to be economical on the most commonly used transmission mode with a constant transfer ratio.

A mileage of the electric car and its energy consumption fundamentally depends on accumulator battery.

Specifications of batteries are presented in table 1.

Table 1. – Specifications of batteries

The type of electro chemical system	Voltage of the element	A currend load	Energy density		Operating temperatures	Resources, number of cycles
			Вт·ч/кг	Вт·ч/л		
Ni-Cd	1,25	> 2	40–60	150	-40…+60	1500
Ni-MH	1,25	(0,5–1,0)	60–80	190	-20…+60	700
Li-ИА	3,6	< 1	100–150	250	-20…+60	1000
ПLi-ИА	2,7	0,2	150–200	370	Нет данных	150

Lithium compounds are used in batteries not to provoke the battery overheating. The energy consumption of the selected accumulator battery can be determined by a formula:

$$W = W_Б - W_P = \frac{\int P_{Мтяг} dt}{\eta_{Мтяг}\eta_{Бразр.}} - \eta_{Мген}\eta_{Бзар.} \cdot \int P_{Мген} dt \qquad (1)$$

where $\eta_Б$ – it is degree of using the battery (drive);

$\eta_м$ – KPD of the electric motor;

P_M – the power on the shaft of the electric motor;

hooks – the traction mode;

gene – the generator mode;

charge – charging mode (recovery);

discharge – discharging mode (traction).

The study of energy systems is based on the energy balance method.

The equation of energy balance is:

$$W_Б - W_P = \Delta W_Б + \Delta W_K + \Delta W_M + \Delta W_{TP} + \Delta W_T + \Delta W_{A,} \qquad (2)$$

where $W_Б$ – is battery power;

W_P – is recovery power;

$\Delta W_Б$, ΔW_K, ΔW_M, ΔW_{TP} – power losses in modules of traction system: in the battery, the controller, the electric motor and in the transmission;

ΔW_T, ΔW_A – are components of energy loss in motion, which are incurred on friction, rolling and aerodynamic losses.

There is an evaluation method of energy specifications of the electric car on the test or on stands. This method consists of test cycles, measuring procedures of a mileage distance and energy consumption of the electric car. Consumed energy is calculated according to the formula:

$$C = \frac{E}{d}, \qquad (3)$$

where E –consumed energy;

d – passed distance.

All the characteristics which are listed above have special significance for the operation properties of a car. Understanding these characteristics is very important for studying a course “The theory of operational properties of cars”. It is recommended you to take classes in the laboratory for better assimilation and classification of the material for students. That’s why the creation of laboratory installation for studying the course “The theory of operational properties of cars” is very important. The method of studying energy characteristics of the electric car on the laboratory installation allows to increase the efficiency of the study. The laboratory installation is presented in Figure 2.

Figure 2. – The general view of the laboratory installation

The laboratory installation consists of two parts: an experimental car (Figure 3); test stand (Figure 4).

Figure 3. – The KART car

1. Internal combustion engine, 2. DC motor, 3. Four-speed gearbox, 4. Cylindrical main transmission, 5. Chassis of the KART car.

Figure 4. – Test stand
1. booth support, 2. the track, 3. roller drive, 4. Rollers, 5. drive belt.

This installation is less expensive and easy to work. It allows to raise the efficiency of educational process and to understand the theoretical and economical processes of the car in details.

References

1. Blokhin A.N., Belyakov V.V., Zezyulin D.V., Vestnik IZHGTU them. M.T. Kalashnikov №1, "The energy consumption of a vehicle with an electric drive when driving in urban environments", 2012.

2. Podrigalo MA, Abramov D.V., Tarasov Yu.V., Efimchuk V.M., Vestnik NTU “KPI”, “Energy Efficiency of a Car and Criteria for Its Evaluation”, 2015.

3. GOST R EN 1986-1-2011 "Measurement of energy characteristics of Part 1" 2012.

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TESLA AUTOPILOT AS AN EXAMPLE OF ACTIVE SAFETY OF MODERN CARS

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Today active safety systems are very popular in modern cars. Active safety systems are currently in demand on new cars. Now there are such active safety systems: anti-lock braking system, anti-swing system, stability control system, Brake distribution system, emergency braking system, electronic differential lock. There are also auxiliary active safety systems: parktronic, adaptive cruise control, downhill assistance system, lifting help system, electromechanical parking bracket, vehicle detection system in blind zones, the "autopilot" system is more often included to them.

First, let’s find out what an autopilot is.

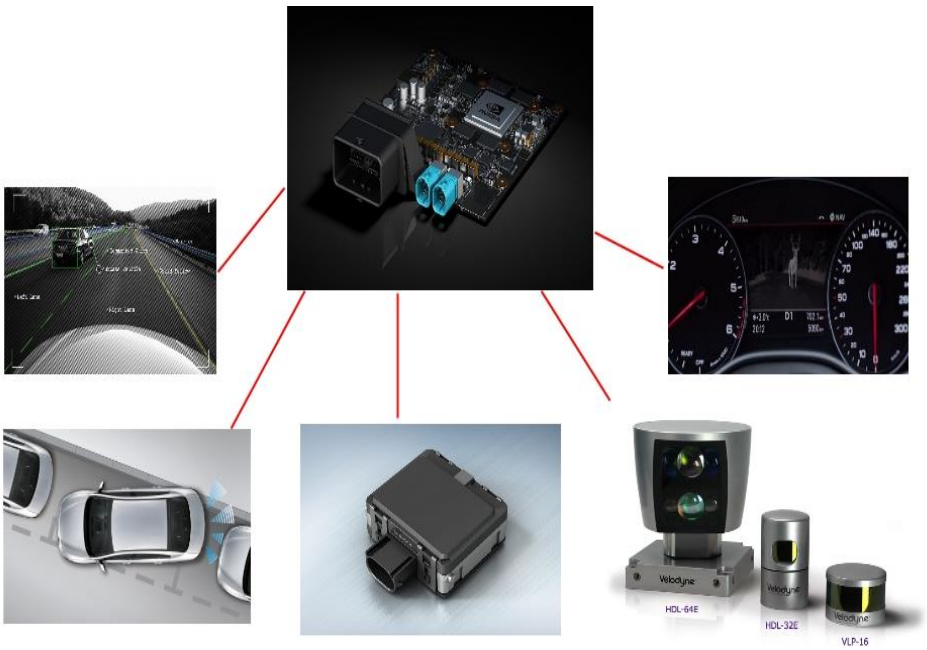

Fig. 1 – NVIDIA Drive PX 2 Autopilot

NVIDIA Drive PX 2 is a software and hardware system with artificial intelligence. In the basic version it is an economical cruise control system like a palm in size. It equipped with special development tools that allow other companies to conduct its training in object recognition, working with maps, building routes and much more. Using a set of cameras and sensors, a 360-degree picture is created around the car, analyzing and identifying objects to calculate a safe and optimal path. For example, Tesla uses eight cameras, one radar and ultrasonic sensors in their cars.

Autopilot system setup. Setting up the system is performed taking into account the range of tasks that it will be faced in future.

Setup starts in the data center. Millions of images of various objects are used to enable the system to recognize various types of cars, pedestrians, road signs and other objects. A database which the system should recognize is formed using this information. In addition to this a lot of videos from cameras installed on cars are used. So the system is able to learn how these objects can move and what can expected from them. This process may take from several weeks to several months, forming a neural network capable of learning.

After all this information has been processed, intensive testing begins to ensure that the system is safe and work correctly. In this process as well as setting simulators are actively used (Figure 2).

The main task of the autopilot. You should understand that this is not a full autopilot – the car cannot drive itself all the way to a given point. The main function is to keep you in the lane. If there is more or less qualitative marking on the road, the autopilot will work. If there is no road marking, the system will warn the driver. In any case, the driver must always keep his hands on the steering wheel. Despite this, the work of the autopilot is especially necessary when traveling long

distances along the tracks, when the main task of driving is to keep the lane and distance.

Fig. 2 – Testing System

Using sensors the system controls the driver keeping his hands on the steering wheel. If he does not do this, the system issues several warnings after that the car can slow down and eventually stop. Then the car will not allow you to turn the autopilot on again, until you get off the road and stop.

The system keeps the car on the lane, monitors the cars around and if someone cuts it, it will react and slow down (Figure 3). The autopilot copes with control not only on the track. If the city has more or less smooth roads and there are markings on it, then the system, for example, can easily drive in a traffic jam.

Figure 3. – The car position on the road with markings, maps, etc.

Is the humanity ready to use autopilot from a moral point of view? We supposed to be ready to use the autopilot system technically. And morally?We think not: the autopilot actions were began to discuss publicly only a year or two ago.

First, we should understand that autopilots will kill people not indirectly, but directly in accidents. What accidents and what people? The surveys showed that there were people willing to prosecute a person for the sake of the dog's life. Eight from ten respondents believe that the autopilot should kill its passenger, rescuing a group of people. Really? Two from ten respondents wanted to save others at the cost of their own lives (Figure 4).

Another questionnaire showed that we are ready to take autopilot's choice, giving the right to choose the victim less valuable to our society. That is, it is better to hit an old criminal than the young one with the car, but due to some peculiarities of racial crime autopilot must kill five times more black people than white.

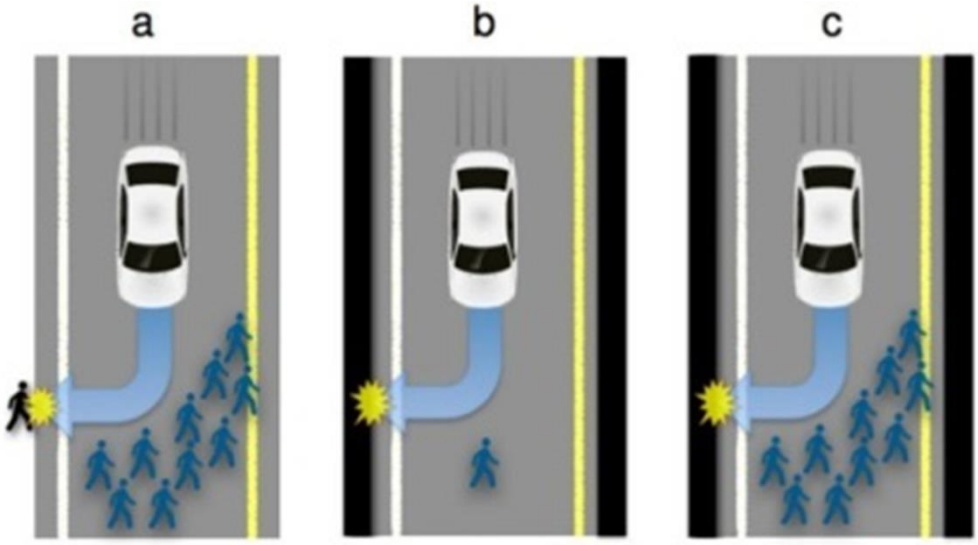

Fig. 4. – Several choices for the autopilot system.

The autopilot will also reduce the total loss of humanity from accidents. The number of victims will decrease by 30–90 percent. The issue of responsibility can be transferred to the money issue. By reducing the total number of accidents, insurance affiliates with automakers will be able to pay back enormous compensation to the relatives of the victims, and will reduce the level of negative attitude.

What will the autopilot system bring to the economy of the planet?

The eco-friendly benefit of the use of autopilots is noticeable on a planet's scale. Fuel companies will suffer. Within the limits of the states economy will make up to 160 billion dollars. Together with the proliferation of electric vehicles, this is an important factor in the pressure of oil prices and various energy superpowers. Transportation will be cheaper and easier. Three quarters of the transportation cost

is the driver's work. Worldwide the cost of transportation will decrease by about a half, and the profitability will increase by means of 90 % of drivers' dismissal. Some food will fall in price. And reducing the price for transporting sand or concrete will decrease the price for the whole construction. Savings are estimated at 180-190 billion dollars only in the United States, but service and medical companies will not receive the same amount of money.

Now more than 80 companies, from the world's largest manufacturers to start-ups are developing the autopilot. Among those who have already announced their projects are Tesla, Volvo, Baidu, Roborace for autonomous racing cars, Nutonomy and WEpod for public transport systems and taxis.

Audi, BMW, Ford and Mercedes-Benz are also working on the auto pilot systems. A number of new cars with autopilot is expected to be announced in 2018-2019.

References

1. https://ria.ru/technology/20161123/1481922845.html
2. https://moscowteslaclub.ru/blog-tesla/obzor-tesla/tesla-edet-po-moskve-sama/
3. https://geektimes.ru/post/278534/
4. https://www.youtube.com/watch?v=1MC033dZzKw
5. https://www.youtube.com/watch?time_continue=121&v=EwDrhQ7bEFg

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THE REVIEW OF AVAILABLE DOOR CONSTRUCTIONS IN BUSES AND COACHES

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The doors of the passenger bus, whether it is a coach, or an urban low-floor bus, can be identified as a separate niche for design and design work. It`s interesting to know that, in a single body in front and rear door sections different door systems can be installed. And this is not a desire of originality, but complex design calculations. Today there are four main types of bus doors: folding, lean-rotary, sliding and lean-sliding.

It is known that the classic type of doors is folding screen, doors ZIS-154 in appeared in the middle of the 20th century. This retro design has a number of valuable qualities. The first is the folding screen, consisted of several doors. It does not take much space in the cabin while opening. The second is the drive characterized by a minimum load on the rotary mechanisms. The third is the mechanism, specified by rapid doors opening and closing. The main disadvantage of such doors is the difficulty of ensuring tightness and thermal insulation. In addition, there are more moving elements in the "curtain", that it requires frequent maintenance. Such doors are less reliable than other. Therefore, more and more

manufacturers prefer more modern designs - lean-rotary doors consisting of two independently movable integral parts.

The mechanism of the lean-rotary doors is often called planetary, that is when you open the door, it rotates around a certain point and the movement of this point is follows by a special trajectory. This type of door systems allowed designers to improve the air tightness, increase the vision area, and locate inclined railings inside of the door. This is especially important for low-floor buses, such as (LAZ-183, Bogdan A701, VAZ A11110 Romashka). In the open state, these doors take a decent amount of storage space on the sides of the door and require the installation of enclosing areas for door opening.

The next type of doors is sliding. It is more typical for rail passenger transport. However, it is adopted by some bus manufacturers, mostly in Asian countries. For example, Korean buses such as Hyundai, AeroCity and Daewoo BS106 in their rear doors use a single-wing sliding design. The moving parallel to the side, occupies relatively little space in the cabin and it can be closed with any bus scrum. Besides it has good tightness, operation speed and simplicity of the mechanism. The disadvantages, of such doors are increased longitudinal dimension pocket causing, certain limitations in the cabin layout.

Maximal airtightness and increased sound insulation are the main distinguishing features of the other type of door systems, namely lean-sliding. These doors do not require additional space in the cabin when they close. This is one of the main characteristic that distinguishes them from above mentioned constructions. Such an opening mechanism is more complicated than in rotary doors and, therefore, more expensive in service. According to the design of the lean-sliding doors, we can determine the purpose of the bus: intercity or suburban. Intercity buses coaches have doors larger than suburban ones. If we consider the possibility of using these doors in city buses, we'll have two preventive things. First, the difficulty of closing when the bus is overcrowded, and second the availability of massive levers appearing in the cabin while closing the doors. By the way, bus manufacturers manage to neutralize this defect, in various ways moreover – to turn it into dignity. For example, in ATAMAN A092H6 buses the levers serve as handrails, for passengers getting on or off the bus.

It should be added that recently suppliers of components specializing in development of door components began to help bus plant engineers. For example, the company CAMOOZZI is the most massive and famous bus manufacturers. Design solutions are implemented in close cooperation with the customer, with special attention paid to safety (in particular, door control systems on microprocessors are offered), abrasion-resistance and reliability in operation.

References

1. Larry Edsall, Masters of Car Design 2008. 320 p.
2. American Design Ethic: A History of Industrial Design. 1986. 190 p.
3. Tony Lewin., How to Design Cars Like a Pro. 2010. 208p.
4. Jordan Meadows., Vehicle Design: Aesthetic Principles in Transportation Design 1st Edition. 2017. 240 p.

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ELECTRIC DRIVE CONTROL PRINCIPLES IN MODERN ELECTRICCAR

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This article present an analysis of existing methods, which can significantly improve the efficiency of the traction motor electric vehicle. The use of vector control of electric parameters of traction motor of electric vehicle is substantiated.

The use of the frequency converter is aimed at solving important tasks. They realize the control of the torque and speed of the electric motor. These requirements indicate the need to limit the current of the engine, as well as the moment of acceptable values. This is done in the processes of starting, braking, and also when changing the load of an electric vehicle.

Doing this is necessary in order to limit the dynamic shock loads in the mechanism of the frequency converter. At the same time there are overloads during operation and the need to adjust the torque of the engine, which is executed continuously.

The first method of control is scalar. The peculiarity of scalar control lies in its prevalence. In addition, frequency converters with scalar control are used where it is important to maintain a certain technological parameter. The change in the amplitude and frequency of the supply voltage serves as the basic principle on which this method is based. This uses the U / f law. The largest range for speed control is 1:10.

The second method used by the frequency converters in the control of the electric traction device of the electric vehicle is a vector. This is a method of controlling synchronous and asynchronous motors, in which not only harmonic currents (voltages) of phases are formed, but also control of the magnetic flux of the rotor, namely, the moment on the shaft of the electric motor.

Vector control is used in the case when during operation the load can vary at the same frequency, that is, there is no clear relationship between the load moment and the speed of rotation, as well as in cases when it is necessary to obtain an extended range of frequency regulation at nominal moments.

Vector control systems are divided into two classes - it is pointless and with feedback. Scope allows you to determine the application of a particular method. The use of gauge systems is possible when the speed of the traction motor of the electric vehicle changes by no more than 1: 100, and the accuracy of the speed support is no more than ± 0,5%. With analogous values of 1: 1000 and ± 0.01%, it is appropriate to use feedback systems.

The advantages of the vector control method are the reaction speed relative to the load variation, and in the region of low frequency rotation of the engine is characterized by smoothness, lack of jumps. Attention attaches the support to the shaft at the zero speed of the rated torque if there is a speed sensor. Speed control is performed when high accuracy is achieved. All of these benefits are important in the practice of electric vehicles.

If in the scalar frequency converters the object of control and control is only the magnetic field of the stator, then in the vector models, the object of control and control is the magnetic field of the stator and the rotor, or rather, their interaction to optimize the rotational speed at different speeds.

Indirect position indicators. These observers are used in idle drives. To measure the position of the rotor, they use the magnetic inhomogeneity of the properties of the engine. For example, asymmetry of windings or heterogeneity of magnetic permeability.

Recently, in the literature, observers are quite popular to measuring and using high-frequency injection method. The method consists in generating a power inverter of the high-frequency test signal and a search for a reaction to this signal of the real position of the rotor. The speed of the rotor while evaluated as a differential position.

On the one hand, it is quite complex and characterized by additional losses and increased noise level. On the other hand, its accuracy strongly depends on the properties of a particular engine. Applicability of this method should be considered individually.

Orientation measuring mistakes. These observers are used in idle drives. They determine the position of the rotating coordinate system, using the internal signals of the control system, depending on the error of its orientation.

Non-adaptive observers are based on engine models. These observers are used in asynchronous drives with speed or position sensors. Using the formulas of the model of electromagnetic processes of the engine, they, in known quantities, simply calculate the estimates necessary for the regulation of unknown quantities.

Adaptive observers are based on engine model. Observers can be used in sensor and in idle drives. The basis of these is also the model of electromagnetic processes occurring in the engine. These observers are built as tracking systems, and besides the model, they also contain a controller that adapts the model to real processes occurring in the engine or drive. In foreign literature, they are called MRAS - Observers (Motor Referanse Adaptive System). Several of these systems are considered in this publication.

Observers based on Kalman filter. Observers based on the Kalman filter are used in idle drives. This observer is a kind of digital filter whose algorithmic construction is based on the laws of mathematical statistics. It allows you to restore an unknown parameter, while minimizing the effect of interference with the measurement of known quantities.

Observers based on the Kalman filter are characterized by the complexity of the computational algorithm and, in theory, should be able to obtain high accuracy of observation. The real accuracy of this observer depends on the accuracy of the knowledge, which are considered to be known, the parameters of the engine and drive. In practice, these parameters are not exactly known and, moreover, they can still change in the process of work.

Adaptive rotor resistance observer. Non-adaptive flow monitor allows you to calculate the amplitude and angle of the rotor flow vector when knowing the angle, currents and parameters of the engine replacement circuit.

If the speed is known, then the adaptation of the model to this observer can be done by any other unknown parameter. The first thing that comes to mind - to adapt to the resistance of the rotor, because it's something we need to know. However, in the model of the complete order, there are two thermosensory components of the substitution circuit.

In the work, the justification of the use of vector control in the frequency converters of a traction electric drive was substantiated, which allows to significantly increase the efficiency of using the battery of the electric vehicle. It was found that the weakness of the control systems is the presence of sensors for the position of the rotor.

It has been determined that the position sensors of the rotor depend on external factors and temperature.

References

1. Electric car: engineering and economics / VA Shchetyna and others. L .: 1987.

2. Kenio T., Nagamory S. DC motors with permanent magnets. M .: Energoatomizdat. 1989 - 184 pp.

3. Murray A. Sensorless Motor Control Simplifies Washer Drives // Power Electronics Technology, June 2006. - p.14-21.

4. Brazhnikov AV Increasing the rotation of rotation evenly-phase frequency controlled electric motor // Collection of scientific works "Improving the efficiency of mining equipment during development of mineral deposits". - Krasnoyarsk: Publishing house GATSMiZ, 1995. - P. 39-56.

5. Kochetkov VP, Brazhnikov AV, Dubrovsky I.L. The theory of the electric drive. - Krasnoyarsk: KPI Publishing House, 1991. - 140 p.

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THE TECHNOLOGY OF REGISTERING TRAFFIC PARAMETERS OF THE VEHICLE

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Many automated systems are set in modern vehicles. Most of them are mandatory due to the standards of the countries of the European Union, but the fixation system is still necessarily installed only on vehicles that are used only in the United States. The reason why the system of fixing its movement parameters is not installed on all cars in the world is the reliability of the results of fixation, although to date most of the physical phenomena occurring during the motion of a wheeled vehicle have been studied.

The reliability of fixing options greatly depends on the algorithm of the system as a whole or algorithm processing signals from sensors that capture the motion of the vehicle parameters (speed, acceleration, angle of the steering wheel and the wheels). Analysis of the scientific and technical literature showed that the

algorithms used in the system of fixing the parameters of the vehicle can be divided into three types: software, algorithms based on current information to fix the system memory and memory protection algorithm of the accumulation of false information. The algorithm has the highest third type of immunity, both in relation to high interference environment and their own noise occurring in the system.

By using algorithm-guard, which allows to load in memory an incoming stream of information to identify false and dubious information (different types of errors, failures that can occur under the influence of various factors on sensors) in order to choose the decision came only through information recognized reliable.

Algorithm-keeper can improve the quality of the system of fixing the parameters of the vehicle, by introducing virtual time value t′ at a fixed rate of false values of wheel speed sensor.

Different systems installed in the car use the same information for its work. Thus the information can be direct and indirect.

The information for control systems can be of three types: information about the control action, information about the external environment, information about the output parameters of the system.

Information about the external environment. Information support in our time is developing in a promising way, as information about the external environment influence on the operation of the car's accident prevention systems to prevent an accident (the concept of zero accident rates). The wheeled vehicle uses the environment to change behaviour during the formation of the period before the accident, as well as in emergency conditions in order to avoid road accidents in general.

The external environment can be divided into information such as "vision" of the vehicle and "communication" of the vehicle, the "vision" of the vehicle consists of scanning wave sensors (radars, lidars, sonars) and video cameras (Fig. 1). "Communication" of a vehicle is a system that is used for communication between cars or between a car and infrastructure (and backwards), as shown in Fig. 2.

Information about vehicle's output parameters. Information on the output parameters of the vehicle movement is divided into information on operating conditions and information on the parameters of the dynamics of the vehicle's movement. The systems of increasing passive safety use sensors that determine the dynamic state of the car. For example, the airbag smoke control system is based on the information from the acceleration sensors, the active seat belts pre-tension also depending on the acceleration increase of the car.

Active safety systems are mostly based on the evaluation of dynamic variables. The more accurate the evaluation of these variables online, the better overall performance of the control system is [The Tire as an Intelligent Sensor]. However, most of the dynamic variables are determined indirectly. Information support base of the car completely depends on the sensors.

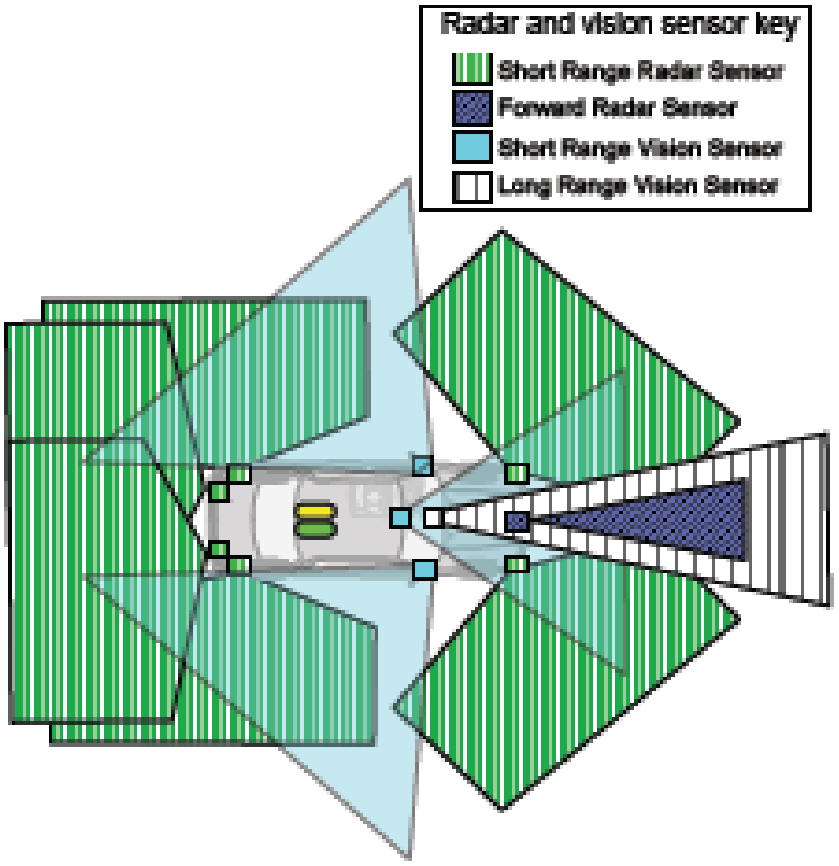

Figure 1. – Integrated Vehicle-Based Safety Systems

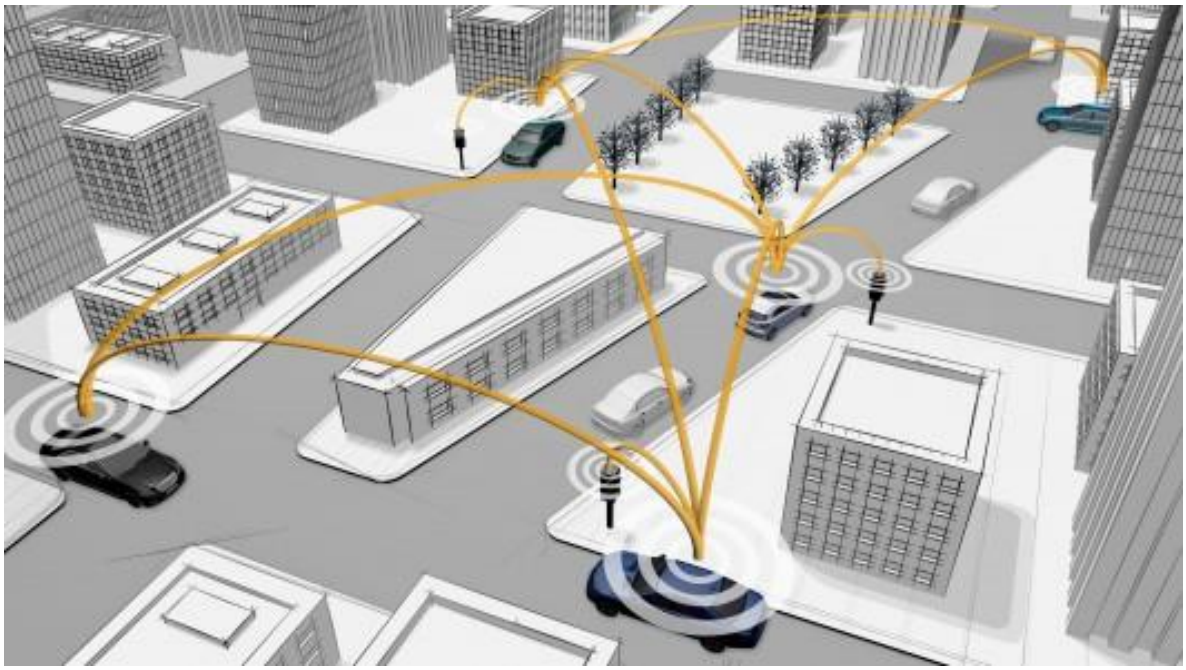

Figure 2. – "Communication" of a vehicle

Conclusions. Today, automated systems are already considered to be one with the vehicle and in the case of improving such important systems as: Passive and active safety system. The availability of information from various sensors of automated systems makes it possible to objectively assess the circumstances of the occurrence of road accidents only taking into account modern methods for analysing the information field of automated systems.

References

1. Реализация интеллектуальных функций в электронно – пневматичном тормозном управлении транспортных средств: монография / О. Н Туренко, В. І Клименко, В. А. Богомолов, Л. А. Рижих, Д. Н. Леонтьев, О. М. Красюк, Н. Г. Михалевич. – Х.: ХНАДУ, 2-е издание, дополнено, 2015. –450 с
2. Regulation № 13 of the Economic Commission for Europe of the United Nations (UN/ECE) – Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking: on condition 30.09.2010 – Official Journal of the European Union – UN/ECE, 2010. – 257p.
3. Дослідження обставин ДТП: підручник для. Т86 вищих навчальних закладів / А.М. Туренко, В.І. Клименко, О.В. Сараєв, С.В. Данець. – Х.: ХНАДУ, 2012. – 320 с.6.

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CONSIDERATION OF THE PARAMETERS OF INFLUENCE ON THE AUTOMOBILE DIESEL START QUALITY

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According to GOST R 54120-2010 the reliable start of a cold diesel engine equipped with all attached implements, should be ensured by not more than three attempts to rotate the crankshaft of the engine with a reliable starting system. One attempt is standardized with a pneumatic starter – 5 seconds and an electric starter – 15 seconds [2]. In Ukraine, there is not a corresponding standard; however, the conditions of the car engine usage and the requirements for performance characteristics do not mostly differ. Pointing out the relevance of work to improve the starting qualities of diesel engines it should be noted that, depending on the ambient conditions and the engine size, starting the diesel engine can take up to 20 minutes for cars and 2...3 hours for trucks at a temperature below –20 Celsius.

The problems of starting the modern diesel engines are mostly related to the cold-starting at low-temperatures [1–7]. In the regions of this country the near-surface air temperature has not decreased below –35 Celsius in the wintertime since the middle of the last century. Nevertheless, starting a diesel engine without the means of starting aid becomes a problem already at a temperature below 5 Celsius

[4]. This is due to the temperature dependence of kinematic viscosity, heat capacity, possible precipitation of the sediments in working fluids, etc. It is also important to consider significant losses of heat during the engine operation through its cold parts and raised gaps.

To guarantee diesel fuel ignition in compressed air it is required to reach air pressure of 1.5...2.5 MPa and temperature of 300...345°C [1]. Air density that depends on air parameters defines the coefficient of filling the cylinder which stipulates the pressure in the end of compression stroke and the temperature during the fuel injection.

An important characteristic of the diesel engine is the level of wear of the friction surfaces that could reach 50-75% during engine preparation to take the load [6], and each cold start corresponds to 2...3 hours working under load. As it follows from the above-mentioned, the problem of a quick start of a diesel engine is supplemented with providing satisfactory conditions of lubrication at the moment starting [4, 5].

According to the results of the study of suggestions as to the ways of improving the diesel engine starting, several directions of enhancing qualities can be identified (in particular, by the degree of applicability): usage of special liquids, stable at low-temperature, as well as addition of flammable substances into the fuel or inlet manifold [1, 4]; volumetric heating of oil, coolant, fuel [3]; increasing in speed of the starter rotation [4]; local heating the places of excessive mechanical resistance to friction, intake air [4, 5].

For the start-up process, it is necessary to provide the indicator torque of the working process in the cylinder that is greater than the current torque of the crankshaft rotation resistance excluding the moment of inertia of the engine moving parts of the engine reduced to the crankshaft. The condition of the engine starting is presented in the form of dependence (1), Nm.

$$\int M_{i\_cyl} d\varphi > \sum \int M_r d\varphi + \int J_{inert\Sigma} \frac{d\omega}{dt} d\varphi \qquad (1)$$

where M_{i_cyl} is a current indicator torque, $\sum M_r$ is a sum of current torques of crankshaft resistance, $d\varphi$ is a generalized coordinate of the crankshaft position, degree of crank rotation, $J_{inert\Sigma}$ is a moment of inertia of the engine moving parts reduced to the crankshaft, ω is an angular rate of crankshaft revolutions, c^{-1}, t – time, s.

The parameter of starting qualities optimization is the minimization time of achieving the starting conditions. In such a manner, it is necessary to influence the factors that lead to a more intensive increase of the magnitude $\int M_{i\_cyl} d\varphi$ and, accordingly, the reduction of $\sum \int M_r d\varphi$ and $\int J_{inert\Sigma} \frac{d\omega}{dt} d\varphi$. The first condition is fulfilled with the increase of $\int p_{i\_cyl} d\varphi$, where p_{i_cyl} is the current pressure in the cylinder during the work stroke, that is, optimizing the conditions of ignition and

combustion of the mixture in the cylinder. Another way is to increase the number of work strokes per a unit of time by speeding up the engine. In the two-stroke engines this parameter is twice better than that in the four-stroke ones.

The resistance torque consists of internal friction of moving parts, drive moments of auxiliaries and the mixture compression in the cylinder. The latter are the forces losses that can be set off by a self-contained starter motor to keep on rotation. A possible solution is a kinematic locking of units which do not work at the moment of starting-up. Reducing frictional losses is achieved by reducing the friction coefficients, reducing normal loads on the friction assembly, and providing better conditions for greasing.

As for $J_{inert\Sigma}$, the engine is usually not capable of changing the inertial parameters of the moving parts. Their influence is based on the action of the inertial component and at the period of their deceleration the magnitude $d\omega/dt$ becomes negative, which allows to keep the motion of the crankshaft. There are some designs of flywheels with variable moments of inertia, which allows to influence the starting characteristics when changing external factors.

When deciding on the application of certain measures to improve starting, we should follow the requirements of reliability, durability, economy and environmental standards. The first priority is solving the problems of resistance to the crankshaft rotation by checking driving units and possible improvement in their layout, the possibility of reducing the compression ratio for unloading the crankshaft. The next stage is a revision of possible measures to reduce friction of moving parts of the engine due to organizing the better greasing conditions by using suitable engine oils and the design of the greasing system, as well as the materials, geometry and quality of the friction surfaces. The final task will be the determination of the minimum required starting speed for obtaining a qualitative working process and the moment of inertia of the moving masses at this speed, calculation of the total moment of resistance to the crankshaft rotation for selection of the necessary starter of the starting system.

Thus, the tasks are set and the approach is proposed to deepen knowledge about diesel engines and to improve their operational parameters. Some modern requirements to starting systems of diesels are substantiated. The existing means for improving the starting and preparing the engine for being loaded are considered. The methods of studying and comparing the factors of influence on the starting characteristics of the ICE are proposed.

References

1. Гуреев А. А., Синицын В. В., Щеголев Н. В. и др. Топлива, смазочные материалы и жидкости для эксплуатации автомобилей и тракторов в северных районах. М.: Химия, 1976. 184 с.

2. Двигатели автомобильные. Пусковые качества. Технические требования / Национальный стандарт Российской Федерации ГОСТ Р 54120-2010 от 21.12.2010г. М.: Стандартинформ. 2011.

3. Деркач В. Л. Аналіз використання передпускового підігріву для

автомобільного транспорту. *Наукові нотатки*. 2013. № 43. С. 75–78.

4. Казаков А. В. Методика оценки эффективности устройств облегчения пуска холодного двигателя автомобиля: дис… канд. техн. наук: 05.22.10. Оренбург, 2018. 137 с.

5. Мараховский В. П. Низкотемпературный пуск форсированных дизельных двигателей. *Двигатели внутреннего сгорания.* 2004. № 2. С. 135–137.

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THE HISTORY OF DEVELOPING THE CAR BODY SHAPE

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The body shape of a car has a very long history of development from carriages to streamlined rapid shape design. It is directly related to the design, layout of the car, materials used in the industry [1]. Human needs influence on the shape of the body, such as: ergonomics, speed, fuel economy, safety (passive), new directions in design.

The development of body has seven stages. They can be called: the early period; the pre-war period; the post-war period; the 60–70s; the 80s; the 90s; the 2000s.

In the early period internal combustion engines were installed in the carriages, that were fenced off from the passengers by a fire-prevention partition. A radiator was installed in front of the engine for better airflow. This design had an unaesthetic appearance. To hide the prime mover, they began to cover it with a metal “box” with opening sides to access the engine. The shape of the hood was set by the shape of the radiator. On the sides of the engine compartment installed lights to illuminate the road. Some manufacturers used a decorative lining, which gave the car individual features. Thus, the appearance of a car of an early period was formed (Fig. 1).

Gradually, the car acquired a more dynamic look [2]. Forming shapes were harmoniously interconnected. There was a division of the body into two visual volumes, the ratio of which set the visual perception of the car. For example, in sports cars, the volume of the engine compartment was elongated, and the passenger was shortened. This created a feeling of high power and high speed. Passenger cars had the opposite: emphasis was placed on roominess.

Fig. 1. Closed and open-type cars: their early period

The end of the early period is characterized by a composition of previously unrelated geometrical forms into the single whole body. There were smooth transitions from one volume to another. Belt horizontal line appeared along the entire length of the car, emphasizing the unity of geometric shapes. Sometimes this line was emphasized with a chrome molding. The wings became more massive and graceful.

At the beginning of the pre-war period, much attention was paid to the design of the car. The design was almost unchanged.

The breakthrough in the automotive industry was an all-metal closed body, and the wooden elements of the frame were becoming a thing of the past. Such a body was much more technological, lighter and stronger. With the arrival of the closed body, the number of cars on which it was installed increased.

At that time, people preferred to choose a more beautiful and technically perfect car than just a technological and cheap one. The concept of "automotive design" appeared. Designers replaced engineers. This did not mean that the engineers did not try to make the car more beautiful, just when creating the body they were repelled by the shapes of the units, the layout and the manufacturability. Designers began to perceive the car body as a whole and independent of the chassis. Shapes began to be determined by the laws of design. If earlier the shape of the body was determined by the construction and production technology, then it became the opposite: the shape called for inventing new solutions and approaches to design and production.

The end of the pre-war period is characterized by the fact that incline lines were basic in the car shape. Shapes have become smoother [3]. There was a feeling that the oncoming air flow deforms the car. Low roofs have become fashionable.

A bright sample of such a car is Tatra T77 with its original drop-shape body (Fig. 2).

During this period the body shapes divided into: sedan, wagon, etc.

The post-war period is characterized by the fact that instead of separate volumes of the rear and front wings, a solid volume with a smooth sidewall appeared there. The proportions of the car have improved, the body has become lower. New solutions allowed to make the body not only elegant, but more spacious, without increasing the size of the car. Smooth roof slope, smooth sidewalls, devoid of any decorations, successful proportions of the bearing body made the car streamlined.

Fig. 2. Tatra: drop shape car

Fig. 3. Rational body with chopped contours

It was at this time when the shape of the body was formed, which fundamentally divided the cars into pre-war and post-war. The evolution of the body shape of production cars was reduced to a decrease in the number of visual volumes, their merging with each other. This led to the emergence of all of us known three-volume body.

In the mid-fifties, the tendency to use aviation motifs in styling reached its peak. Cars of this period often directly copied the elements of the external appearance of aircraft, as a rule – combat fighters.

The sixties are characterized by a simplified design. An individual, specific to the automotive industry, design language emerges that best expresses the properties and qualities of a passenger car – a fast and comfortable vehicle. Angular shapes are coming back. The body becomes simple and rational with "chopped contours". The chrome-plated body is a minimal (Fig. 3).

In the eighties design was changed. Now the shape of the car was determined by the laws of aerodynamics. Angular contours of cars of those times changed streamlined aerodynamic shape. Intensive research began in the field of aerodynamics [4].

By the mid-80s, this form has become generally accepted. Only a few manufacturers adhered to the style of the past, borrowing only a few elements from the new streamlined style. Characteristic features of the new direction are: a wedge-shaped body with smooth contours, a minimum number of protruding decorative parts, large block headlights, large rear windshields, a sloping hood, large bumpers and sidewalls, small grilles, spoilers and aerodynamic cover plates, streamlined rear view mirrors (Fig. 4).

In the 90s, aerodynamic style continued to develop the that appeared in the 80s. Cars were not much different from their predecessors. Large plastic bumpers began to be painted in the body color instead of the previously used black ones.

The mid-90s gave rise to "biodesign" [5]. It is characterized by the fact that cars have received a streamlined shape inherent in nature. Shapes became rounded and the volumes merged almost into the one body (Fig. 5).

Fig. 4. Shape created under the influence of the aerodynamics laws

Fig. 5. A shape of the car comprises the trend to merge volumes

At the beginning of the new century, the tendency to merge all volumes into one disappears. Modern cars have received pronounced body volumes with a rational geometry [6].

Nowadays, there is a complicated body shape with a deviation from rational computer geometry [7]. Great influence on the body shape has the requirements of vehicle passive safety. Aerodynamics is improving. Each element of the body is

merged into the other, and add each other. For example, new headlights are the continuing of the grille lines, etc. (Fig. 6).

Fig. 6. Modern car body shape

After analyzing the stages of developing the car body shape design, we can conclude that sometimes the trends of past times return. And if we try to look into the future, we can assume that biodesign with its inherent natural forms will again find its place.

As for our familiar cars, which are driven by people, the shapes will become more futuristic, unusual for us. There are cars ahead of time.

This suggests that we are on the edge between the current and the future period of development. A new stage in the development of car design is near, and soon we will see something that will fascinate and amaze us.

References

1. Песков В. И. Основы эргономики и дизайна автомобиля. Нижний Новгород, 2004. 225 с.

2. Розанов Н. Автомобиль в поисках индивидуальности. *Автомобили*. Вып. 1. 1998.

3. Розанов Н. Нарисованные ветром. *Автомобили*. Вып. 12. 1998.

4. Рожнов И. Аэростиль. Часть первая (1948-1953). *Мотор*. Вып. 5. 1998.

5. Розанов Н. Автомобильный дизайн переходного периода. «ТЕХНО» *Автомобили*. Вып. 1. 2001.

Mirzoshoiev S. F.

IMPROVING THE METHODS OF CAR MAITENANCE BASED ON THE DIAGNOSTIC TECHNIQUE INFORMATION

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Motor transport enterprise diversification, consolidation, and the development of entrepreneurship have resulted into the polarization of automobile fleets and the concentration of a significant quantity of cars at a limited number of small enterprises. The current maintenance and repair system was formed on the basis of a simplified transport infrastructure operating model: the car basically works linked to the motor enterprise it belongs to.

At the same time, the entire vehicle maintenance and repair station was concentrated within the framework of a specific PJSC and a full range of repair works was carried out locally. In the established maintenance and repair system, the inflexibility in terms of ensuring the trouble-free on-route vehicle operation manifests itself in the uniformity of approach to the useful life of a car: the list of functions and the frequency of MOT are identical both for a brand-new car and the one subject to major repair and earmarked for write-off.

The gradual development of new modes of transportation has led to an increase in the time spent by the rolling stock operating outside the limits of the main production base, and, as a result, has increased the role of preventive maintenance of vehicles. Therefore, the creation of a flexible “adaptive” vehicle technical condition control and management system containing the elements of case-by-case approach for each particular car has become a priority task [1, 400].

The adaptive vehicle maintenance and repair system (MOT and R) is meant to be a system that can adapt to changes in internal and external conditions due to changes in its structure and parameter values. The level reached by modern technical diagnostics (TD) makes it possible to virtually implement any task necessary to identify and predict the technical condition of cars during their operation.

Thus, when carrying out vehicle technical maintenance, the introduction of basic principles of the “adaptive” vehicle technical condition control and management system with elements of case-by-case approach for each particular car requires operational control of the current state of the car, the development of multi-factor forecasting models and the creation of a database that allows the use of modern information and analytical technologies in TD [2, 398].

Based on the results of analysis of the current state of motor transport (MT) and its subsystem, namely, technical operation of vehicles (TOV), it was revealed that the bulk of the cars in Ukraine is concentrated at small and large enterprises. This has brought about organizational and technological vacuum, resulting in virtually uncontrolled operation of cars at most small enterprises of motor transport, worsening of the rolling stock technical status (TS), an increase in the number of accidents caused by malfunctioning of cars and environmental pollution. The current TM and R system applied in technical operation of vehicles that sets the average mileage and the work content of their technical impacts and allows the use of a number of adjustment factors for a particular vehicle leads to significant cost increases necessary to maintain the efficiency of the rolling stock.

Due to the use of in-car on-board diagnostics, the development of satellite navigation systems, mobile communication and modern technologies, it has become possible to carry out remote monitoring with an assessment of the level of vehicle technical condition, which makes it possible to virtually implement any task of detecting and forecasting the vehicle technical condition. This, in turn, allows switching to an adaptive TM and R system of cars, the key point of which being the development of information and communication system as well as a base of predictive models, which provide through monitoring the remote reception of the necessary current information obtained from the rolling stock, further processing and producing corrective adjustments [3, 312].

To implement the adaptive system of TM and R of cars, an information and communication model of the vehicle remote monitoring system in terms of operation was developed on the basis of the general approach to the study of the system «Car – Driver – Operating Conditions – Infrastructure of Vehicle Operation (transport and highways)», which includes the system of monitoring components interaction: the car including the driver and an on-board information system (On-Board Information Complex); conditions of vehicle operation (road, transport, atmospheric and climatic conditions and the labor culture); the transport infrastructure and the road infrastructure. To implement the synthesis and analysis as well as the formation of possible options of information system schemes for carrying out vehicle monitoring under operating conditions, morphological analysis of the investigated system was used. This makes possible the formation of possible options of the information vehicle monitoring system under operating conditions in the form of dependencies (schemes).

A structured information model of the information software complex (ISC) "IdenMonDiaOperCon "HNADU-16", which actually provides the operation of the information system used for evaluating the parameters of the vehicle technical condition under operating conditions, is created. The developed models of the information and communication system database used for monitoring the parameters of vehicle technical state in the form of a plurality of components and the elements of the information system, technical parameters of the vehicle engine, technical parameters of the vehicle state and parameters of the vehicle operating conditions actually describe it within the scope of the research objective. Analysis of the information structural elements of the model of monitoring system of the vehicle technical state parameters made it possible to determine the set of monitoring system consisting of 60 elements, as well as the set of elements of the group consisting of 7 elements, the current general information element for all 7 information groups - «Time of data collecting», which is an essential element due to the semantic dependence of the received data on monitoring the parameters of the vehicle technical condition on the time of data collection. The data obtained as a result of the analysis carried out is sufficient to create a database management system for monitoring the parameters of the vehicle technical condition under the operating conditions of relational type [4, 488].

As a result of experimental research, the structure and interconnection of the information software complex functional capacity was developed with a view to obtain information on the vehicle operating conditions, the basis of the system interaction of which are the following main functions: provision of position determination and monitoring of vehicle technical condition parameters, solving the task of assisting the driver while operating a vehicle, provision of vehicle transport safety. To study and evaluate the operating conditions during the processes of monitoring the parameters of vehicle technical condition, the means of monitoring the infrastructure of motor transport and motor roads that allow within the information software complex (IPC) to combine information on transport, road, atmospheric and climatic conditions of the vehicle operation state on the network operator server were used. The result of the processes of monitoring the vehicle workflow under operating conditions was to determine the actual parameters of the

vehicle technical state itself, to adjust the operating conditions, and to precisely determine the location and exact time according to the parameters produced by the navigation satellite systems implemented by the GPS receiver and exchange this information with the workplace of vehicle operating processes monitoring as well as other participants of monitoring the vehicle work processes. The development of identification, monitoring and diagnosis algorithms that enable to predict the parameters of the vehicle technical condition was performed, using the information software complex (IPC). With the help of developed algorithms and the information monitoring system, transport and road infrastructure, there was carried out a study of the vehicle technical state parameters and operating conditions. The application of the developed algorithms makes it possible to automate the process of monitoring the vehicle technical state parameters within the framework of the developed ISC «IdenMonDiaOperCon «HNADU-16» by means of ITS. Generally, the overall error rate does not exceed 15% [5, 222].

References

1. 1 Транспорт і зв'язок України за 2014 рік. К. Консультант, 2015. – 222 с.
2. Автомобільний транспорт України: стан, проблеми, перспективи розвитку: Монографія / Державний автотранспортний науково-дослідний і проектний інститут; За заг. ред. А.М. Редзюка. – К.: ДП «Державтотранс НДІпроект», 2005. 400 с.
3. Говорущенко Н.Я. Техническая эксплуатация автомобилей / Говорущенко Н.Я. – Х.: Вища школа, 1984. 312 с.
4. Техническая эксплуатация автомобилей: учебник для вузов / Под ред. Г.В. Крамаренко. – Изд. 2-е, перераб. и доп. – М.: Транспорт, 1983. 488 с.
5. Волков В.П. Интеграция технической эксплуатации автомобилей в структуры и процессы интеллектуальных транспортных систем. Донецк, Изд-во "Ноулидж", 2013. 398 с.
6. Зубрицкас И.И. Адаптивная система управления техническим состоянием автомобилей. Монография. Депп. ВИНИТИ, № 555 – В2004.05.04.2004 г. – 136 с.
7. Волков В.П., Матейчик В.П., Комов П.Б. [та ін.] Інформаційні технології в технічній експлуатації автомобілів. Харків, ХНАДУ, 2015. 388 с.

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LIQUEFIED PETROLEUM GAS AS AN ALTERNATIVE FUEL FOR VEHICLES

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The vehicle was invented at the turn of the last century and has had unprecedented evolution, providing a modern human being with the opportunity to overcome the long distances, comfort and convenience of travel. The development

of an automotive industry has ensured the rapid development of the oil industry. To its leading position in the world economy, it is largely obliged to the internal combustion engine (ICE). Today in Ukraine the problem is topical.

But it became apparent that the car gave rise to a number of problems, three of which can be considered universal. These are environmental problems, resource consumption and vehicle operation. Today, only the operation of the vehicle can be considered a technically solved problem.

Entering the XXI century, oil product manufacturers can not but ask themselves about the fate of today's motor fuel in the future. Will the world refuse from the ICE or from petroleum products such as motor fuel in favour of another source of energy – environmentally clean, efficient, inexpensive, whose resources, unlike oil, are unlimited. Today there are no answers to this question, but leading global automotive concerns invest billions of dollars in the development of alternative fuel technologies. In this direction, they are stimulated by ever-increasing demands for the environment of transport.

Currently, among many alternatives to fuel, the best chances to push traditional gasoline and diesel fuel are natural gas and alcohol, primarily due to its low cost and well-established production.

An increasing number of vehicles are converted into gas fuel. The main argument of "gasification" is a significantly lower price of propane-butane. With the fact that the purchase and installation of the system should cost about $350 US and the most expensive installation costs $ 500 US (for a four-cylinder engine), with the current ratio of prices for propane-butane and gasoline all costs pays off for 7-15 thousand kilometers of mileage, after which the owner of the car has a saving on fuel almost 2 times.

Another significant advantage of gas fuel compared to gasoline is that gas does not wash off the oil film from the cylinder walls, resulting in substantially increased engine life and prolonged service life of the engine oil. In addition, a larger octane number of propane-butane significantly reduces the probability of detonation processes, and the engine starts to work noticeably ‘softer’ than on gasoline. Another important argument is that in theory the exhaust of "gasified" vehicles is cleaner than that of cars with gasoline engines.

At the same time, there are also disadvantages that appear in the investigation of the transition of vehicles to gas. Firstly, it is a cylinder in the trunk or under a car that takes up space and needs some attention. It is necessary to carry a spare wheel in the luggage compartment if the cylinder is installed in place of the spare wheel. Secondly, the car becomes heavier by about 60 kg. Thirdly, additional maintenance costs of approximately 250 UAH, replacing two filters of rough and fine cleaning, expenses for repair and maintenance of the system. All this testifies to the fact that the topic of refurbishment of vehicles for gas fuel today is relevant.

Propane-butane (liquefied petroleum gas) is a mixture of two gases. Propane-butane is obtained from petroleum and condensed gas-bearing gas. For this mixture to remain liquid, it is stored and transported under pressure of 1.6 MPa (16 atmospheres). The process of refueling machines propane outwardly very similar to refueling gasoline, because it is liquefied gas.

These two gases (propane and butane) differ in their boiling point, at which they pass from liquid to gaseous state. Propane ceases to pass into gas and remains in liquid state at a temperature of -43° C, for butane this temperature is 0° C.

In this mixture, butane acts as a fuel, and propane in turn creates pressure. The percentage of butane and propane is regulated depending on climatic conditions. For example, in winter, at low temperatures, the amount of propane should be at least 70–80% (at such temperatures, the use of a mixture of propane and butane is more effective with an increased level of propane, which ensures the reliable evaporation of liquefied petroleum gas (LPG), and as a result of its introduction). In the summer, the proportion of propane in the mixture should not be more than 40%, as at high temperatures a mixture with a lower propane content is more effective (otherwise, excess pressure will be created in the pipelines and the cylinder, which affects the integrity of the entire system).

The heat of gas combustion is a little more than that of gasoline. However, with the increase in the amount of filing in the air engine, the heat of combustion decreases slightly. If the power of the engine running on gasoline is taken as 100%, then the power of the engine running on the gas will be approximately equal to 90% that leads to a decrease in the maximum speed by about 4% (in modern gas systems, this percentage tends to 0%), but do not forget about saving money. The world price of gasoline to gas is 10:6.

The decrease in engine power is due to lower gas combustion rates than gasoline. And as a result there is an incomplete filling of the engine cylinders with a gas-air mixture. The early installation of the angle of ignition at 3-5 degrees can eliminate this flaw sometimes. Under conditions of operation, there is no big difference in the gas or gasoline when driving a car.

Thus, equipment helps us to save moneyand make driving of cars with gasoline engines more accessible. Properly selected, installed and the configured equipment will not harm our car. This direction needs to be maintained and developed until other more accessible and environmentally friendly fuels or new electronics are available in Ukraine.

References

1. Набивач В. М. Якість авто бензинів та екологічна безпека / В. М. Набивач, В. О. Герасименко // Довкілля та здоров`я. – 2002. – № 2. – С.26–28.

2. Міхненко Є. Високооктанова кисневмісна добавка до бензинів // Міхненко Є. // Харчова і переробна промисловість. – 2002. – № 6. – С. 14–15.

3. Манусаджянц О. И. Автомобільні эксплуатаційні матеріали: / О. И. Манусаджянц, Ф. В. Смаль : підручник для технікумів. – М.: Транспорт, 1989.

4. Ємельянов В. Е. Автомобільний бензин й інші види палива: властивості,застосування / В.Е. Ємельянов, И.Ф. Крилов. - М. : Астрель, АСТ6 Профіздат, 2005. – 207 с.

Morozovskyi D. Y.

SPORTS AND RACING ELECTRIC CARS DEVELOPMENT TRENDS WITH AN APPLICATION OF A MULTISTAGE GEAR-BOX

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Nowadays in case of a quick oil depletion many automotive manufacturers move to the new level in their attempt to find and use alternative sources of energy. They are trying to use solar energy, hydrogen, electricity etc. as sources of energy. Development of automobiles with an electric motor gains momentum the most intensely. As we know, a great number of innovative technologies are basically arisen in the world of sports. Participants of world games such as 24 Hours of Le Mans (24 Heures du Mans), Formula E Championship, Formula SAE introduce newer and newer designs in their constructions of cars. The idea of creating a car to participate in circuit race competitions with a usage of an electric motor and a gear-box had arisen in the laboratory of rapid automobiles with the existing material base. Considering a modularity of constructions of KhADI cars, the task was to device a rear module using available units and aggregates. We began with setting parameters, namely, the maximum speed Vmax=220 km/h, the acceleration 11 m/s^2. We got the power value of 92 kW by calculating the required power of the motor using the following formula:

$$N_v = \frac{M_a \cdot g \cdot \psi_v \cdot V_{\max}}{3{,}6 \cdot 1000 \cdot \eta_{tr}} + \frac{\kappa \cdot F \cdot V_{\max}^3}{3{,}6^3 \cdot 1000 \cdot \eta_{tr}},$$

where M_a – automobile mass (575 kg),

g – acceleration of gravity (9.81 m/s2),

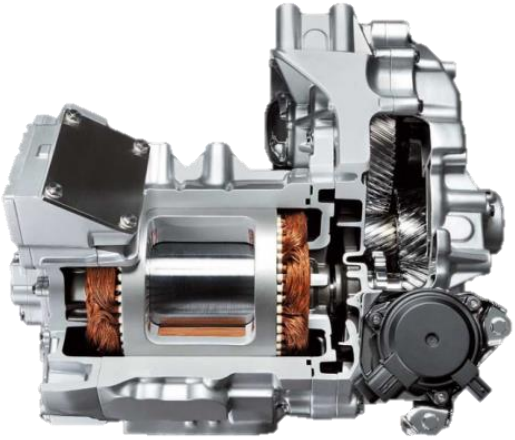
ψ_r – rolling resistance coefficient, which can be overcome by a car on the highest speed (0.012),

V_{max} – car required maximum speed (220 km/h),

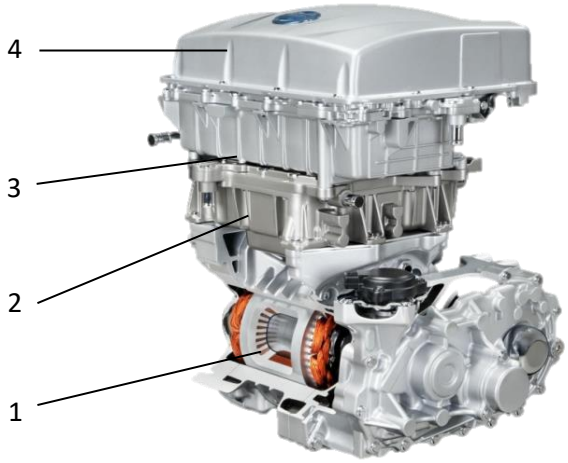
N_{tr} - efficiency of a transmission (0.9).

The Nissan Leaf car motor seemed to be the most suitable among all the nearest analogues (pic. 1).

The present electromotor has power of 90 kW, and torque reaches 280 Nm from the very beginning and stays constant from 0 to 2730 Rpm. There're a control unit and an inventor which are mounted on the motor. Also motor's provided with a water cooling system (pic. 2).



Picture 1 – Electric motor EM61, three-phase, synchronous



Picture 2 – 1. Electric motor. 2. Invertor with the power controller. 3. Control unit. 4. Cover of a control unit.

Lithium ionic modules were chosen as a feeding for the electric motor (pic. 3). The mass of each module is approximately 3.8 kg. The module has the following characteristics: tension – 7.6 V, capacity of each module – approximately 0.5 kWh.

Picture 3 - Lithium ionic battery module

The capacity of 24 modules having these parameters is enough for 30 minutes of using in a racing mode (with a maximum loading of the motor). It's about 35-40 km on the Ukrainian race tracks.

By analyzing analogues of racing automobiles, we concluded that a linkage including a multistage gear-box is used at most.

We calculated the main gear using the following formula:

$$U_0 = 0{,}377 \cdot \frac{n_V \cdot r_k}{V_{\max} \cdot U_{КП}},$$

r_r – radius of a car wheel rolling (0.283 m),

n_r – motor revolutions which provide the maximum speed (5000 Rpm),

U_{gb} – gear-box ratio which provides the maximum speed on the highest transmission (let it be the number 0.683 for a five-step two-shaft gear-box).

$$U_0 = 0{,}377 \cdot \frac{5000 \cdot 0{,}283}{220 \cdot 0{,}683} = 3{,}551$$

Further we determined the gear-box ratios.

Because we design a car for the racing, a very important point is the absence of slippage of the drive wheels when the vehicle is started.

To do this, we must equate dynamic factor of cohesion:

$$D_\varphi = \frac{a \cdot \varphi_x}{L - h_g \cdot (\varphi_x + \psi_v)}$$

and the dynamic factor of the car in first gear, when it starting (neglect air resistance):

$$D = \frac{P_k}{m_a \cdot g} = \frac{M_e \cdot U_1 \cdot U_0 \cdot \eta_{TP}}{r_\partial \cdot G_a}$$

Thus, we have the equality:

$$\frac{a \cdot \varphi_x}{L - h_g \cdot (\varphi_x + \psi_v)} = \frac{M_e \cdot U_1 \cdot U_0 \cdot \eta_{tr}}{r_\partial \cdot G_a}$$

Based on this equality, the gear ratio of the first gear was calculated:

$$U_1 = \frac{G_a \cdot a \cdot r_\partial \cdot \varphi_x}{M_e \cdot \eta \cdot U_0 \cdot (L - h_g \cdot (\varphi_x + \psi_v))}$$

$$U_1 = \frac{5460{,}75 \cdot 1{,}6 \cdot 0{,}283 \cdot 1{,}8}{280 \cdot 0{,}9 \cdot 3{,}551 \cdot (2{,}5 - 0{,}35 \cdot (1{,}8 + 0{,}012))} = 2{,}754$$

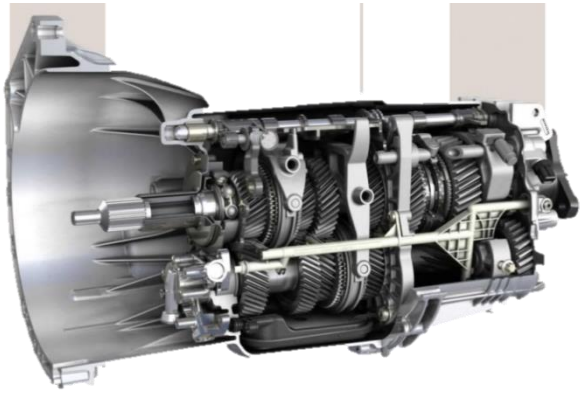
Then ratios of transmission for intermediate gears were determined using the formula:

$$U_i = \sqrt[p-1]{(U_1)^{p-i}},$$

As a result, we got the following numbers:

- main transmission - 3.551;
- first transmission - 2.754;
- second transmission - 2.138;
- third transmission - 1.660;
- fourth transmission - 1.288;
- fifth transmission - 0.683.

The Audi 80 Avant gear-box is the most suitable with its parameters. We can use it to build an electric car rear module (pic. 4).



Picture 4 - five-step Audi gear-box

The advantage of this gear-box is a big number of modifications. It allows us to match almost all gear ratios to provide a maximum acceleration and better dynamics of car racing, that is to setup a car best for any race track.

References

1. Алекса Н.Н., «Методические указания к курсовому проекту по разделу «Определение основных параметров проектируемого автотранспортного средства (автомобиля)» / Н.Н. Алекса, А.С. Федосов. Х. 1991. 325 с.
2. Волков В.П. Теорія експлуатаційних властивостей автомобіля.навч. посібник ХНАДУ, 2003. 292 с
3. https://youtube.com/watch?v=4GG3QRPGIPc;
4. http://nissan-elektro.com.ua
5. http://www/3dnews.ru/822742

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EXAMINATION OF ROAD TEST METHOD TO OBTAIN DATA OF TECHNICAL STATE OF RENAULT KANGOO

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The method of road check of traction properties of the car during acceleration and outburst is offered. The benchmark values for the Renault Kangoo with a 1.5 Diesel engine (Figure 1) and Continental VancoContact 2 195/65 R15 95T tires are calculated.

Under the influence of various factors, the functionality of the vehicle (ATZ) in the process of operation deteriorates - decreases power and achievable speed, increases fuel consumption and braking distance, etc. In this connection, it is necessary to carry out periodic audits of the ATP (to monitor the condition).

Figure 1 – Car Renault Kangoo

Under the influence of various factors, the functionality of the vehicle (ATZ) in the process of operation deteriorates - decreases power and achievable speed, increases fuel consumption and braking distance, etc. In this connection, it is necessary to carry out periodic audits of the ATP (to monitor the condition).

Because of this, the driver must evaluate the technical state of his power unit by his own feelings ("something it is worse dragging lately"). It can feel the loss of power when it becomes noticeable, that is, it is much more than acceptable (known cases when the driver began to complain about the state of the engine when the traction power dropped by half or even tripled).

In such circumstances, it is necessary to offer vehicle users a simple method of checking traction properties without stationary diagnostic equipment, that is, directly on the road, available for sale by any driver, but still quite accurate, in order to detect loss of traction power in a timely manner.

Generally described method [1] is not entirely new, it has repeatedly sought to use researchers in different countries and finally abandoned because of low accuracy and complexity of the measurement path freewheel or acceleration - but in a ground test this method is used widely, although requires complex and expensive equipment . We recommend not measured way, and you change the speed - it is much easier and can be performed using common household devices such as a stopwatch with memory, built-in mobile phone.

Based on the results of the road test processing using Excel, we received the graphically necessary data. Examples of these results are shown in Figures 2 - 4.

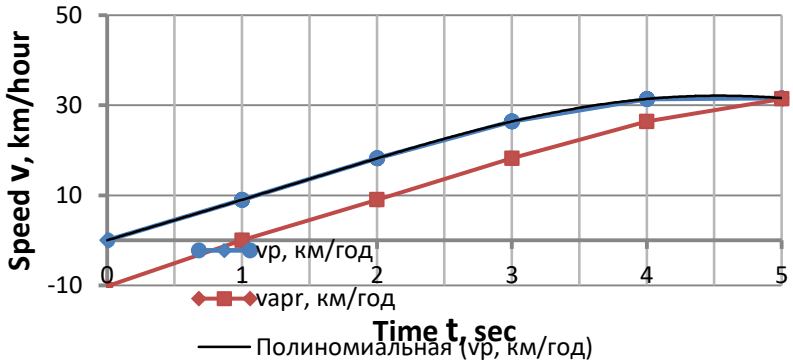

Figure 2 - Dependence of speed of acceleration of the car from time on the first transmission when driving to the South (lifting)

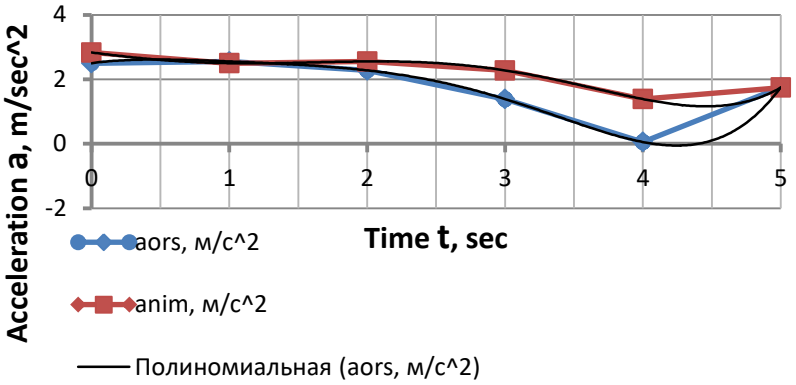

Figure 3 - Dependence of acceleration of acceleration of the car from time to time on the first transmission when driving to the South (lifting)

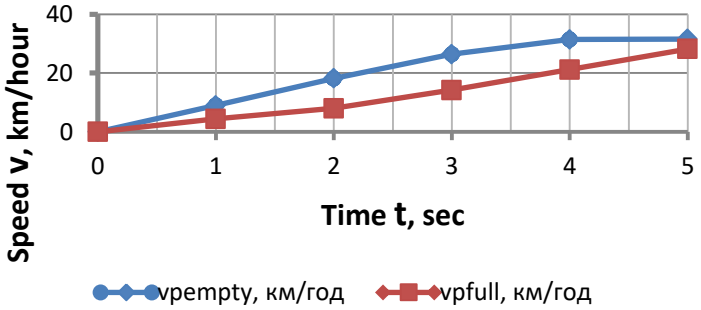

Figure 4 - Dependence of speed on time on the first transmission at different load of the car

Thus, a well-known method for determining the resistance of a car by the results of a single run really does give good results at speeds up to 100. The improved method of the known method proposed in the article allows the use of data obtained at different speeds, including more than 100, and gives values that are in good agreement with the published data obtained by more complex methods.

Comparison of the results of calculations and experiments showed that the proposed method of checking engine power over time overclocking, and the chassis on the time of the run gives results that coincide well with the experiment.

The air resistance coefficient for the Renault Kangoo 1.5 dci is defined as Cf = 0.74 (in the literature Cx = 0.745 at the frontal area of 2.75 m2). This is the value that is observed on the road.

References

1. Brief Car Reference. / AM Ponizovsky, Yu.M. Vlasko, MB Lyalikov and others. – Moscow : JSC "TRANSCOSCALTING", NIIAT, 1994. – 779 p.
2. Rabinovich E. Kh. Theoretical substantiation of the dynamic method of checking traction properties of cars. // Report of the TESA KHNADU Department on FDI 2005-2006. Manuscript.
3. Електронне джерело. – Режим доступу: https://www.renault.com.ua.

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RADAR BASED DRIVER ASSISTANCE SYSTEMS

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Changing lanes always poses a risk, especially if a vehicle in the neighboring lane is going faster. Then there is a blind spot to consider – an area behind the car that is not visible in the external rearview mirrors. Valeo's Lane Change Assist system alerts the driver if there are vehicles in this area or vehicles approaching rapidly from the rear. This information is extremely valuable, especially if the driver suddenly decides to change a lane.

The lane change assistant monitoring system. The lane change assistant Side Assist serves for preventing accidents during the lane change manoeuvres on motorways and dual carriageways. Two radar sensors installed behind the bumper monitor the areas on the right and left next to and up to 70 m behind the subject vehicle. The system is activated above the speed of 10 km/h. The system has distinct information and warning stages. If the system detects a potential risk without a lane change being indicated (indicators not activated), this is indicated by activation of the warning lamp in the relevant rearview mirror with a fade-in action. The warning stage is activated if a potentially hazardous situation is present and a driver indicates a lane change by switching on the respective indicator. The warning lamp in the rearview mirror begins to flash. If a lane departure warning system is additionally installed, the warning stage is additionally activated during of a steering movement in the direction of the side on which the hazard is present (even without the indicator being switched on). If the lane boundary is crossed, the vehicle is automatically steered in the opposite direction.

Parking space departure assistant. The radar sensors of the lane change assistant are also used for the parking space departure assistant. When reversing out

of a transverse parking space, this system warns about moving objects in the area of the vehicle's rear end. The radar sensors measure the distance and the speed of an approaching object, and determine from the time remaining before a potential collision. Information and warnings are output to a driver; if a collision is inevitable, the vehicle is braked to a standstill with maximum braking action.

System requirements:

- The detection angle of the radar sensors is approx. 180°.
- Detection area approx. 50 m range laterally to the right and to the left.
- Speed range of the subject vehicle from 1 km/h - 12 km/h.
- Speed range of detected vehicles/objects > 4 km/h.

Warnings:

- Visual display in the instrument cluster (text + gong, if no PDC installed).
- Acoustic warning (beeping) (if PDC is installed).
- Independent braking intervention approx. 0.8 s before a potential collision.

The Blind Spot Monitor. The Blind Spot Monitor warns you about vehicles in your blind spot. Two radar sensors in the rear of the vehicle monitor the traffic space beside and behind the vehicle. The system measures the distance and the speed difference between your vehicle and other vehicles.

Parking space departure assistant with Blind Spot Monitor. The parking space departure assistant warns of approaching vehicles/objects when reversing out of a parking space. The radar sensors measure the distance and the speed of an approaching object, and determine the time remaining before a potential collision.

System limitations:

- The detection angle of the radar sensors is approx. 110°.
- The detection area has an approx. 20 m range.
- Speed range of the subject vehicle from 1 km/h - 12 km/h.
- Speed range of detected vehicles/objects > 4 km/h.

Warnings:

- Visual display in the instrument cluster (text + gong, if no PDC installed).
- Acoustic warning (beeping) (if PDC is installed).
- Independent braking intervention approx. 0.8 s before a potential collision.

Advanced driver assistance systems such as parking space departure assistant and the lane change assistant monitoring system aim to reduce road accidents drastically and the associated casualties by helping drivers to avoid collisions altogether. These systems react faster than any human, are constantly vigilant, and are already being adopted and deployed across various car segments, from premium to economy models.

References

1. Popken M (2006) Audi side assist. In: Hanser automotive electronics + systems, Carl Hanser Verlag, Munich, 7–8, pp 54–56.

2. Meinecke M-M, Steinmeyer S, Ah-King J, Degerman P, Nyström T, Deeg C, Mende R (2013) Experiences with a radar-based side assist for heavy vehicles. International Radar Symposium, Dresden, IEEE, pp 720–725.

3. Vukotich A, Popken M, Rosenow A, Lübcke M (2008) Fahrerassistenzsysteme (Driver assistance systems) ATZ and MTZ 2 (special edition), pp 170–173.

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ELECTRONIC CONTROL SYSTEMS FOR VEHICLE PASSIVE SAFETY

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Modern vehicles are equipped with various systems that increase the vehicle active safety, but despite this, the number of accidents on the roads of our country is slowly declining [1-2], that can be explained by the drivers' safety. Regarding this, manufacturers of modern vehicles began to pay more and more attention to improving the electronic control systems that increase the vehicle passive safety. It is known [2-3] that systems providing passive safety reduce the level of injuries and the number of fatal cases among road traffic accident victims.

In the XX century passive safety systems were based on mechanical properties of systems that limited their functionality. From the beginning of the XXI century systems providing passive safety began to include electronic components that expanded the capabilities of such systems due to the speed of processing information by sensors and actuators. Passive car safety systems can be divided into 2 groups: systems providing internal passive safety and systems providing external passive safety.

Internal passive safety systems include safety belts, airbags, head restraints, energy absorbing body parts, as well as interior decorative body elements.

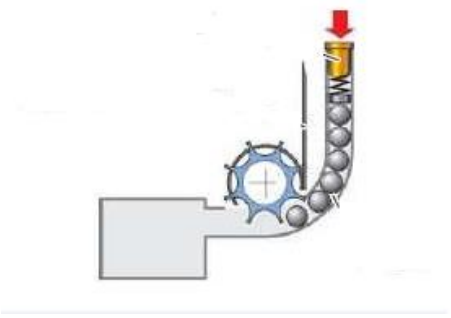
External passive safety systems include: body design, bumpers, glass, and external decorative elements.

Availability of electronics and expansion of functional capabilities of vehicle passive safety systems allowed to create: belt tensioner, electronic head restraints, emergency battery breaker, front and side airbags, emergency hood lifting system, vehicle body lifting system before the side hit.

Belt tensioner. The complete set of any modern car necessarily includes a seat belt, but not every car is equipped with a special device - seat belt tensioner, because of its high cost. The belt tensioner is designed to prevent the movement of the person during the accident. The seat belt tensioner provides for the free belt assembly of up to 130 mm in 13 ms in case of detecting the fact of an accident [3].

The belt tensioners, are more often mounted on the seat belt locking (Fig. 1a), but there are exceptions (Fig. 1b). In accordance with Internet sources [3] tensioners of the seat belt are of the following types: cable, ball, rotary, rail, tape.

a



b

Figure 1. – The belt tensioners.

These tensioners have a mechanical or electric drive. The mechanical drive is activated due to the combustion processes of the elements in the trigger.

The electric drive is actuated by supplying the voltage to the electric motor according to the information received by the electronic control unit with the accelerator sensor.

In modern designs of belt tensioners, the tension effort is limited to a torsion shaft that is located in the seatbelt reel [3].

Electronic head restraints. Head restraint is a protective device embedded in the upper part of the seat, which is a safety stop for the occipital part of the head of the driver or passenger in the car.

Head restraints are installed to reduce the effect of uncontrolled head movement, especially backwards, as a result of an accident due to the collision of another vehicle behind.

The headrests are either constructed as part of an elongated seat backrest, or are fitted with adjustable pads.

Head restraints are installed in order to mitigate the effect of uncontrolled movement of the head, especially backwards, as a result of an accident due to the collision of another vehicle from behind [4].

Emergency battery breaker

Emergency breaker designed to prevent short circuit in the electric system and possible car ignition. The emergency battery breaker is equipped with cars in which the battery is installed in the cabin or luggage compartment.

There are several designs of an emergency breaker like a trigger, which turns the battery off or the battery-switching relay (Figure 2) [5].

The trigger is set on the positive terminal of the battery. The squib is triggered by a command from the passive safety control unit. The opening is carried out due to the gases arising from the triggering of the squib. The trip relay is also triggered by a command from the control unit [5]. After activation, the trigger or relay requires replacement.

Front and side airbags. AirBag is a system that provides passive safety (Supplementary Restraint System) in vehicles. It is an elastic shell filled with air or another gas. Airbags are widely used to mitigate impact in the event of a collision of vehicles with obstacles.

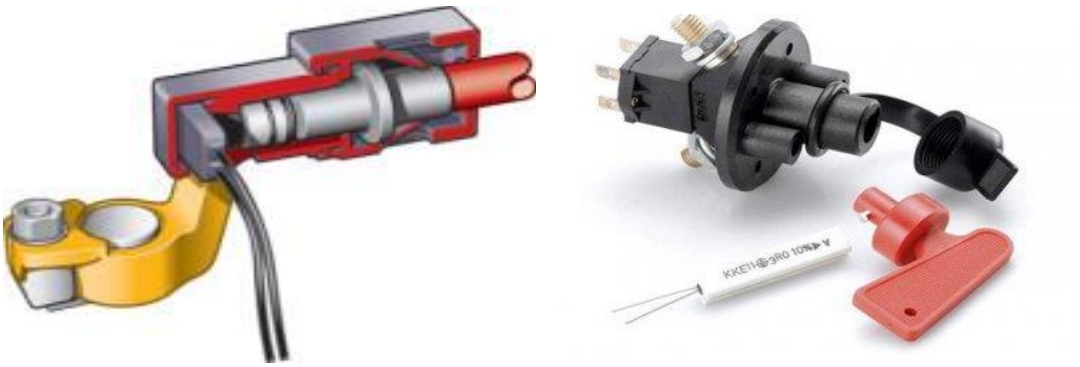


Fig. 2. – Emergency battery breaker

Almost all modern cars are manufactured with the expectation of the subsequent installation of airbags, so you should not worry in advance about “where to install them” and “is there a place for them in the car”. The principle of distinction of bags in the cabin is on the basis of their main classification [6].

Front airbags are designed to offset the momentum in a frontal collision. The driver's airbag is located in the steering wheel, and the passenger’s is hidden in the panel. The main purpose of front airbags is to prevent injury to vulnerable areas on the body: the head and neck. The airbag absorbs about 90% of the total impulse, and also considerably softens the contact of the face with the surface in front of it.

Side airbags are located in the extreme cavities of the driver's and passenger's seats. Unlike front side airbags are designed to mitigate the effects of impact in the body, and not just for the upper body. We can also divide airbags into driver’s and passenger’s ones.

Fig. 3. – Front and side airbags

Emergency hood lifting system. A high-tech electronic system that tracks information from various sensors in the event of a traffic accident instantly raises the hood of the car in order to ease the process of injury to pedestrians.

The system control unit, which is located under the front passenger seat, evaluates the signals from the sensors in the bumpers and the wheel sensors, and, if necessary, gives the command to lift the hood [7].

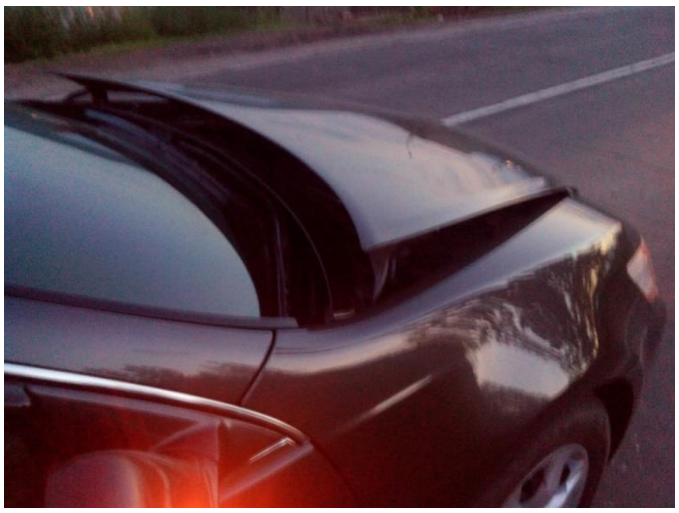


Fig. 5 – The system of emergency hood lifting

Car body lifting system before the side hit. The system of lifting the car body works with the help of the height adjustment of the body relative to the roadway. Due to the replacement of stabilizers of electric motors on a modern pneumatic suspension, all four wheels will start working in tandem with the same number of small motors. They join the subframe and lower arms. Electric motors restrain roll and thus ensured the lifting of the car body.

Such a suspension allows you to raise the corresponding side of the body by eighty millimetres before an emergency on the road during a side collision. At the same time, the impact is softened due to the energy quenching in the rapids and the floor of the car. Conducting numerous studies, German experts have concluded that this invention will help to reduce damage to the sides of the car after the accident exactly twice [8].

Conclusion. The analysis of vehicle passive safety systems showed significant changes in the design of standard elements ensuring road safety through the use of electronic components and sensors. The reliability and quality of the work of automated systems that ensure passive safety of the vehicle, such as seat belt tensioner, electronic head restraints, emergency battery breaker, front and side airbags, an emergency hood lifting system, a car body lifting system before the side hit, increase the probability of ensuring the lives of participants in a road accident almost twice.

Existing systems that increase safety are constantly being improved, and new ones are being created, so this list cannot be considered as complete. The risk of injury in case of an accident will always be available, especially in high-speed collisions, but advanced developments reduce it to a lower level.

References

1. https://www.drive.ru/technic/4efb330700f11713001e337d.htm
2. http://livesave.narod.ru/passivnayabezopasnost.html
3. http://systemsauto.ru/passive/stretch.html
4. http://www.infocar.ua/term_regulpoggolovnik.html

5. http://systemsauto.ru/passive/switch.html
6. https://carprofy.ru/sistemy-bezopasnosti/podushki-bezopasnosti-vidy-ustrojstvo-naznachenie-i-princip-raboty/
7. https://www.drive2.ru/l/4325077/
8. https://automend.ru/news/audi-a8-novuyu-model-avtomashiny-zhdyot-neobychnaya-sistema-bezopasnosti/

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HELP SYSTEM IN THE OVERTAKING OF TRUCKS

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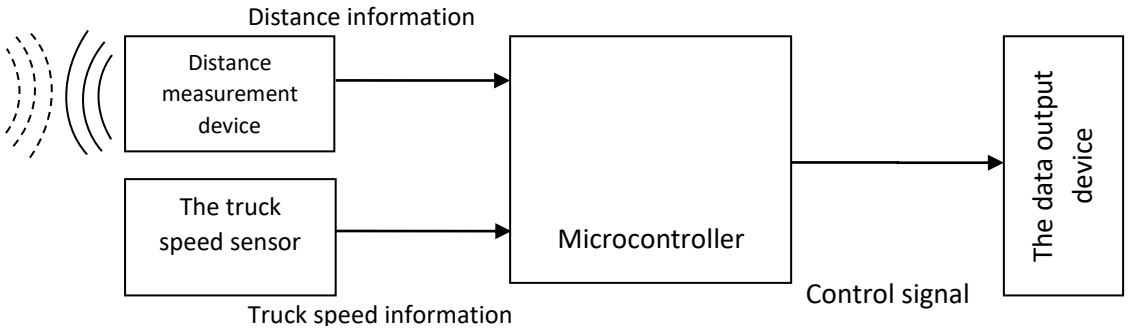
The goal of this research is creating a system that will help drivers to perform a safe maneuver overtaking a truck on two-lane roads and prevent a collision of oncoming cars during this maneuver. The developed system can be installed on any large vehicle and thereby improve traffic safety on two lanes by reducing the chance of colliding oncoming cars at the time of overtaking a large vehicle.

When trucks are driving on two-lane roads, they are creating difficulties for the movement of other vehicles which are moving behind. This is due to the fact that with their large dimensions trucks are obstructing the view of the road to drivers who are moving behind. Also, due to their length, a driver needs more time to perform the overtaking maneuver, so they are moving for a long time in the oncoming lane. As a result, drivers may encounter an oncoming car during the truck overtaking.

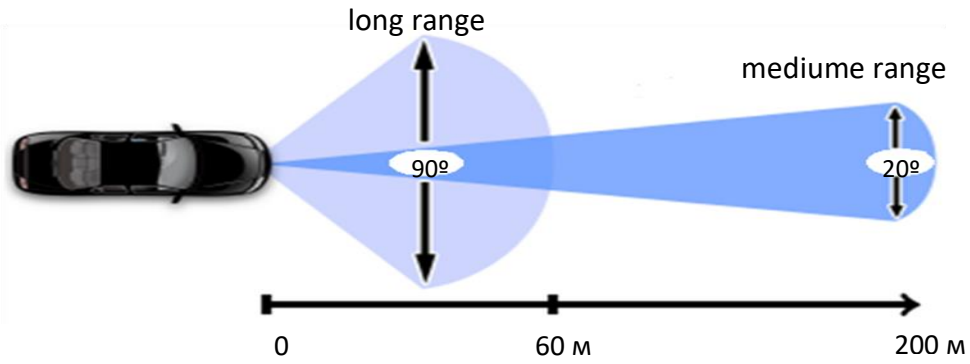
The structural scheme of the system. Help system during overtaking trucks consists of the distance measurement device, the signal processing and the control system (microcontroller), the truck speed sensor, and the data output device. The proposed structural scheme is presented in picture 1.



Picture 1 - Structural scheme, help system in the overtaking of trucks

The distance measurement device is designed to detect objects located in front of the truck and determine the distance to them. Delphi ESR 2.5 radar is used as a measuring device. Delphi ESR 2.5 has two detection ranges - medium and long. With the long range, the radar can detect objects at the distance of 200 m,

with a viewing angle of 20°. While the medium range can detect objects at the distance of 60 m, with a viewing angle of 90° [1, 2].



Picture 2 – Radar detection ranges of ESR 2.5

The microcontroller, based on the inserted algorithm, determines the time at which a vehicle moving behind can carry out a safe overhead maneuver of this truck and pass it to the data output device. STM32L476JG microcontroller from STMicroelectronics is used, because it has a high degree of performance (due to tact speeds of 80 MHz), large volumes of memory (128 MB RAM and 512 MB flash memory), CAN network availability and low cost (the cost is $ 5) [2, 2].

The truck speed sensor provides the microcontroller with information about the current truck velocity, which is required in calculations to determine the start time for safe overtaking.

The data output device displays information about the permission/prohibition of overtaking this truck received from the microcontroller. To display information about the permission / prohibition to perform the maneuver overtaking a truck was LED sign chosen, because they have solid construction, excellent visibility at night and misty weather (pic. 3) [3, 2].

Picture 3 - LED mark that prohibits the movement of freight vehicles

The algorithm of system operation. Help system during overtaking trucks works by the following algorithm:

- verification of connection and serviceability of system components;
- information request about the speed of truck from the speed sensor;
- determining the position of a truck (moving or standing);
- if it stands, a repeated request for information from the speed sensor;

- if it moves, the command to the radar at the beginning of the measurement;
- information request about distance and speed from the radar;
- definition of the time of convergence;
- identification of detected objects;
- determining the time required to overtake this truck;
- determination of the possibility of safe overtaking, on the basis of performed calculations;
- transmission of information from the microcontroller to LED mark on the permission / prohibition of overtaking of truck;
- displaying of received information by LED sign.

Since, in its device, the radar has its own microcontroller. It calculates the speed of convergence with the detected object. This is done by comparing and finding the difference between the distance values, with a time interval of comparison, $t_{зт}$ = 50 ms (speed of radar update)

$$\Delta S = S_1 - S_2 \ , \qquad (1)$$

where S_1 – distance to the object, m;
S_2 – distance to the object by 50 ms, m.

Knowing the distance travelled by the detected object and truck, and the time during which this distance was passed, according to the law of motion, the speed of convergence with the detected object is determined.

$$V_{зб} = \Delta S / t_{зт} \ . \qquad (2)$$

The received speed value is transmitted to the STM microcontroller.

According to the traffic law, the microcontroller determines the time of convergence, the time at which the distance between the truck and the detected object will be zero

$$t_{зб} = S / V_{зб} \ , \qquad (3)$$

where S – distance to the object, m.

Since the radar is not capable of identifying the detected objects, but only transmits information about the distance to them and their speed, the following objects will be included in its working range: passing and oncoming vehicles, road signs, trees, shrubs, etc. The identification of the microcontroller is as follows. "Oncoming vehicle" if the speed of convergence the object is, or exceeds by more than 100 km/h. "Fixed object" if the speed of convergence with the object is equal to the velocity of a truck. "Passing vehicle" if the speed of convergence/distance with the object is in the range from 0 to 20 km/h.

The time required to overtake a truck is defined as follows

$$t_{обг} = S_{обг} / 0{,}28 \times V_p \ , \qquad (4)$$

where $S_{обг}$ – the distance to be overcome to overtake a truck, m;

V_p – speed difference between moving vehicles, m/s.

The moment to start the safe overtaking of a truck is determined by the microcontroller on the basis of two criteria:

- safe exite to the oncoming lane. This criterion is based on the difference between the time before approaching an inertial vehicle and the time it takes to overtake the truck. If it exceeds 5 seconds, then the system determines the criterion as "satisfactory". Otherwise, the system defines it as "unsatisfactory".

- possibility to return to your lane. This criterion is based on the distance between the truck and the associated vehicle. If it is, or exceeds 25 m, the system determines the criterion as "satisfactory". Otherwise, the system defines it as "unsatisfactory".

Provided that the two criteria are "satisfactory," the system sees this as an opportunity for a safe overtaking maneuver, and a signal of the ability to start overtaking is displayed on the LED sign. Otherwise, a warning signal of the danger sign of an overtaking maneuver is displayed on the LED.

The analysis of the work and the principle of the existing systems can help the driver to perform the safe maneuver overtaking a truck. The developed system is able to work in any weather conditions, time of a day and in any temperature ranges. It has the ability to be applied in mass use, it has a higher degree of reliability due to the use of the radar.

References

1. Delphi Automotive Systems. Delphi ESR Datasheet, 2011. URL: http://delphi.com

2. Krylov Ye. N. STM32—32-razryadnyye mikrokontrollery. [Krylov E.N. STM32-32-bit microcontrollers.] URL: https://cyberleninka.ru/article/v/stm32-32-razryadnye-mikrokontrollery-na-osnove-yadra-arm-cortex-m3

3. N. I. Vukolov, A. N. Mikhaylov. Znakosinteziruyushchiye indicatory [Sign synthesizing indicators] // pod red. V. P. Balashova. M.: Radio i svyaz', 1987. – 592 p.

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THE ANALYSIS OF USING AUTOMOBILE SOLAR PANELS

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Today the world’s oil and fuel reserves are gradually running down and the environmental problems are solving, the world is looking for alternative solutions of such problems. A new source of energy is being developed and searched. A solar element is such a source.

The solar cell is a current source based on semiconductor elements (from Si, GaAs, etc.) that convert the energy of solar radiation into electric directly.

The efficiency of solar panels is up to 22%. Solar cell batteries are used:

• on spacecraft,

• in automated devices

• portable radio stations

• radio receivers, etc.

The voltage of solar panels is up to tens of Volts, power – up to tens of kW.

Thus, we analyze the main advantages, disadvantages and characteristics of solar panels used on electric vehicles.

The advantages are:

• renewavity, because solar energy is an unlimited resource;

• abundance (the surface of the earth is illuminated by 120 thousand terabytes of sunlight that is 20 thousand times more than the world);

• availability in every spot on the globe.

That's why it's necessary to use solar energy in car manufacturing.

Germany now ranks first in the world in the use of solar energy and has its maximum potential.

That's why it's necessary to use solar energy in car manufacturing.

Nowadays there are experimental and some serial sunmobiles. Moreover, there are some samples among that can reach the speed 200 km/h at the expense of their solar batteries .

The main obstacles to the developing heliovehicle are:

• dependence on weather conditions and the time of day,

• low power to weight ratio of solar radiance (about 1 kW / m2)

• low efficiency of solar cells (about 15%).

With an area of solar cells covering the entire non-glassy surface of a vehicle of dimension close to a Golf-class car, that is, about 6 m^2, the solar car perceives energy of about 6 kW, which is not enough for such a vehicle to move in one stream with modern cars, and after accounting efficiency of modern solar cells is only 1 kW.

However, a car with a minivan-type body is well suited for installing solar panels, because a car with this body has a large roof area of about 6–8 m^2, in turn, allows for more energy due to the large size of the roof. But we should not forget about the possibility of using buffer batteries, which can store the energy obtained during the parking of the vehicle and when braking by an electric motor.

In most modern solar vehicles, the main source is the battery. The solar battery is used to constantly recharge the battery, that is, to increase the daily run of the electric vehicle. To date, there is not enough light and energy-intensive rechargeable batteries, but developments in this area are going fast enough, and we can hope that similar batteries will appear in the nearest future.

The problem of little power density of solar radiation, of course, is not solved, but with an increase in the efficiency of photovoltaic cells, it will no longer be so significant. Therefore, great attention should be paid to the development of the photo-cell base.

Consequently, at the moment there are several copies of serial cars with solar panels: Venturi Astrolab and Toyota Prius.

The original Venturi Astrolab uses a 16 kW (21 hp; 22 PS) electric motor in place of the internal combustion engine fitted to most cars. This electric motor also had a claimed maximum torque output of 5 kg/m; 50 Nm), delivered instantly. The top speed of the Venturi Astrolab 120 km/h. With its bodywork composed of 3.6 m2 (39 sq ft) of high efficiency (21%) solar cells. The Astrolab is a unique concept of zero emission vehicle. To attain this level of performance while using very little energy, Astrolab has been designed like a Formula 1: its carbon monocoque chassis is ultra-light and serves as an oversized protection cell ensuring the safety of its occupants in the event of a collision.

Its profile recalls the aqua-dynamic design of great racing yachts. The average daily intake of the solar cells enables a range of 18 km. If greater range is required, the onboard batteries extend this to 100 km.

Figure 1. – Venturi Astrolab

The second example is Toyota Prius. Its power system consists of a solar panel on the roof of the car, a nickel-metal hydride battery and a control unit with a voltage converter. The maximum output power of a solar battery is 180 Watts. When the car is moving, solar powered electricity is directly supplied into the 12 V onboard system and then is used to feed the auxiliary devices to reduce the load on the lithium-ion battery.

References

1. https://www.venturi.com/automotive-4/astrolab/
2. https://www.carbodydesign.com/archive/2006/10/13-venturi-astrolab/
3. http://ust.su/solar/media/section-inner10/3161/
4. http://delight.co.ua/n_615.htm

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ELECTRONIC SYSTEM OF OPERATION

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It is know, that one of the factors significantly affecting the workflow of a diesel engine is the inertia angle of fuel injection regarding the upper dead point (UDP) of the compression stroke. For each value of the crankshaft's rotational speed, there is an optimum inertia angle of fuel injection, in which the efficiency of the diesel engine will have the maximum value for it and given conditions of operation. In order to obtain the maximum efficiency (and hence the minimum fuel consumption), for each mode of operation of a diesel engine it is necessary, under other equal conditions, to change properly the angle of pre-injection of fuel. This can be achieved by changing the angle position of the camshaft PNVT regarding the crankshaft. This principle was applied to engines of automotive industry, but on diesel locomotive diesels due to the significant complication of their design, such a technical solution in practice has not been applied. Therefore, usually the optimum value of the fuel injection prevention angle is set for the crankshaft rotation speeds that area close to the nominal.

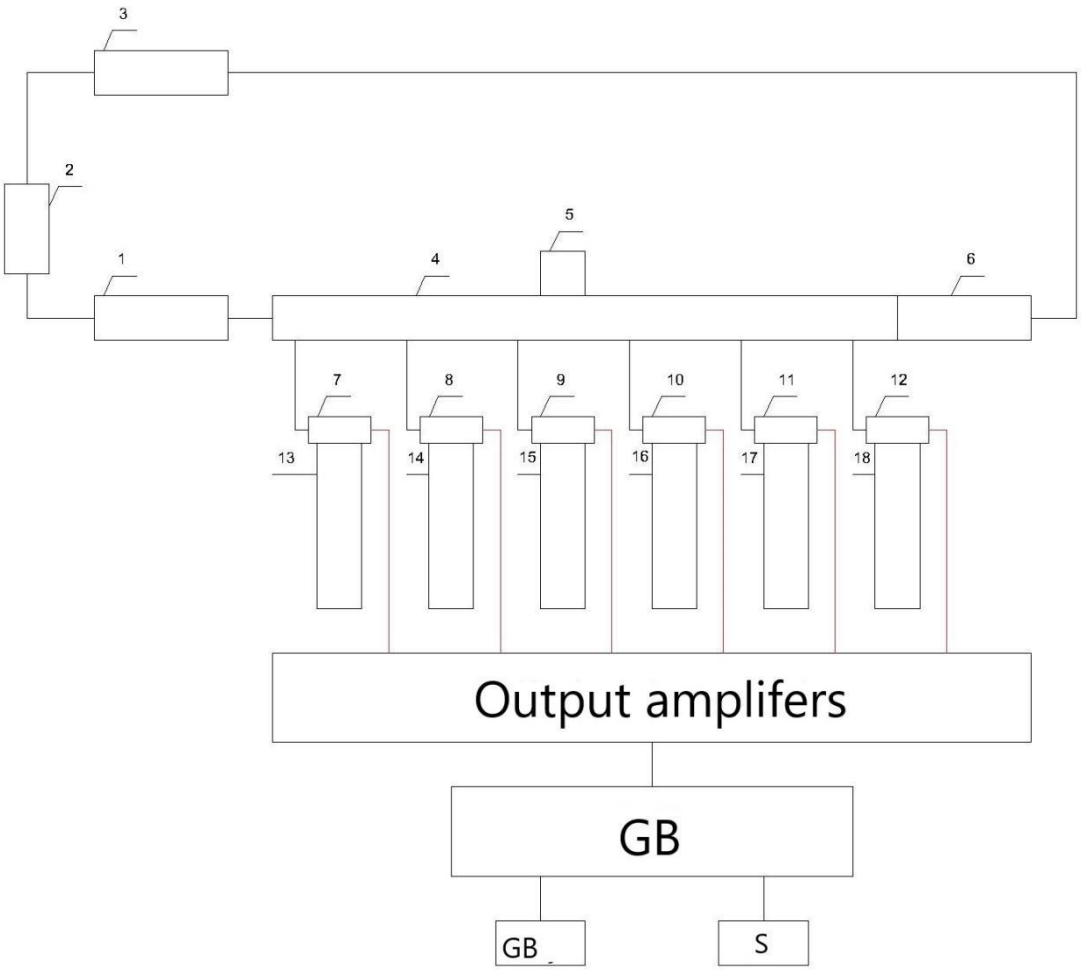
It is possible to change the angle of pre-injection of fuel, if you use fundamentally other systems of fuel supply to diesel. The functional scheme of one of these systems, recently created, is presented in Figure 1. The main elements of the system area high pressure fuel pump 1, a fuel battery 4 and nozzles 13 - 18, equipped with electromagnetic valves 7 - 12, respectively. The high-pressure fuel pump 1 continuously supplies fuel from the tank 3 through the filter 2 to the fuel accumulator 4. In the latter, by means of the bypass valve 6 constant pressure is maintained, the value of which is equal to 50 MPa to 130 MPa.

Each of the nozzles 13 - 18 is equipped with an electromagnetic valve, respectively, 7 - 12. With the absence of current in the coil of the electromagnet, fuel is not supplied, to the nozzle spray, as the valve to which the fuel from the accumulator 4 is supplied is closed. When a current is fed into the winding of an electromagnet, the valve opens, and the fuel from the battery 4 is eventually fed through the corresponding nozzle into the diesel cylinder.

Thus, the start of the fuel supply to the cylinder and its duration are uniquely determined by the moment of supply and the duration of the current pulse coming from the output amplifier to the electromagnetic valve.

Current pulses controlling electromagnetic valves 7 - 12 are formed by a control unit (CU), which is a specialized industrial computer.

Output amplifiers match the control signal parameters generated by the unit, with the parameters of the windings of electromagnets.Valves 7 - 12. Signals for control of nozzles 13 - 18 are formed by the unit of the in processing information from the control bodies (CB) and sensors in accordance with the program put in it.



1 - high pressure fuel pump; 2 - fuel filtre; 3 - fuel tank; 4 - fuel accumulator; 5 - fuel pressure sensor; 6 - bypass valve; 7 - 12 - electromagnetic valves; 13 - 18 - nozzles; CU - control unit; MB - management bodies; S - sensors (crankshaft frequency, synchronization, oil pressure in diesel engine oil system, fuel pressure, etc.)

Figure 1 - Scheme of the functional fuel supply system with a fuel accumulator.

The given fuel system provides adjustment of an angle of advance of fuel injection and considerable reduction of fuel consumption. At the same time, it has a significant drawback in the form of an additional complex system of high-pressure fuel.

As a result of studies carried out in different countries, non-accumulative fuel systems of diesel engines were developed, including the electronic fuel management system ESUVT.01 for diesel engines 64H31,8 / 33 of TEM2 locomotives, created at LTD Diesel Automation (Saratov). The system is designed for automatical adjusting the speed of the crankshaft of the diesel engine. In this case, the angle control of fuel injection prevention is provided within ± 5 degrees. at the rotation angle of the crankshaft according to the prescribed law, depending on its frequency of rotation.

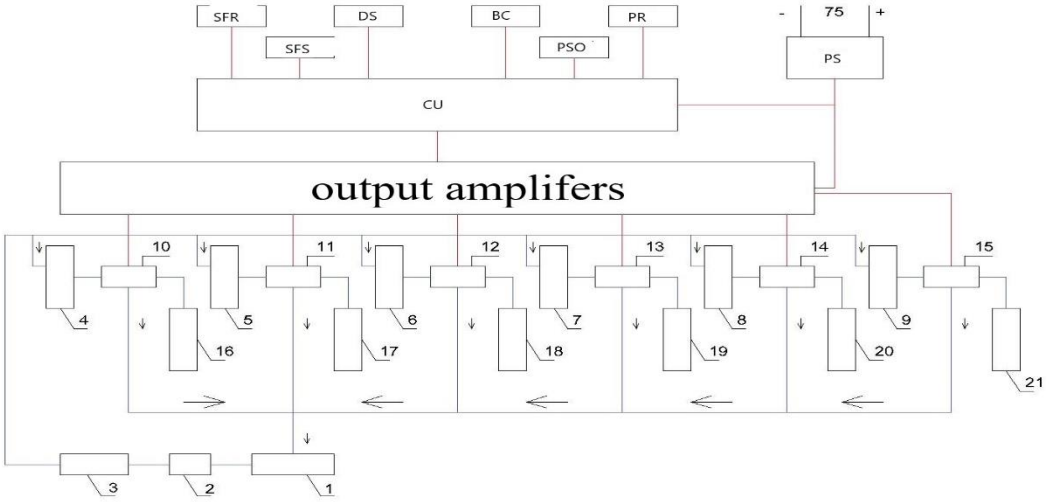
ESUVP.01 system allows to change individually the fuel delivery time within each range of ± 20% of the calculated, obtained during the regulation of the rotational speed. This allows you to level out. load on cylinders. In addition, the system provides:

- eight-position task of rotation frequency of a crankshaft of a diesel engine with the established accuracy;
- the ability to change the task of the crankshaft rotation speed for each position;
- separate task of the rate of increase and decrease of the speed of the crankshaft when changing the position of the controller;
- disconnecting any cylinder or part of the cylinders by disabling the supply of control signals to the corresponding electromagnets of the injector valves;
- limitation of the fuel supply according to the given law, depending on the frequency of rotation of the crankshaft;
- limitation of the fuel supply according to the given law, depending on the pressure of the supercharger;
- formation of two-phase fuel supply (pilot injection);
- stopping of the diesel engine when the signal "Work" from the control and the power system panel are switched off, breakdown of the chains of the crankshaft speed sensors, the phase mark of the camshaft and synchronization, the achievement of the limiting crankshaft rotational speed, and the reduction of the pressure in the oil system of the diesel engine below the permissible value.

The functional scheme of the electronic system ESUVT.01 is shown in Figure 2. Its main elements are fuel pumps of high pressure 4 - 9, which are driven by cams of camshaft, electromagnetic valves 10 - 15, injectors 16 - 21, control unit, output amplifiers, a set of sensors, a programmer PR and a power supply unit. As in the fuel system, which has been already considered in the article, the unit is a specialized industrial computer, and the output amplifiers agree parameters of the control signals produced by the control unit, with the parameters of the windings of the valve electromagnets.

Programmer (PR) performs the functions of the keyboard of a personal computer. It allows, if necessary, to change quickly the program embedded, and display the current values of various parameters on the screen available in his display. The system allows instead of the programmer to connect a portable personal computer, which with the program "GazService" provides operational change of the program management system, its configuration and archiving of current parameters of the system in real time, which are presented in the form of charts.

The power supply unit CU supplies the DC unit, the programmer PR and the electrical circuits of the sensors with a direct current voltage of 24 V. The unit is connected to the power supply of the on-board diesel locomotive and at the input voltage, equal to 75 ± 20 VDC, maintains an output voltage of 24 ± 2 V.



1 - fuel pump; 2-fuel filter; 3 - auxiliary fuel pump; 4 - 9 - high pressure fuel pumps; 10 - 15 - electromagnetic valves; 16 - 21 - nozzles; CU - control unit; SFR - sensor of the frequency of rotation of the crankshaft of the diesel engine; SFS - sensor of the phase mark of the camshaft of the diesel engine; DS - synchronization sensor; BC - bodies of control of the test bench; PSO - pressure sensor of oil; PR - programmer; PS - power supply unit;

«-» - hydraulic lines; «-» - lines of electronic communications

Figure 2 - Functional diagram of the electronic system ESPP.01

References

1. Коссов Е. Е., Нестрахов А. С., Аникиев И. П., Бычков Д. А. "Микропроцессорная система регулирования дизель-генератора" М.: Интекст, 1999 г., 184 с.

2. Левин М.И., Островский Э.С., Леснер Е.Ю. Микропроцессорная система управления углом опережения впрыскивания топлива. Статика Двигателестроение, 1988.– № 6.– С. 16-18.

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IMPROVEMENT OF PASSIVE SAFETY SYSTEMS OF THE CAR

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The use of the pyrotechnic cartridge is aimed at solving important tasks. They realize the control for the condition of the car after the accident and avoid the possibility of locking seat belt anchorage. These requirements indicate the need to

installation in the fastening belt pyrotechnic elements. They only work if all specified characteristics are fulfilled after an accident or in mechanical mode.

Doing this is necessary in order to avoid a situation where a person remains fastened in a burning car or going to the bottom of the river. At the same time, a person needs to leave the car as soon as possible.

The devices of elongation and damping of a safety belt provide the possibility of reducing the impact and vibration load on the person and partly on the equipment located in the car. The reduction of shock and vibration load is achieved by effective energy absorption, as well as changes in the direction of vectors of kinetic energy that affect a person.

But sometimes situations arise where, despite the various seat belts, they do not work or fail. In this case, the person continues sitting on a seat. This is not very good, especially when a person sufferes some kind of injury, whether the car explodes or hangs over abyss. In this case, it would be good to apply systems that help get rid of fasteners and get out of the car.

It is possible to embed an additional key at a distance of the elongated hand, so that a person can mechanically press this button and leave the car without a traumatic neck. The purpose of the research is to develop a system that will enhance the passive safety system, due to the introduction of a pyrotechnic cartridge in the attachment of seat belts.

In order to achieve this goal, the following tasks need to be solved: analytical review of existing passive security systems, identification of their features, advantages and disadvantages; analysis of the vehicle before and after the accident; definition of requirements for the system being developed; development of the structural scheme of the passive safety system; selection of sensors, controllers and actuators of the system.

The combination of elements used to protect passengers from injuries in accidents is called a passive safety system. It is the that system, not only protects the passenger himself, but also his car.

In more details, consider the system of seat belts and an emergency battery breaker, because they will be needed to implement our investigation.

When installing the battery in the cabin or luggage compartment, the car may be equipped with an emergency breaker. The purpose of the circuit breaker is to break the battery connection with the on-board network.

In order to eliminate the disadvantages of the considered analog systems, the passive security system must have the following parameters:

- Determine where the car is located. In order to set the pyro-cartridge system to work when the vehicle is in a position on wheels and ± 30 ° in a horizontal direction, the person does not move out of the seat and does not cause the assemblies to be incompatible with life: determine the speed of the car. In order to the system to not work when the car collided, but is in motion; additional protection. In order to a pyrotechnic knot not to injure a human when struck; mechanical button. In order for a person to boom in a snooze in mechanical mode, press it and leave the cabin; ability to work at any time of work; reliability of the system; high speed of operation.

Since we need to have information not only about external factors, but also about internal ones, the system tracks all the changes related to the car and its position and, according to the information received, issues commands for the operation of pyrotechnic means, namely, pyrotechnic catridge seat belt anchorages and side windows of the car.

The system receives a signal from the impact sensor, vehicle position, speed, presence of the person in the cabin and smoke. After that, the signal passes through the signal conversion unit, which reduces the voltage to the optimum and goes to the microprocessor, which in turn handles the external data about the condition and condition of the car, the signal transformer unit, which reduces the voltage to the optimal and goes to the block of transformation of signals that reduces. the voltage to the optimum and goes to the microprocessor, which in turn handles the external data about the condition and condition of the car, as well as the presence of people in the car. The microprocessor reads the data about the impact, checks on where the people are located, what speed of the car is, in which position it is located.

Conditions under which the system will not work at all, namely:

- the car is in a position on the roof or on the side;
- the blow was of little strength;
- in places where there is no man;
- not prolonged, mistaken pressing of system operation keys.

References

1. Accelerometer URL: https://en.wikipedia.org/wiki/Axelometer.
2. Danov B.A. Electronic control systems of foreign cars: under the arm. Kiev, 2002. 175c [in Ukrainian].
3. Impact sensor URL: http://avtosovet.com.ua/avtoporada/datchik-udaru-vidi-priznachennya-ustanovka.
4. . Litvinenko V.V., Maistr.A.P. Automotive sensors, relays and switches. Moscow, 2004. 213 [in Russian].
5. Sosnin D.A., Yakovlev D.F. Latest Automotive Electronic Systems. Kyiv, 2005. 375 p [in Ukrainian].

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RADAR BASED DRIVER ASSISTANCE SYSTEMS

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During the last years, modern cars include more and more electronic systems. These systems are often operated by a computer or a network of computers programmed with powerful software. One of these new services is adaptive cruise control (ACC) (or autonomous intelligent cruise control, ACC) and a front assist. The focus of ACC has mainly been directed towards high-speed highway application, but to improve the comfort of the driver also low-speed situations must be considered. The paper presents ACC system that is capable of car following in

low-speed situations, e.g. in suburban areas, as well as in high-speed situation, working together with the radar-controlled Front Assist traffic monitoring system.

Need for ACC and Front Assist systems. ACC adaptive cruise control helps to avoid accidents by always keeping your car at a safe distance from the traffic ahead. Working together with the radar-controlled Front Assist traffic monitoring system, adaptive cruise control system keeps you at a safe distance from the vehicle in front and that makes driving much easier in slowing and stopping. It means you will feel more relaxed and comfortable on long journeys, knowing you have an extra helping hand.

Overview. Pre-set the speed range which you want Adaptive Cruise Control to brake and accelerate the car within - you can restrict your car's speed to the limit of the road you are on, for example. The safe-distance technology is built on the familiar cruise control system by adding a radar sensor. It immediately detects traffic slowing ahead and automatically reduces your speed to match. If you are driving too close to the car in the front, it will warn you in two stages: first, with visual and acoustic signals, and then with a short braking jolt. If necessary, the system will bring your car to a complete stop. It happens with the help of Front Assist system which primes the brakes if it senses a collision.

Design of the radar sensor. The adaptive cruise control unit is composed of the control unit itself and the radar sensor. The control unit and sensor form a unit, and are mounted in the front of the vehicle on the adjustable carrier plate. To be able to determine the distance and position of vehicles travelling in front, four radar beams are transmitted. To identify a target reliably, two radar beams must be reflected by it. The control unit calculates the distance on the basis of the time difference between transmission and receiving of the radar beams. For correct functioning of ACC system, correct alignment and an unobstructed view of the sensor.

Adaptive Cuise Cntrol. There are different variants of Adaptive Cruise Control (ACC) systems. A distinction is made between a single radar and a double radar. In the case of a single radar, one radar sensor is provided; in the case of a double radar system, two radar sensors are provided. Further differences exist with regard to the desired speed that can be selected. With ACC Low system, a desired speed of up to 160 km/h can be set; ACC High system operates up to a speed of 210 km/h. In a manual variant, ACC system relinquishes control at 30 km/h, and the driver is prompted to resume control of the vehicle. In conjunction with the multifunction camera and PDC sensors, ACC system can also carry out automatic starting after a brief period at standstill. This is referred to as ACC stop and go variant.

City Emergency Brake function is a component of the area monitoring system (Front Assist). If the adaptive cruise control unit J428 in interaction with the front camera detects an impending collision at a speed below 30 km/h, the system initiates a visual and acoustic warning and, if necessary, a braking action. It is needed, until the vehicle comes to a stop.

Front Asist area monitoring system. City Emergency Brake function reacts to vehicles travelling in the same direction and to stationary vehicles. The system also reacts if the safety belt is not applied, the driver's door is open or the accelerator

pedal is depressed. City Emergency Brake function does not react to crossing or oncoming vehicles and objects with a small radar reflection. Further system limitations are, for example, narrow vehicles or vehicles travelling offset to the side, tight cornering situations, and a low friction coefficient between tyre and roadway, for example owing to sand or ice. The driver however also has the option to "override" the function by applying full throttle or performing avoidance manoeuvres. City Emergency Brake function however cannot always prevent an accident. Therefore it is advised to test the system. Otherwise, you will sooner or later end up causing an accident.

Advanced driver assistance systems are systems developed to tomate/adapt/enhance vehicle systems for safety and better driving. Safety features are designed to avoid collisions and accidents by offering technologies that alert the driver to potential problems, or to avoid collisions by implementing safeguards and taking over control of the vehicle. Adaptive features may provide adaptive cruise control, automate braking, keep the driver in the correct lane, or show what is in blind spots.

References

1. Wang and R. Rajamani, Adaptive cruise control system design and its impact on highway traffic flow, Proceedings of the American control conference, Anchorage, AK, pp.3690-3695, May 8-10, 2002.

2. P. Ioannou and C. Chien, Autonomous intelligent cruise control, IEEE transaction on vehicular technology, vol. 42, pp. 657-672, November 1993.

3. Degerman P, Ah-King J, Nyström T, Meinecke M-M, Steinmeyer S (2012) Targeting lane-change accidents for heavy vehicles. VDI/VW conference on driver assistance systems and integrated safety, Wolfsburg, VDI Verlag GmbH, pp 167–175.

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