повністю автоматичного обертання в полі. За розрахунками інженерів, схваленими користувачами обладнання, час обертання скорочується на 20-30%, а також економиться паливо .

Якщо в машині Джон Дір, зламався, то на мобільний телефон (від трактора) надсилається СМС-повідомлення з поясненням поломки. Ця пропозиція послуг є результатом такого передового розвитку. Це телематичне рішення для дистанційного керування через Інтернет.

Тому, завдяки сучасному дизайну та високій ефективності різних брендів, трактори John Deere є найпопулярнішими тракторами в Україні, американські трактори цінують українські агровиробники.

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ENSURING INCREASE IN THE DURABILITY OF DIESEL CRANKSHAFTS BY TECHNOLOGICAL METHODS

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The peculiarities of the wear of the necks of crankshafts are analyzed. Modification of the surface of the crankshaft neck with mineral and organo-mineral materials makes it possible to increase the wear resistance of the coupling in the entire range of heating temperatures of the lubricant, reduce the values of friction coefficients and temperature in the tribocontact zone and, accordingly, significantly increase the durability of the tribonode.

Key words: *wear resistance, technology, crankshaft, modification, neck, strengthening.*

Problem. During the operation of such complex and expensive units as internal combustion engines, sudden failures occur, the cause of which are parts with defects that require replacement or repair, and the necessary technologies for this in most cases are not available. As a result of wear, the initial dimensions of the mating surfaces of the parts change, and their geometric shape is distorted if the wear proceeds unevenly [1-3].

Analysis of research and publications. The operation of parts under loads exceeding the calculated ones, and violation of the rigidity and relative position of the parts in the assembly, in addition to wear, can lead to more noticeable residual deformations in the form of bending, twisting, dents, etc. Parts operating at high temperatures are also subject to gas corrosion and distortion. and additional parts, pressure, welding, surfacing, metallization, electrolytic recovery [1-3]. The study of literary sources, domestic and foreign experience in the repair and restoration of parts showed that

the known technologies and methods of parts restoration: electric arc surfacing, electric contact methods of welding materials, electric arc metallization, plasma surfacing, etc., are in a number of cases complex in technological execution, labor-intensive, low-productivity, limited in the possibility of application to eliminate certain defects. Crankshafts are the most complex and expensive parts of the "shaft" class. Their cost is 10-25% of the cost of the engine, and after reaching the limit state, about 20% of the shafts are discarded. Technologies for the restoration of crankshafts by applying coatings are mainly focused on ensuring the wear resistance of the necks, but at the same time the fatigue strength decreases by 25-30%, and the resource is inferior to the norm. Sputtering is used, and the main sprayed material is chrome-nickel powders, which provide the necessary performance characteristics, but at the same time, they are high in cost. and the development of technology for restoring cast iron crankshafts by spraying with a mixture of powders that provide the necessary regulatory resource.

Research results. The wear resistance and fatigue strength of deposited coatings can be significantly increased by applying surface plastic deformation after deposition using equipment that forms a favorable texture of the coating [1-3]. In most cases, the increase in wear resistance due to the deposition of a high-carbon alloy material leads to a decrease in the endurance limit of the parts being repaired. The analysis of crankshaft restoration processes showed that some of them contain energy-intensive operations, the other part increases wear resistance, but at the same time decreases fatigue strength. To solve this problem, expensive equipment or materials are often used, which are not always justified in repair production. Bearings that are heavily loaded and operate at a high rotation frequency require a constant supply of lubricant under pressure to ensure hydrodynamic lubrication. When overhauling a diesel engine, in order to restore the geometry of the necks and gaps in the bearings, it is possible to grind the shaft necks to the repair size with the installation of liners of the repair size according to it, or to restore the shaft necks to the nominal size by spraying or surfacing. The most optimal finishing operation for processing shaft necks should be considered modification with geomaterials, which allows obtaining a roughness of no more than Ra = 0.1 μm. There is a need to develop new approaches when choosing a tribo combination and the necessary period of its operation. Therefore, the development of the method of choosing the composition of geomaterials depending on the working conditions and the specified period of operation of the tribocombination remains relevant. The analysis of applied recovery technologies showed that:

- without further strengthening of the shaft necks, the fatigue and tribotechnical durability of the shafts is not ensured;
- the issue of developing such a technological process of crankshaft restoration that would ensure the necessary operational properties of the connection and the manufacturability of products (low labor intensity, processing accuracy, specified parameters of the coating roughness) remains relevant.

As a result of functional stoppages of diesel engines, caused by breakdowns of its individual parts and crank-connecting assemblies of the engine or other reasons, and accuracy failures - the deviation of the values of the dimensional parameters of the necks beyond the permissible limits. The consequences of such failures are increased wear and tear of the shaft necks. Cracking of the necks and melting of the anti-friction ball of the liners, as a rule, lead to the deformation of the crankshafts, less often - to the breakdown of the shaft, i.e. to critical or catastrophic consequences. As a result of neck wear, shape deviations from roundness (ovality) and cylindricity (conicity, barrel-likeness or saddle-likeness) are formed. To reduce the likelihood of burrs, scratches and scratches on the necks and to reduce the rate of wear, it is necessary to increase the hardness and wear resistance of the surface layer of the shaft necks. The wear of crankshafts significantly affects the rate of wear of other diesel parts. From the above data it follows that the dominant degradation processes causing the majority of functional ones, there are phenomena caused by frictional processes with marginal or mixed (semi-liquid) lubrication, fatigue processes are much less common. The most promising compositions for strengthening friction surfaces are mineral and organomineral materials [3]. Then the method is selected. Currently, the modification of friction surfaces is carried out by the friction method or ultrasonic treatment [3]. To strengthen the necks of crankshafts, the friction method is the most promising. In order to reduce the probability of seizing and galling during the break-in period

and increase the durability of the "shaft neck - bearing liner" tribo combination by reducing the rate of wear, especially during the break-in period, the most promising direction of strengthening the crankshaft necks is the creation of a metal-ceramic thin film coating on the surfaces. To obtain high wear resistance of the coating, it is necessary to obtain a heterogeneous structure, which has a plastic and strong matrix and solid fillers. Metal-ceramic and metal-organo-ceramic films have this structure. Currently, compositions of geomaterials (natural silicates with a layered structure) based on serpentinite and vermiculite [2] and polymer-silicate nanocomposites based on polytetrafluoroethylene and serpentinite [3], which are able to form protective metal-ceramic and polymer-ceramic films on friction surfaces, are widely used to modify friction surfaces. The rate of formation (build-up) of the layer is proportional to the local flashes of temperature and pressure at the spots of actual contact. The most simple and technological method of modifying the necks of crankshafts is the friction-mechanical method, which allows you to carry out mechanical processing and modification on the same machine without reinstalling it. A steel or cast-iron indenter is used to modify the necks of crankshafts using the friction-mechanical method, which is pressed against the surface being strengthened with the necessary force. A mixture of mineral or organo-mineral materials with lubricant is fed to the tribocontact zone. The crankshaft is rotated on a lathe or a specialized crankshaft grinding machine. The mechanism of formation of a wear-resistant metal-ceramic coating on the friction surface during the friction-mechanical processing method by applying a lubricating composition containing minerals, organo-mineral or polymer-mineral compositions can be conditionally divided into 2 stages, which are performed in two technological operations:

- Applying the composite modifying material to the friction surface and forming separate areas, depending on the energy parameters (speed of sliding and the force of pressing the indenter to the surface being strengthened) is from one to several minutes (maximum 6 min);
- Formation of a wear-resistant metal-ceramic coating.

The execution time of this technological operation does not exceed 1 hour (45–50 min.). The wear resistance of the coating depends on the parameters of the forming (running-in) mode. The formation of a wear-resistant metal-ceramic coating occurs as a result of the course of the following processes. During the first technological operation, the friction surface is layered with harder particles compared to the hardness of the material being strengthened, which are part of the mineral or composition, and the particles are densely hardened into the recesses of the microrelief. These processes are a necessary condition for the launch of two processes: abrasive wear (wear) and the unstable process of forming a protective ceramic film. The microrelief is cleaned of all contaminants (products of wear and decomposition of lubricants, etc.) present on the friction surface. Modification of the friction surface for the formation of thin-film metal-ceramic, organo-metal-ceramic and polymer-metal-ceramic coatings allows to increase the wear resistance of the "crankshaft neck - bearing liner" tribocombination. It is necessary that the composition ensures the creation of a coating that has maximum hardness with minimum modulus of elasticity and coefficient of friction. The technological process of restoring crankshafts of diesel engines with the formation of composite coatings is carried out in the following sequence:

1. Washing and cleaning the shaft;
2. Defection;
3. Grinding the necks to the repair size;
4. neck modification;
5. Crankshaft quality control.

Conclusions: Currently, composite materials are practically not used, which allow to ensure the specified durability indicators of restored parts, due to insufficient study, lack of recommendations for their use depending on operating conditions and sufficient experience of application in solving technological tasks.

To increase the durability of crankshafts to 40,000 hours and avoid burr, it is necessary to reduce the rate of wear of the friction surfaces by 1.5 times.

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ОСОБЛИВОСТІ СУЧАСНИХ МЕХАНІЗОВАНИХ МИЙНИХ УСТАНОВОК ДЛЯ МИТТЯ АВТОТРАНСПОРТНИХ ЗАСОБІВ

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До технічне обслуговування автотранспортних засобів – АТЗ (легкових та вантажних автомобілів, автобусів, спеціальної автомобільної техніки), входять операції, які залежно від характеру та умов виконання об'єднують у певні групи та охоплюють цикл робіт технічної профілактики. Це такі групи робіт, як: прибирально-мийні, регулювальні і заправні, кріпильні, контрольно-діагностичні, мастильні [1].

Прибирально-мийні роботи призначені для підготовки автотранспортних засобів до наступних операцій технічного сервісу – ТС (технічного обслуговування – ТО або поточного ремонту – ПР і капітального ремонту – КР) і надання автотранспортному засобу належного зовнішнього вигляду [2].

Постановка проблеми. Щоб підтримувати належний зовнішній вигляд автотранспортного засобу, видаляти з поверхні його деталей бруд, хімікати і солі, якісно виконувати контрольно-діагностичні роботи, після повернення автотранспортного засобу з лінії треба проводити прибирально-мийні роботи [3].

До групи цих робіт входять: прибирання; попереднє обполіскування; миття спеціальною сумішшю і водою; остаточне обполіскування; сушіння або протирання автотранспортного засобу; нанесення захисного шару воску; полірування пофарбованих поверхонь; нанесення антикорозійного покриття; підфарбовування і пофарбування; дезінфекція автотранспортного засобу загального користування і спеціального призначення.

Ці роботи необхідно виконувати якісно, з високою продуктивністю та найменшою собівартістю. А для цього треба використовувати надсучасні технології, обладнання та засоби миття.

Основні матеріали дослідження. *Прибирання автотранспортних засобів:* Під час прибирання АТЗ – видаляють пил і сміття з кузова легкових автомобілів і автобусів, кабін і платформи вантажних автомобілів, протирають двигун, щитки приладів і внутрішній бік капота, а також очищають шасі від грудок бруду, снігу й криги. Для прибирання АТЗ використовують пилососи, волосяні щітки, обтиральні матеріали та інші допоміжні засоби.

Зміст технологічного процесу миття автотранспортних засобів, як правило складається однією-двома технологічними операціями, які застосовують однотипні прийоми і дії та виконуються в заданій послідовності. Миття автотранспортних засобів може буде ручним і автоматизованим.

Слід відмітити, що ручне миття автотранспортних засобів та його агрегатів виконується, як правило, власниками машин з використанням додаткового обладнання і приладдя (щіток для ручного миття, сопел, інжекторів тощо). У таких мийних установках силовою частиною є