Виконано порівняльне дослідження при відновлювальному наплавленні електродом без модифікуючої домішки і з нею. Встановлено, що при не оптимальній технології модифікування частка кисню в покритті досягає 0,32-1,04%, що підтверджує низьку засвоюваність домішки. У разі запропонованої технології введення модифікатора кисень відсутній, в тому числі і навколо включень. Його не виявили і в покритті без модифікуючої домішки. Що стосується впливу інших компонентів, то вони істотних відхилень не вносять.

Крім того, перевагою комбінованого методу зміцнення модифікуванням магнітною складовою детонаційної шихти є і кристалізація покриття в області перехідної зони з рівномірним розміром зерна - 35 ÷ 40 мкм і зменшеною довжиною зони термічного впливу до 185 мкм. У вихідному покритті розмір зерна в покритті досягає 50 мкм, а зона термічного впливу - 1000 мкм, що на 25-30% і в 5,4 рази відповідно більше, ніж при введенні домішки. Технологія без модифікування супроводжується і формуванням грубої дендритної структури.

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УДК 620.1.631.372

APPLICATION OF NANOMATERIALS IN TECHNICAL SERVICES

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The purpose of nanotechnology is to create nanosystems, nanomaterials, nanodevices that can have a revolutionary effect on the development of civilization. Nanotechnology promises great potential for application in the development of new materials, biotechnology, microelectronics, energy and armaments. Collapsible vehicle service is a further development of research in this area and is mainly based on the provisions of nanoscience. Disassembled service means a set of technical and technological measures aimed at carrying out operations of maintenance and repair of components and mechanisms without disassembly and assembly operations using advanced developments in the chemical industry [1-3].

The result of many years of research by scientists is the fact that friction is now

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presented not only as a destructive phenomenon of nature, but also as a creative process capable of self-organization. This allowed to develop new, previously unknown methods of technical service of machines, in particular the disassembled restoration of units and components in the process of their continuous operation. In the future, research in this area has been further developed, there is and is successfully developing an independent scientific and technical direction - disassembled technical service of machines and mechanisms. Disassembled service may include operations of running-in, diagnostics, prevention, chemical tuning, cleaning and restoration of both individual friction joints and units, as well as machines and mechanisms in general [4,5]. Given the lack of funds in the majority of the population, a certain shortage of available quality fuels and lubricants maintenance in working order is possible through the use of special maintenance and maintenance technology and disassembled service technologies, in particular based on nanoparticles and nanotechnologies.

Known autochemicals for disassembled service of tractor equipment can be attributed to nanotechnological developments by three main criteria:

• use of nanosized particles in their composition (ultrafine diamonds, metal powders, polytetrafluoroethylene (PTFE), modified graphite, etc.);

• use of components obtained (produced) using nanotechnologies, such as sol-gel technologies (conditioners);

• formation on the friction surfaces due to the interaction with the active components of these drugs protective nanosized (nanostructured) coatings and structures (ionic metal-cladding additives, conditioners, geomodifiers).

Undoubtedly, all the above properties to some extent are inherent in almost all repair and restoration of autochemistry, used for disassembled service (restoration) of vehicles. In some cases, they are crucial in order to be attributed to nanotechnology drugs, and in others, can be attributed to ancillary (additional) effects. For example, in all drugs, along with macroparticles can be nanosized particles. It should also be noted that almost all issues of tribology are related to the study of processes occurring in the surface layer (interfacial boundary) of the contacting parts.

The simplest nanomaterials of autochemicals or car cosmetics can be fragments of substances crushed to the nanoscale state or obtained by some other physical or chemical method, having at least one dimension of a length of not more than 100 nm and exhibiting qualitatively new properties (physicochemical, functional, operational, etc.). These can be spherical (multifaceted) particles, nanofibers (eg, PTFE), montmorillonite plates or serpentine needles.

In reality, the range of analyzed objects is much wider - from atoms and molecules to their clusters and polymeric organic molecules containing more than 100 atoms and having a size of even more than 1 μm in one or two dimensions. It is fundamentally important that they consist of a small number of atoms, and, consequently, they already largely show the discrete atomic-molecular structure of matter, quantum effects, and the energy of the developed surface of nanostructures.

In accordance with the above, currently the nanotechnological preparations of autochemistry for use as additives and additives to lubricants of tractor equipment

should include the following developments:

Preparations on the basis of nanodiamonds (Lubrifilm Di-amond Run In, Fenon Nanodiamond Green Run, etc.). Nanodiamonds that are part of the additives (diameter 4-6 nm) and cluster carbon structure the oil film, increase its dynamic strength, act on the crystal lattice of the metal surface, strengthening it, forming new friction surfaces, reducing ultimate friction and wear (especially at high loads and shortages of lubricating material). As a result, running-in time is reduced and the quality of friction joints is optimized, engine performance is improved, fuel and oil are saved, and the amount of harmful emissions is reduced and engine start-up is facilitated.

Metal conditioners (Energy release, SMT2, etc.). As a result of tribochemical reactions (formation, decomposition and reduction in the friction zone of metal compounds with active product molecules), these conditioners form a protective boundary layer (20–40 nm). The protective layer acquires plastic and elastic properties, antifriction qualities and at the same time resistance to high loads.

Reconditioners (Old Chap, Tensai). The drugs are created using sol-gel technology. Along with the formation on the friction surfaces of the protective layers further enhance the bearing capacity (strength) of the lubrication film. Polymolecular system of the drug, which includes nanoscale complexes (clusters) of organic substances, structures the boundary oil film and increases the adhesion of oil to metal.

Reducing additives or remetallizants (Return Metal, Renom Engine NanoGuard, etc.) contain oil-soluble or powdered organometallic compounds. Implement the tribochemical ("ionic") mechanism of metal plating of friction surfaces due to the formation (recovery) on the friction surface of the metal container, nanostructured protective film. Additives contribute to the "treatment" of nano- and microdefects of friction surfaces and the restoration of their efficiency.

Geomodifiers (Fenom nanotechnology, RVS, etc.). Autochemical preparations based on minerals of natural and artificial origin (nano- and micro-levels) are called "geomodifiers", "geoactivators", "repair and restoration compounds" (RVS technology) or "revitalizants". Getting on the friction surface together with the lubricant or in the composition of the plastic lubricant, initiate the process of formation on the rubbing surfaces of metal-ceramic nanoscale structure with high wear resistance and low coefficient of friction.

The use of repair and restoration drugs for disassembled service is determined by the technical condition of the vehicle. The need for a particular effect or drug is assessed on the basis of the results of technical diagnostics. According to the results of the diagnosis, either prophylactic drugs with a "milder" effect or drugs that provide a more intense effect on the joints and units of the rubbing car are prescribed. The considered nanopreparations allow: to considerably increase wear resistance of details; reduce the duration and improve the quality of friction surfaces; effectively increase abrasion resistance and reduce pitting of contact surfaces in heavily loaded friction pairs; reduce the temperature of operating units, noise and vibration.

Developments are most effective in the conditions of extreme friction, at high

loadings and sliding speeds, the raised friction temperature and insufficient greasing characteristic of the worn out friction connections of equipment with big service life, on operating modes and at overloads. The formation of stable protective metal films is a rather long (gradual) process, so during the tests, as well as during the regular operation of the equipment, there may be no sharp (sudden) improvement in performance, but be sure to note their positive dynamics, which improves reliability and resource of units and units of equipment.

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