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TECHNOLOGY FOR INCREASING THE WEAR RESISTANCE OF VEHICLE COMPONENTS OPERATING IN FRICTION CONDITIONS

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Abstract: To increase the wear resistance of vehicle parts, heat treatment (carburizing, nitriding, hardening), surface hardening (laser alloying, surface hardening), as well as modern surface treatment technologies such as grinding and polishing are used, which create stronger and more wear-resistant layers of materials.

Keywords: Vehicle, improving, operating, laser, polishing.

Introduction. Maintaining the performance of power units of automobile and tractor equipment for a long time is a very urgent task today. In this regard, work is being carried out to develop and master the technology for applying advanced coatings to increase surface hardness. However, the development of coatings that increase wear resistance is inextricably linked with research aimed at studying the properties of the coatings themselves, as well as their impact on the performance of the products themselves. To ensure long-term and trouble-free operation of units with friction pairs, not only advanced coatings are used, but also methods for applying special microrelief, protective materials and lubricants. Many scientific schools are working on solving the problem of increasing resources. Each approach involves testing and calculations. This paper shows the effect of ceramic coating on the service life of the crankshaft of a KamAZ vehicle engine. This paper examines the possibility of using a ceramic coating as a means of protecting the crankshaft journals from wear. Data from studies on increasing the service life of friction pairs are presented. Dependencies that characterize the wear rate are presented. A fragment of a method for calculating crankshaft deformations caused by residual stresses is proposed.

The operation of automobile and tractor equipment is inextricably linked with the occurrence of wear and tear of rubbing parts and components of the transmission, engine and other systems. Increasing wear resistance is a very urgent task, which allows reducing the costs of maintenance, repair and operation of equipment.

The object of the research: The crankshaft is the basis of the internal combustion engine. It is used to convert the rotational motion of the engine crankshaft into the linear motion of a piston. Main parts of the crankshaft that are subject to wear:

- Crankshaft;
- Connecting rod bushings and bearings;
- Piston rings;
- Cylinder liners.

The applied coatings must ensure long-term operation of friction units. In addition to long-term operation, it is necessary to ensure high reliability of operation. To meet these requirements, the antifriction layer must have the following properties:

1. high fatigue resistance, which is expressed in the ability of the material not to collapse under the influence of changing loads over the entire range of operating temperatures;
2. high wear resistance, expressed in the ability of materials to resist wear under certain friction conditions;
3. low friction coefficient;
4. high corrosion resistance when exposed to lubricants;
5. good workability;
6. high technology and low cost;
7. high resistance to scuffing;
8. the ability of the material to reduce the impact of foreign solid particles;
9. availability of applied materials; low toxicity of materials, which will provide the opportunity to organize “green” production technologies;
10. lack of catalytic activity of the material towards oils. The mechanical interaction of the surfaces of parts occurs as follows.

When one surface slides relative to another rough surface, the microroughnesses come into contact, i.e., mechanical adhesion of the opposing projections of the rubbing surfaces occurs. As a result of the mechanical interaction of the irregularities, elastic and plastic deformation of the projections is observed, as well as "plowing" of the opposite less hard surface by the hard irregularities. The set of forces caused by the mechanical interaction of individual microroughnesses and the resistance to the relative movement of the surfaces is essentially the mechanical component of the friction force.

The method of the research: There are three methods of monitoring the parameters of surface roughness and waviness:

• contact - using probe devices (profilometer, profilograph);

• non-contact - using optical devices (microscope and microinterferometer);

• visually (by comparison with roughness samples).

The roughness of the working surface of a part of a mechanical system depends on a large number of different factors and their combinations. The quality of the surface is affected by the manufacturing method and type of mechanical treatment, physical and mechanical properties of the part material, and during the operation of the mechanical system - operational factors. Most of the determining factors and their combinations are random in nature, and the process of forming the working surface of the part can also be considered random. Therefore, the profile parameters are considered as random variables and the methods of mathematical statistics are used to assess the surface roughness. The main statistical characteristics of the working surface of the part are: the mathematical expectation of the magnitude of deviations of irregularities from the mean line (or the heights of profile irregularities), the mean square deviation, the correlation function, and the spectral density. The conjugation of two parts is characterized by a mutual correlation function and a mutual spectral density.

Currently, there are three types of bonds that characterize the atomic-molecular interaction of surfaces:

• chemical;

• molecular (hydrogen and under the action of van der Waals forces);

• electrostatic (as a result of the action of a force field).

The strongest bonds are those caused by van der Waals forces. These forces are observed during the interaction of bodies with high-quality surfaces, when the gap between the irregularities of the contacting surfaces is 0.3 ... 0.5 nm. The pressure resulting from the atomic-molecular interaction depends on the materials of the mating parts, the profile parameters and the presence of oxide films. For example, for steel surfaces contacting at a distance of 5 ... 10 nm, the pressure reaches 100 kPa.

It is not yet possible to calculate the molecular component of the friction force in real conditions due to the complex nature of adhesive bonds and a large number of variable factors that determine the interaction process. Therefore, to evaluate it, empirical values of the molecular component of the coefficient of external friction and average normal stresses acting in the zones of actual contact are used.

Conclusion. Thus, ceramic coatings are a promising way to harden the surfaces of automotive parts. They ensure reliable functioning of the mechanisms. Ceramic materials have high heat resistance, chemical resistance, wear resistance and electrical insulating properties. This allows the use of ceramic materials in various units and components. They are especially effective in highly loaded friction units operating under high temperature and mechanical loads. Thanks to the ceramic coating, components, assemblies and parts are protected from corrosion and their hardness increases. Depending on the application method and layer thickness and ceramic composition, surface wear can be reduced by 25-30%. Thus, the use of coatings makes it possible to increase the service life and overhaul mileage of automotive parts. Due to the thermal conductivity of the friction pair materials and the environment surrounding them, there is a redistribution of heat flows into the environment and the friction pair materials themselves. In other words, friction is always accompanied by an increase in the temperature of the mating parts materials, the environment (air, lubricants, working fluid). The conditions of heat exchange of friction parts with the environment, the thermophysical properties of materials, the parameters of the working surface profiles of the parts and the operating mode of the mating together determine the average temperature of the rubbing surfaces, which significantly affects the friction coefficient, the nature of wear of parts and the durability of the mating.

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