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Ways to Improve the Lubricating Properties of Greases

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Abstract. The article analyzes the conditions of use and the main characteristics of greases. Taking into account the ability to form a strong film on the metal surface and a wide range of operating temperature, we conducted a number of experiments using molybdenum disulfide in laboratory conditions. The study shows that the use of molybdenum disulfide MoS_2 additives to greases reduces the wear of parts, increases the service life of friction units and reduces the likelihood of high-loaded parts being bullied and elasticity at low temperatures.

Keywords: Greases, Molybdenum Disulfide, Protective Properties, Friction Units, Wear Of Parts, Additives.

Introduction.

Dozens of brands of greases are used during the assembly and operation of the car. Each lubricated unit has its own specifics of work.

The lubricating properties of greases, unlike the lubricating properties of motor oils, should not only reduce friction and wear, but also have vibration resistance, colloidal stability, stickiness with contacting surfaces, mobility and pumpability.

Greases are a three-component colloidal system consisting of a base oil (dispersed medium), a thickener (dispersed phase) and modifiers (slightly soluble additives). Each of these components performs its own specific function: the thickener gives the lubricant density, the oil lubricates the friction surfaces, and additives improve their functional properties.

Research analysis.

To improve operational properties, anti-wear, extreme pressure, antifriction, anticorrosive, protective, and antioxidant additives are added to lubricants.

Anticorrosive and anti-wear additives have become the most widespread as additives to greases. Additives contained in greases improve the antifriction, anti-wear, extreme pressure properties of these lubricants, promote their adhesion to lubricated surfaces, increase their thermal and colloidal stability, reduce corrosion and rust.

The selection of additives in the manufacture of lubricants is carried out taking into account their purpose. When introducing additives, they must take into account possible harmful side effects on the structure and properties of lubricants. For example, additives that increase stickiness are used to lubricate the undercarriage, they are harmful in the case of lubrication of high-speed bearings. Too sticky grease is usually squeezed out with difficulty and can lead to overheating of the bearings. Therefore, when introducing additives both during the manufacture of lubricants and during their application, it is necessary to study the entire complex of the effects of these additives.

We have studied: the conditions of use and the main characteristics of greases that affect the operation of the units. And it was also considered ways to reduce the wear of car parts using greases with various additives.

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Additives such as molybdenum disulfide, zinc sulfide, talc, copper and other metals are introduced into lubricants in powder form. Copper powder improves the lubricating properties of lubricants under certain conditions. Zinc and lead powders improve the sealing properties of lubricants for threaded connections. Molybdenum disulfide powder reduces the wear rate of metals under friction conditions. Their effect as a dry lubricant is most evident in areas of intense friction.

It is known from literature sources that the use of additives of molybdenum disulfide MoS_2, tungsten disulfide WS_2, copper phthalocyanine ($C_{32}H_{16}N_8$), as well as polymer materials – poly-tetra-fluoro-ethylene to greases reduces wear of parts, increases the life of friction units and reduces the likelihood of high-loaded parts being bullied and elasticity at low temperatures. Poly-tetra-fluoro-ethylene is characterized by the lowest coefficient of friction compared to other substances, also retains softness up to -20°C, and strength and chemical properties up to +300 °C.

The research results show that reducing the wear of car parts can be achieved using greases with various additives. Table 1 shows the change in the properties of greases in the presence of various additives.

Table 1.
Changing the properties of greases in the presence of various additives

Lubricant with additives	**Drop-off temperature,°C**	**Penetration at 25°C**	**Colloidal stability, %**
Solidol without additives	85	260	3
Solidol with the addition of molybdenum sulfide			
3%			
5%	100	268	3,7
10%	108	282	5,8
15%	175	295	6,0
	190	300	6,2
Solidol with the addition of manganese sulfides			
3%			
5%	88	263	3,4
10%	100	268	5,5
15%	165	270	5,8
	185	278	6,1
Solidol with graphite addition			
3%	80	250	3,2
5%	78	252	4,1
10%	70	255	4,3
15%	65	258	4,6

The use of MoS_2 additives to greases increases the effectiveness of lubricants, increases the life of friction units and reduces the likelihood of high-loaded parts being bullied and elasticity at low temperatures, with an increase in the specific load, the coefficient of friction decreases, reaching 0.02 (at 2800 MPa).

Molybdenum disulfide has strong anisotropy of mechanical properties. It was found that the MoS_2 film on the surface of the rubbing parts has basic (basic) crystal planes almost parallel to the surface. Molybdenum disulfide MoS_2 has a hexagonal crystal lattice, with layers of molybdenum atoms alternating in parallel planes, each of which is surrounded on both sides by sulfur atoms firmly bound to it. Since the bond between the two sulfur atoms is weak enough, the shear resistance along the plane of their separation is very small. At the same time, the adhesion of molybdenum disulfide particles to the metal surface is so great that small contact pressures of 0.4-0.5 MPa with a relative shift are sufficient for these particles to form a strong film on the metal surface.

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We have conducted a number of experiments in the laboratory using molybdenum disulfide - MoS_2. To do this, they took 100 grams of solidol grease and injected MoS_2 in different amounts from 0.4 to 1 gram. After thorough mixing in a porcelain mortar, we obtained a homogeneous mass and conducted tests to determine the drop-off temperature, solubility in water, penetration, and colloidal stability. Table 2 shows the results of the analysis of the change in the properties of greases in the presence of molybdenum sulfide.

Table 2.

The results of the experiment to determine the quality of the lubricant after the introduction of molybdenum disulfide.

№	Indicators	Solidol	MoS_2 content in solidol (g)			
			0,4	0,6	0,8	1
1	Appearance and color	brown				
2	Drop-off temperature, ºC	85	110	130	150	175
3	Water resistance	Does not dissolve				
4	Penetration	260	270	285	290	295
5	Colloidal stability	3	4	5	6	6

It follows from Table 2 that the presence of MoS_2 in solidol affects its individual indicators. For example, the melting point of solidol is in the range of 85-95ºC, with the introduction of MoS_2, the drop-off temperature rises to 175ºC. The number of penetrations also increases and colloidal stability increases. We have limited the MoS_2 content to 1000 mg, since there is no need to use lubricants with higher obtained indicators when operating cars.

Conclusions.

From the experimental data and analysis carried out, we came to the conclusion that the presence of molybdenum disulfide in solidol significantly improves the quality of lubrication and increases the effectiveness of lubricants. This provides:

-reducing the consumption of lubricants;

-increasing the reliability and reducing the metal consumption of the mechanism;

- reduction of operating costs.

With an increase in the concentration of MoS_2, the physico-chemical parameters differ significantly from the initial values. The resulting lubricant can be used in both open and closed vehicle assemblies, especially in non-removable ones, such as ball joints, steering rods.

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