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Development of Technology for the Production of Grease Based on Local and Secondary Raw Materials

Alimova Zebo Khamidullaevna
Ph.D., Professor, Tashkent State Transport University, Uzbekistan;
Sobirova Dilorom Kobulovna
Ph.D., Associate Professor, Tashkent State Transport University, Uzbekistan
zeboalimova7841@mail.ru

Abstract. The article investigates the possibility of obtaining a plastic lubricant based on secondary raw materials and local raw materials. Obtaining grease from waste allows replacing industrial raw materials, which will affect the economy of their production. At the same time, the use of waste ensures the environmental safety of the environment. The resulting grease in laboratory conditions is not inferior to general-purpose lubricants in terms of its quality.

Key words: greases, protective properties, friction units, wear of parts, calcium hydroxide, acetic acid, lubricating properties.

Introduction.

There are much more mechanisms in the car filled with special lubricants than with oils. Due to the ability to stay close to the friction pair, the lubricant lasts much longer, and its consumption is ten times less than oil. The durability of rolling bearings, in addition to the load and speed, also depends on the correct selection of lubricants. The lubricant absorbs the energy of impacts, thereby preventing fatigue destruction of rolling elements and the formation of tracks in the bearing cage. Greases work better than oils in nodes such as hubs. Therefore, the bearings of the semi-axles of the rear wheels of cars are filled with grease. The properties of the lubricant depend less on temperature and do not lose the ability to protect the metal from dry friction even when water enters. Each lubricated unit has its own specifics of work.

Research analysis.

It is known that various oils are used as a binder in greases, for example industrial oils I-20 and I-40. Having studied the existing waste of motor oils, we decided to use them after regeneration as the main component of grease.

The purpose of this work is to obtain a new grease based on secondary raw materials that meets the quality requirements of the standard. Regenerated engine oil is offered as secondary raw materials instead of industrial raw materials (industrial oil I-20).

Greases based on a sodium thickener have a high drop-off temperature (120-130°C), but at the same time have low water resistance.

Greases with calcium thickeners have low thermal resistance, but they have increased water resistance.

Taking into account the features of sodium and calcium thickeners, it was advisable to mix them, i.e. to create a complex thickener with a combination of these properties.

$$CH_3COOH + NaOH \rightarrow CH_3C^{=O}_{-ONa} + H_2O$$
$$2CH_3COOH + CaOH_2 \rightarrow (CH_3C^{=O}_{-O})_2Ca + 2H_2O$$

To obtain thickeners in the laboratory, we used solutions of caustic sodium ($NaOH$), calcium hydroxide ($Ca(OH)_2$) and acetic acid (CH_3COOH).

To calculate the required number of components, we proceeded from the reaction of the molecular weight.

$$CH_3COOH + NaOH \rightarrow CH_3C^{=O}_{-ONa} + H_2O$$

(12+3+12+32+1) + (23+16+1) → (12+3+12+32+23)
60 + 40 → 82

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$$2CH_3COOH + CaOH_2 \rightarrow (CH_3C^{=O}_{-O})_2Ca + 2H_2O$$

(2*(12+3+12+32+1)) + (40+32+2) →(2*(12+3+12+32)+40)

120 + 74 → 158

When obtaining a complex thickener, we mixed sodium soap with calcium soap in various ratios. To obtain the initial grease, the previously regenerated engine oil was heated to a temperature of 90-100°C and, a complex thickener was introduced in small portions in an amount of 15% in ratios:

A- $20CH_3COONa + 80(CH_3COO)_2Ca$

All this mass was mixed and brought to a temperature of 150-160°C for 2-2.5 hours. Then the resulting mass was cooled to a temperature of 40°C, then a filler was introduced. Washed dried bentonite was taken as a filler and the resulting mixture was heated to 60-65°C with constant stirring on a magnetic stirrer for 45-50 minutes, the temperature was not raised higher, because at a higher temperature bentonite collapses and the uniformity of the mass is disturbed.

We conducted similar experiments with the ratios of thickeners:

B- $30CH_3COONa + 70\ (CH_3COO)_2Ca$

C- $50CH_3COONa + 50\ (CH_3COO)_2Ca$

The results of the experiment are shown in Table.1.

Table. 1

The effect of the ratio of the thickener components on the performance of the prototype grease at an oil concentration of 80%, thickener 15% and 5% filler

The name of the indicator	Thickener Na + Ca soap %		
	A (20/80)	B (30/70)	C (50/50)
Drop-off temperature, °C	118	128	137
Water resistance	withstands	withstands	withstands
Lubricating properties of kgf/N	178/1744	188/1842	211/2068
Penetration at 25°C, mm	320	320	310

It follows from the table that according to the indicators "drop-off temperature" and "water resistance", the most acceptable ratio of components in a complex thickener is sample C. However, there were differences in penetration. Therefore, our research was continued to optimize the component composition of the tested lubricant. The test results are shown in Table 2.

Table.2

Influence of bentonite content on the indicators of the tested grease

The name of the indicator	A_1(80-15-5)	B_1 (75-15-10)	C_1 (75-10-15)
Drop-off temperature, °C	137	137	137
Water resistance	withstands	withstands	withstands
Lubricating properties of kgf/N	211/2068	211/2068	211/2068
Penetration at 25°C, mm	310	300	280

Sample:

A_1 - oil - 80%, thickener - 15%, filler - 5 %

B_1 - oil - 75%, thickener - 15%, filler - 10 %

C_1 - oil - 75%, thickener - 10%, filler - 15 %

As the data of Table No. 3 show, the change in the filler concentration has an ambiguous effect on the amount of penetration, therefore, we believe that when composing the formulation, the optimal filler concentration is 15% (sample C_1) .

Thus, we have obtained a prototype of PSC grease based on waste and local raw materials. Table 3 provides comparative data of the obtained new PSC grease and the well-known lubricants “Solidol-J” and “Solidol-S”

Table 3

The result of comparing the data of prototypes and lubricants produced by the industry.

The name of the indicator	Solidol-J	Solidol-S	PSC
Drop-off temperature, °C	Не ниже 78	85	137
Water resistance	выдерж.	выдерж.	выдерж.
Lubricating properties of kgf/N	168/1646	168/1646	211/2068
Penetration at 25°C, mm	230-290	310	280

Conclusions.

It can be seen from the comparison results that the grease we have obtained is not inferior to industrial samples. The advantage of the new PSC lubricant obtained consists in obtaining a new complex thickener in laboratory conditions, and replacing industrial raw materials with waste (regenerated engine oil) it will solve environmental and economic problems. This is the effectiveness of the possible application of the PSC lubricant obtained by us.

Currently, the PSC lubricant is undergoing operational tests at a motor transport company. We believe that the use of the developed technology for the production of PSC grease can give a certain economic and environmental effect.

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