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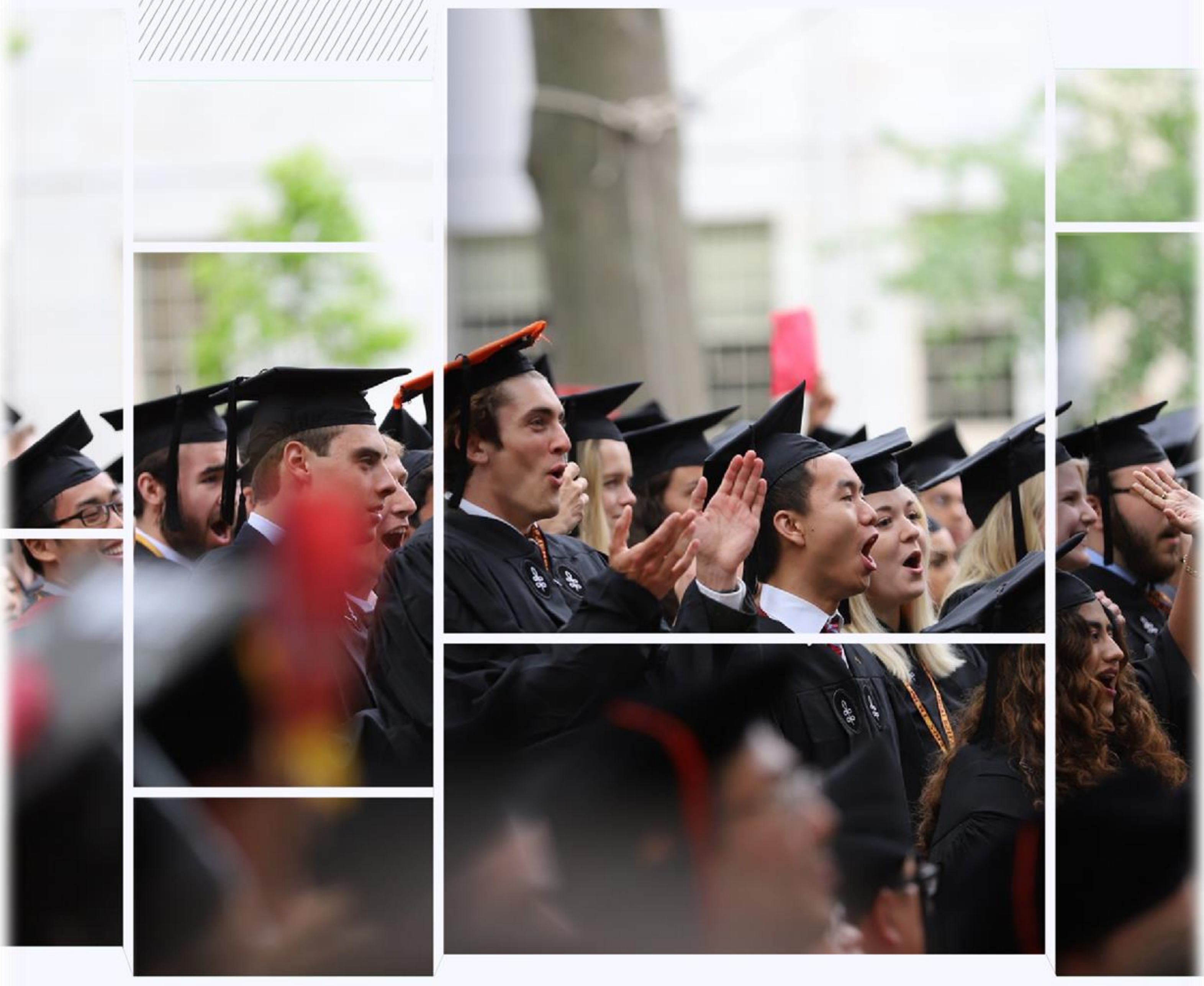

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EFFECTS OF ANTI-SMOKE ADDITIVES ON DIESEL FUELS

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Abstract. Currently, one of the important problems of obtaining complex acting additives for diesel fuels is considered. To do this, it is necessary to select the complex additives formed by dibutyl esters, finding the ratio between nitro and metal sulfonates. In this work, research work was carried out on the effect of additives against smoke on diesel fuels under the influence of ether and sulfonate additives, and the results of testing are presented.
Keywords. Diesel fuel, ethers, metal sulfonate, HFRR instrument

Introduction. It is important that additives, while improving some qualities, do not worsen other qualities of the fuel and their properties in general. It is best to use multifunctional additives. When several additives are introduced into the fuel composition, their effectiveness should be maintained independently of each other and the undesirable interaction should be excluded [1].

According to the main purpose of additives for medium distilled fuel, the following classification may be proposed. [2]:

- antioxidant-for long-term storage of fuel and deactivation of catalytically aggressive metals in fuel;
- depressant, reducing the crystallization temperature of the fuel;
- anti-corrosion;
- against wear;
- increasing the purity of fuels;
- prevent the formation of ice crystals in the fuel;
- increasing the cetane number of diesel fuel;
- biocidal.

To assess the lubrication of diesel fuels, a number of tests are used, including laboratory, operational and bench tests.

Any test for diesel fuel lubrication must meet the following criteria[7]:

- increased wear mechanism in real conditions, mainly friction method;

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- slight heating of the liquid from friction;
- covering the places of contact with the liquid, as in the case of fuel pumps;
- obtaining recurring and recurring results;
- ease of execution of the result.

There are several standard methods for determining the lubrication of diesel fuel:

> SL-BOCLE (ASTM D-6078),
> HFRR (ASTM D-6079, ISO 12156),
> BOCLE,
> PLINT TE-70 SLIM.

Although there are many methods in the literature diesel fuel lubrication, the most promising are the HFRR and BOCLE methods.

On the other hand, most of the information in the literature under study was obtained by the HFRR method, which differs depending on the type of fuel and additive. The hfrr method is easier to use and is characterized by the possibility of sealing, which makes it possible to study the lubrication of essential oils or fuels that are in a gaseous state under normal conditions [3]. The hfrr method provides more stable results than pump tests [4].

Research materials and methods. A sample of the tested fuel is placed in a container where the specified temperature is maintained. The metal ball is firmly fixed on the vertically located holder and pressed with a load on the horizontally fixed metal plate. The ball performs reciprocal movements with a certain frequency and stroke length. In this case, the surface of the ball in contact with the plate is completely immersed in fuel. The metal characteristics of the ball, the plate, temperature, the load applied to the ball, the frequency of the ball and the length of the blow are clearly indicated.

The diagram of the hfrr tool is shown in Figure 1

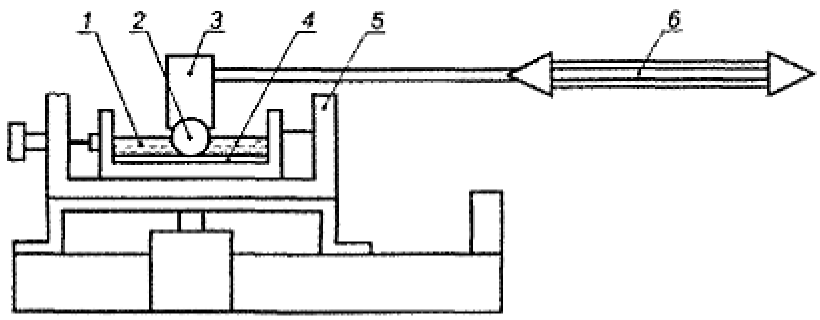


Figure 1. Scheme of the HFRR instrument;

1-fuel tank; 2 - metal ball; 3-load; four - metal plate; 5 - heating element; 6-direction mutual movement.

Research findings and discussion. The size of the burn scar on the bearing, measured with a microscope, indicates the lubrication of the fuel. When calculating the exact diameter of the burn scar, temperature and relative humidity are also taken into account at the beginning and end of the experiment. Permissible values of temperature and relative air humidity are strictly defined (Fig. 2).

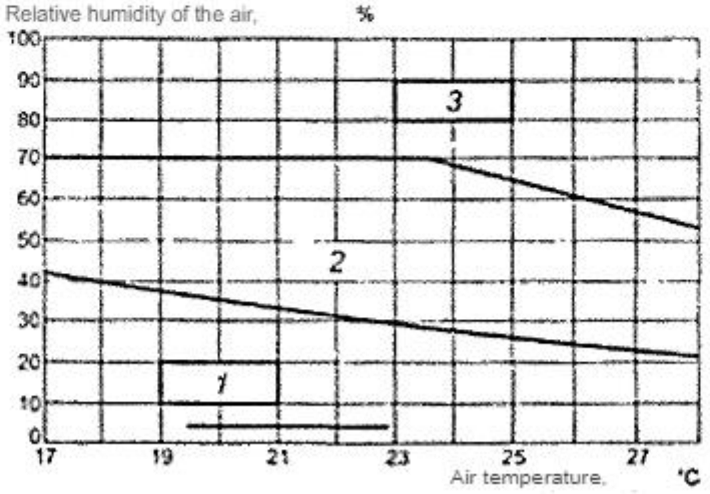


Figure 2. Fixed temperature and relative humidity
Air when tested for HFRR. 1-insufficient humidity, 2 - acceptable humidity range, 3-excessive humidity.

According to ISO 12156, the method is used in petroleum diesel fuel standards (European EN 590 [5] and American, introduced since 2005, ASTM D-975 [6]). The specified maximum wear scar diameter is EN 590 at 460 μm and ASTM D-975 at 520 μm.

Determination of the degree of lubrication of synthesized esters and benchmark products in the composition of deep hydrotosed diesel fuel (sample A) was carried out at a temperature of 60 ° C in the hfrr apparatus according to GOST ISO 12156-1-2006. The choice of" winter "diesel fuel (sample A) is associated with its lower lubrication (stain diameter (KDD) = 675 μm when burning) compared to" summer " diesel fuel (sample B) (DPI = 626 μm). Tests of the hfrr apparatus were carried out in the central factory Laboratory of the Ufa oil refinery.

For the preparation of test mixtures, esters and sulfonate additives synthesized in the amount of 0.5%, 1% and 2% were added to diesel fuel.

The test results are presented in Table 4.1. Sample 1-Fergana NQIZ diesel fuel; sample 2 - Bukhara NQIZ diesel fuel; sample 3-Chinoz NQIZ diesel fuel.

Table 4.1.

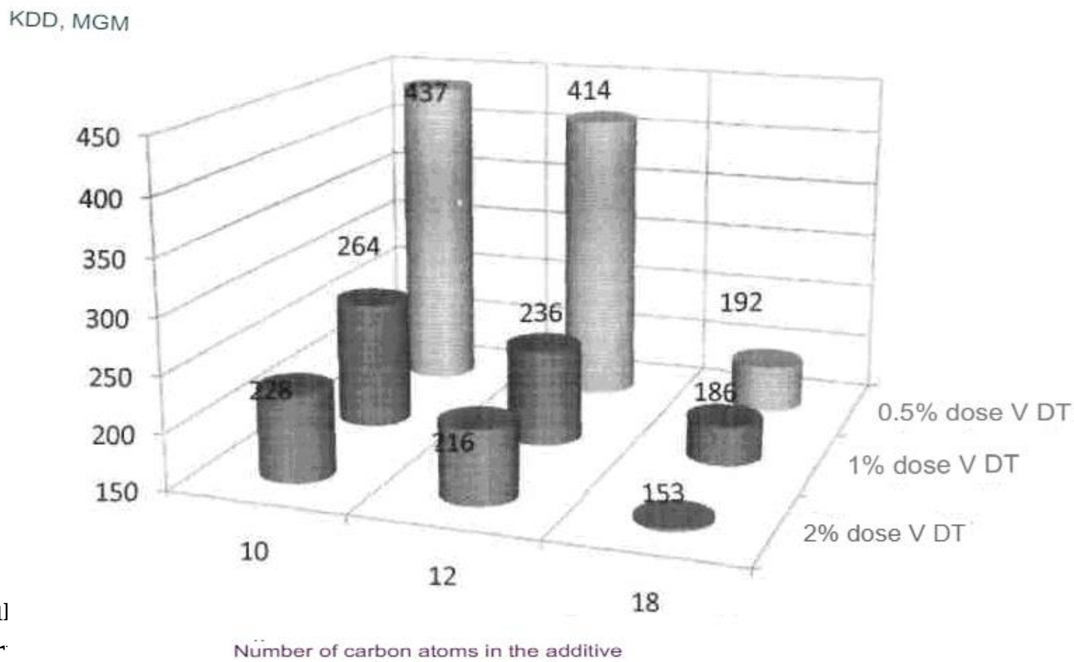
Results of testing the lubricating properties of diesel fuel mixtures with additives of synthesized compounds

№	Sample naming	Content, %		KDD, μm	Note
		Fuel	Additional		
1	Diesel fuel	100,0	0,0	675	-
2	Diesel fuel1 and additional	95,0	5,0	672	without effect
3	Diesel fuel2 and additional	95,0	5,0	652	without effect
4	Diesel fuel3 and additional	95,0	5,0	622	without effect
5	Diesel fuel1 and additional	98,0	2,0	228	the effect is good
6	Diesel fuel1 and additional	99,0	1,0	264	the effect is good
7	Diesel fuel1 and additional	99,5	0,5	437	low effect

8	Diesel fuel2 and additional	98,0	2,0	230	the effect is good
9	Diesel fuel2 and additional	99,0	1,0	267	the effect is good
10	Diesel fuel2 and additional	99,5	0,5	447	low effect
11	Diesel fuel3 and additional	98,0	2,0	231	the effect is good
12	Diesel fuel3 and additional	99,0	1,0	268	the effect is good
13	Diesel fuel3 and additional	99,5	0,5	457	low effect

Comparison of the data presented in Figure 3 with the dependence of the values of the adsorption energy of dialkyl oxalates on the number of carbon atoms in the ether found by calculation (Figure 3) shows a complete correlation. This means that in dialkyl oxalates and similar types of ether, their lubricating properties can be predicted by quantum chemical calculations.

The lubricating property of diesel fuel with a different type of diester in the composition was found to be unsatisfactory. Thus, it can be seen that the adsorption capacity of Diester is significantly dependent on the location of ester groups in diester molecules. Isolated ester groups do not show the desired effect.



d (sample 8) a .0%). The lubr 10), have acceptable limits only in doses of more than 1%. With a decrease in the dose of" biodiesel " to 0.5%, the lubricating effect is significantly weakened, although the LLI value equal to 433 microns corresponds to the norms established by EN-590 (not higher than 460 microns).

As you know, in addition to the value of the heat of adsorption and the strength of the metal bond of the molecule, its anti-wear effect also affects the nature of the orientation of the molecule in the adsorbed (boundary) layer. When an additional molecule is directed parallel to the surface of the metal in the boundary layer, its

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hydrocarbon part also affects the total interaction energy of adjacent layers of molecules in the boundary layer. The energy of the interaction of layers with the parallel direction of the additive molecule is significantly influenced by the number of carbon atoms in the hydrocarbon part of the additive (fig. Thus, the strength of the adsorption layer depends on the adhesion force of the polar COO group of additional molecules to the metal surface and the binding force between the hydrocarbon chains of the additive molecules.

Summing up the results of test tests of samples of esters and reference products of various structures used as an active ingredient in anti-wear additives, it should be noted the exceptional properties of diisooktiloxalate without unsaturated bonds and impurities of resinous substances that worsen performance. features of reference products widely used in the production of anti-wear additives for diesel fuel (tall oils, vegetable acids).

Conclusion. 1. Test tests on the lubrication of synthesized esters and benchmark products in deep-hydrolyzed diesel fuel were carried out at a temperature of 60 ° C in the hfrr apparatus according to GOST ISO 12156-1-2006.

2. The results obtained show that the molecule must have at least two properties to improve its lubricating ability. These properties - polar heteroatom - play an important role in the presence of oxygen, the nature, number and location of carboxyl groups, as well as the length of the hydrocarbon chain, which in turn also improves the lubricating properties of diesel fuel.

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