UDC 665.7.038: 665.753.4: 665.766.2

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Additives to the diesel fuel on the basis of petroleum acids

Possibility of obtaining from petroleum acids of compounds, that can be used as antistatic additives to the diesel fuel is shown. Salts of petroleum acids, complexes of salts with nitroalkanes, and also hydroxyethers have high antistatic properties and their using favors quality work of engines and decision of environmental protection problems.

As internal combustion engines are improved, increasingly stringent requirements are applied to fuels aimed at ensuring high reliability of their operation, fuel efficiency and environmental friendliness. This also applies to diesel fuel, which is widely used by freight motor transport, water and railway transport, agricultural technique. Also diesel fuel is used as caldron fuel and its production volumes are constantly growing.

The production of modern diesel fuels is practically impossible without the use of additives of different functional purpose, that simultaneously correct a number of qualitative characteristics, which are necessary for transportation, storage, operation of fuel, and also contribute to reducing the emission of harmful substances in an environment [1,2].

Now additives are the required element of the technical culture of production and use of fuels. The world assortment of additives includes several dozen types that differ from each other in purpose but search and development of new additives with improved properties remains topical for Ukraine within the program of import substitution and the creation of new additives, which simultaneously favor the high-quality work of engines and the solution of environmental problems.

In the given work the possibility of using of derivatives of petroleum acids as antistatic additives to the diesel fuel is examined.

Petroleum acids are alicyclic monobasic or less often dibasic carboxylic acids, which contain five- and six-membered saturated hydrocarbon cycles. The carboxylic group at them is connected directly with a cycle or through a lateral hydrocarbon chain. Besides monocyclic, there are also bi- and polycyclic petroleum acids. Their content in oils ranges from traces to 3% [3].

The most common method of separation of petroleum acids is the method of their leaching from different fractions of petroleum - from kerosene, gas oil, diesel fraction, as well as from natural bitumen.

Petroleum acids have long become an important technical raw material and have found application as solvents of polymers, dyes and caoutchouc, as components of varnishes, antiseptic additives, additives to printing inks, substances for impregnating wood to prevent its decay.

Most of the petroleum acids are used in the form of their metal salts. They serve as thickeners in plastic greases, additives for lubricants, oils and fuels.

It is known from the literature that some derivatives of petroleum acids are used as anticorrosive, antifertilizer additives, additives that prevent carbon formation in a combustion chamber [4,5].

The paper [4] shows the possibility of using salts of petroleum acids, their complexes with nitroalkanes, as well as hydroxyethers of petroleum acids with propylene oxides as antistatic additives to diesel fuels. Static electrization of petroleum products not only causes explosions and fires, but it is also a factor hindering the intensification of some technological operations with oil and petroleum products. One of the most common methods of combating electrization is to reduce the resistivity by using antistatic additives.

It is known from the literature that as antistatic additives compounds that belong to the classes of organic salts or organic complexes are used successfully. It is also well prevent the accumulation of statistical electricity in diesel fuel compounds containing the following functional groups: –CN, –OH, –Br, $–NO_2$, $–SO_2H$, and also nitrocompounds [1,2,4].

They were synthesized and investigated as an antistatic additive to diesel fuel:

1) Ca–, Zn–, Mn–, Ni–, Cu–, Cr– salts of petroleum acids, which were added in quantity 0.01-0.1 mass %;
2) complexes of chromium, nickel and cobalt salts of petroleum acids with nitroalkanes (in quantity 0.001%);
3) hydroxyethers of petroleum acids and propylene oxide with different molar ratios (5% solutions).

The effeciency of the additives was evaluated on the basis of the measurement of the specific electrical conductivity (□) of the fuel. The results of the measurement after 30 days after preparation are presented in the table.

Table

Electrical conductivity of diesel fuel with various antistatic additives

Salts of petroleum acids							
Salts (0.1 mass %)	Ni – salts	Zn – salts	Mn – salts	Cu – salts	Cr – salts	Ba – salts	Co – salts
□, пSm/m	>1000	491	415	161	>1000	434	830
Complexes of salts with nitroalkanes							
	salts of Cr – nitroalkanes C_8		salts of Ni – nitroalkanes C_8			salts of Co – nitroalkanes C_8	
□, пSm/m	678		288			240	
	salts of Cr – nitroalkanes C_{12}		salts of Ni – nitroalkanes C_{12}			salts of Co – nitroalkanes C_{12}	

□, пSm/m	695	273		338
Hydroxyethers of petroleum acids and propylene oxide				
Molar ratio	1:1	1:2	1:3	1:5
□, пSm/m	>1000	545	800	805

It can be seen from the table that among the salts of petroleum acids, Ni- and Cr-salts have the highest electrical conductivity. All complexes of salts with nitroalkanes show a high antistatic effect, but the largest one is for chromium salts. Similarly, hydroxyethers of petroleum acids and propylene oxide of all compositions effectively increase the electrical conductivity of fuel, but the best result is shown by hydroxyethers with a molar ratio of the initial components of 1:1.

From the given data it can be concluded that the petroleum acids contained in the petroleum as impurities and deteriorating the quality of petroleum products in the processing of such petroleum, it is expedient to extract from petroleum distillates and use not only as raw material for the production of useful substances in various industries, but also for synthesis of diesel fuel additives on their basis.

The salts of petroleum acids, their complexes with nitroalkanes, as well as hydroxyethers have high antistatic properties and the addition of these compounds as additives to diesel fuel contributes to maintaining the safe value of electrical conductivity of fuel for a long time.

The best antistatic additive, probably, is hydroxyethers, because they are well soluble in hydrocarbons and are low-toxic, since they do not contain metal and nitrogen atoms. The use of such additives not only desides the technical problems of engine operation, but also reduces the load on the environment.

References

1. Данилов А.М. Применение присадок в топливах: Справочник. – СПб.: Химиздат, 2010. – 368 с.
2. Митусова Т.Н., Полина Е.В., Калинина М.В. Современные дизельные топлива и присадки к ним. М.: Техника, 2002. – 64 с.
3. Наметкин Н.С., Егорова Г.М., Хамаев В.Х. Нафтеновые кислоты и продукты их химической переработки. М.: Химия, 1982. –184 с.
4. Абдуллаева Н.Р., Исмаилов Т.А., Мамедова Т.А. и др.. Синтез и исследование антистатических присадок к дизельным топливам на основе нефтяных кислот // Нефтехимия. – 2011. –т. 51, № 4. – С. 309 – 312.
5. Мамедова Т.А., Талыбов А.Г., Велиев Х.Р. и др. Синтез этиленгликолевых эфиров нефтяных кислот и использование их в качестве добавок к дизельным топливам // Нефтехимия. – 2011. –т. 51, № 3. – С. 233 – 236.