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INVESTIGATION THE EFFECT OF HETEROATOMIC COMPOUNDS IN DIESEL FUEL ON THE EFFECTIVENESS OF DEPRESSORS

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The fluidity of diesel fuel (DF) at negative temperatures is determined by low-temperature characteristics, such as: cloud point (Cp), cold filter plugging point (CFPP) and pour point (Pp). The using of winter and arctic grades of diesel fuel (CFPP not higher than –25 and –45 °C, respectively) makes it possible to ensure stable and uninterrupted operation of equipment in extreme conditions. Depressant additives (depressors, DA) are introduced into DF to achieve the best low-temperature characteristics. The use of depressors prevents the enlargement and association of n-paraffin crystals that are part of the fuels. The improvement of low-temperature properties occurs due to the adsorption of additives on n-paraffin crystals or their co-crystallization.

From the literature data, it`s known that the quality and various properties, including low-temperature ones, of petroleum fuels are also determined by the content of heteroatomic compounds in their composition [1]. The effect of heteroatomic compounds on the low-temperature properties of fuels has been poorly studied, so this topic is of great interest.

The aim of this work is to evaluate the effect of a depressor additive on the low-temperature properties of a DF sample for further work on the study of the effect of heteroatomic compounds on the effectiveness of depressor additives. The object of the study is a commercial DF and two different depressors.

The low-temperature properties presented above: Cp, CFPP, Pp of the DF sample under study were determined in accordance with the requirements [2]. Then two depressor additives were introduced and the characteristics of the resulting blends were determined in a similar way. The obtained results are presented in the Table.

Based on the Table, it can be seen that the studied DT sample meet to the Arctic DF brand.

Table 1. Low-temperature properties of the DF sample and it`s blends with additives

Sample	Cp, °C	CFPP, °C	Pp, °C
DF	–35	–45	–46
DF + DA1	–37	–45	–54
DF + DA2	–37	–45	–54

The addition of both additives to DF sample had a significant positive effect on Pp (Pp decreased by 9 °C).

The introduction of additives into the fuel sample under study had practically no effect on the CFPP. The effectiveness of depressor additives, i.e. the susceptibility of DF to them, is determined by the composition of the sample itself. For the study, a commercial DF was used, which may already contain various impurities and additives in its composition, because of which the additional introduction of a depressor didn`t have the expected effect.

Thus, it has been experimentally established that depressor additives from different manufacturers have the same effect on the low-temperature properties of the DF sample under study. It can be concluded that the introduction of the studied depressor additives has a positive effect only on the Cp and Pp of the DF sample.

Commercial fuel was chosen as the test sample at the first stage of the work, since its composition practically does not contain heteroatomic compounds after the hydrotreating process. In future work, it`s planned to conduct research and study the role of the addition of individual heteroatomic compounds to the test sample on the low-temperature properties and effectiveness of depressor additives.

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RESEARCH OF PLASMA-CHEMICAL SYNTHESIS OF NANOSTRUCTURED OXIDE FUEL COMPOSITIONS FOR HIGH-TEMPERATURE GAS-COOLED REACTORS

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One of the promising directions for the development of nuclear hydrogen energy in Russia is the use of high-temperature gas-cooled reactors for the energy-efficient production of hydrogen in the process of methane steam reforming.

The used nuclear fuel (NF) in the form of ceramic uranium oxide fuel enriched with the uranium-235 isotope, along with its advantages, also has significant disadvantages: brittleness, low thermal conductivity and the risk of cracking, a short operating cycle (3–5 years), limited natural reserves of the uranium isotope-235, production of power-grade plutonium [1]. While the use of thorium-232 reduces the cost of isotopic enrichment [2].

The approximate content of thorium in the earth's crust is 3–5 times higher than the reserves of uranium, and the use of such nuclear fuel drastically reduces the production of power-grade plutonium, allows you to create ultra-small (up to 10 MW) and small (up to 100 MW) nuclear power plants for the production of hydrogen in remote and hard-to-reach regions.

However, this NF still has a flaw – low thermal conductivity. It is promising to use dispersive nuclear fuel (DNF) in the form of fuel oxide compositions (FOC), including oxides of fissile metals (uranium, thorium), uniformly distributed in an oxide matrix, which has a high thermal conductivity and a small neutron absorption cross section.

The common disadvantages of the technologies used for obtaining FOC (separate production and mechanical mixing, the “sol-gel” process, etc.) are the multistage nature, duration and high energy and labor costs [1, 2].

The use of gas-discharge plasma for plasma-chemical synthesis of FOC from dispersed aqueous-organic nitrate solutions (AONS), including an organic component (alcohols, ketones) and solutions of an aqueous nitrate solution, should be attributed to one-stage, uniform distribution and the required composition phases, low energy and labor costs [3].

The paper presents the results of theoretical studies of the process of plasma-chemical synthesis of FOC from dispersed solutions of AONS, including an organic component (ethanol, acetone), aqueous nitrate solutions of fissile (uranium, thorium) and matrix (magnesium, aluminum, yttrium) metals, as well as the results of experimental studies of the process on model solutions of AONS containing neodymium (instead of uranium) and cerium (instead of thorium).

The effect of temperature and mass fraction of air (oxidizer) on the process of synthesis of FOC is shown in Fig. 1.