THE USE OF HEAVY n-PARAFFINS FOR INCREASING THE EFFECTIVENESS OF COLD FLOW IMPROVERS

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Nowadays, the most effective way to obtain diesel fuel (DF) of winter and arctic brands, that meet the requirements [1], is to use of cold flow improvers.

The range of cold flow improvers produced on the domestic market and also the composition of DF is very varied. The effectiveness of cold flow improvers largely depends on the composition of the fuel. The presence of n-paraffins in fuels significantly degrades their low-temperature properties because heavy n-paraffins freeze at positive temperatures. At the same time, according to the mechanism of action, formation of the first n-paraffins crystals triggers the action of depressive additives.

The aim of this work is to study the effect of heavy n-paraffins on the effectiveness of cold flow improvers.

A sample of straight-run DF and also its blends with three cold flow improvers and heavy n-paraffins (P), was selected as the object of the study. Heavy n-paraffins were obtained from a sample of heavy gasoil, the concentration of heavy n-paraffins in blends was 0.1 %wt. The used concentrations of cold flow improvers are shown in Table 1 (it is concentrations recommended by cold flow improvers manufacturers).

In this work low-temperature properties (cloud point – T_{cp}, cold filter plugging point – CFPP and pour point – T_{pp}) was determination according to the methods described in [2–4]. The results of determination low-temperature properties of straight-run DF sample and its blends with cold flow improvers are shown in Table 2. The results of determination low-temperature properties of blends with the addition of heavy n-paraffins are shown in Table 3.

As can be seen from the data presented in Tables 2–3, the addition of heavy n-paraffins leads to the deterioration of all low-temperature properties of straight-run DF.

In addition, from the presented data it can be seen that the addition of 0.1 %wt. heavy n-paraffins had a different effect on the cold flow improvers effectiveness.

Thus, for improver A, the addition of heavy n-paraffins increased the effectiveness of action in relation to CFPP by 6 °C, but had a negative effect to T_{pp} (+3 °C). For improver B, the addition of heavy n-paraffins increased the effectiveness of the action in relation to CFPP by 2 °C, but had a negative effect to T_{pp} (+4 °C). For improver C, the addition of 0.1 %wt. heavy n-paraffins did not have a change in the CFPP, but had a positive effect on the T_{pp} (–12 °C).

Table 1. Cold flow improvers concentrations

Cold flow improvers concentration (per 100 ml sample), ml		
A	B	C
0.26	0.50	1.00

Table 2. Results of determination of low-temperature properties of DF and blends of DF with cold flow improvers

Blend	DF	DF + A	DF + B	DF + C
T_{cp}, °C	–4	–5	–4	–5
CFPP, °C	–5	–25	–6	–10
T_{pp}, °C	–16	–42	–31	–30

Table 3. Results of determination low-temperature properties of blends with the addition of heavy n-paraffins

Blend	DF + 0.1 % P	DF + A + 0.1 % P	DF + B + 0.1 % P	DF + C + 0.1 % P
T_{cp}, °C	–3	–1	–1	–4
CFPP, °C	–5	–31	–8	–10
T_{pp}, °C	–15	–39	–27	–42

References

1. *USS 305-2013 "Diesel fuel. Specifications".*
2. *ASTM D2500-05 "Standard Test Method for Cloud Point of Petroleum Products".*
3. *ASTM D6371-17a "Standard Test Method for Cold Filter Plugging Point of Diesel and Heating Fuels".*
4. *ASTM D97-17b "Standard Test Method for Pour Point of Petroleum Products".*

LOW-TEMPERATURE PROPERTIES OF GASOIL AND DIESEL OIL FRACTIONS IN COMPARISON

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Diesel fuel oil is a product of direct distillation of oil primarily used in internal-combustion engines. Gas-oil is a product of the distillation of oil or petroleum products sold as an additive in the diesel fraction and as a kind of fuel for boilerhouses and trucks.

In areas with a cold climate, the issue is which fuel is suitable according to this area for its best storage, transportation and operation. To determine the fuel pumping quality under refrigeration we have distinguished a number of indicators: setting point (Tz), cloud point (Tp), filtration temperature limit (Tf).

The aim of this work is the experimental determination of the low-temperature properties of samples of gasoil and diesel fuel oil fractions and their comparison for possible transportation, storage and use in places with low temperatures.

Six samples of diesel fuel oil fractions (DF) and gasoil fractions (GF) were taken as an object of study. Operational characteristics were determined for each sample in the research.

The study was carried out using a low-temperature indicator of petroleum products INPN SX-800.

Table 1. Reference data on the dependence of setting point on the molecular weight of hydrocarbons

Alkane	Tz, °C
n-ethyl-methylethane	–129.72
n-hexane	–95.32
n-heptane	–90.6

The operation of the device is based on a change in the optical permeabilitycoefficient of diesel fuel oils with a gradual decrease in sample temperature.

The setting point is explained by the content of high molecular weight paraffin hydrocarbons of a normal structure, which primarily precipitate upon cooling [1]. The dependence of low-temperature properties on the molecular weight of hydrocarbons is established: the more hydrocarbons with a high molecular weight the worse the performance of the fuel. This dependence can be shown on the example of reference data for hydrocarbons of the "Alkanes" class, collected in Table 1 [2].

The data on the low-temperature properties of the samples are shown in Table 2.

When analyzing sample №1, the following data were obtained: Tz=–8.3 °C, Tp=–6.8 °C, Tf=–14.2 °C. The indicators are negative; therefore, the sample relates to diesel fuel fractions.

The obtained values of sample №2 are worse in comparedto №1. Positive temperatures Tz=8.3 °C, Tp=11.2 °C, Tf=9.5 °C. The sample is a fraction of atmospheric gasoil.

Table 2. Experimental low-temperature properties of gasoil and diesel fuel oil fractions

Sample number	Tp*, °C	Tz**, °C	Tf***, °C
DFC №1	–6.8	–18.3	–14.2
GC №2	11.2	8.3	9.5
GC №3	10.7	11.3	8.8
DFC №4	–17.5	–24.1	–23.5
DFC №5	–23	–28.1	–24.3
GC №6	12.3	12.4	10.9