

INVESTIGATION OF THE COMPOSITION AND PROPERTIES OF STRAIGHT-RUN DIESEL FUELS

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Nowadays low-tonnage production is developing in the oil-producing regions, which assumes either the use of straight-run products as fuel, or is based on bringing the quality of straight-run fractions to the level of commercial fuels at the production site. However, in both cases the quality control of the product remains a priority, since the use of poor quality fuel entails spoilage of equipment and as a result economic losses. Four samples of straight-run diesel fuel, obtained from low-tonnage production, were selected as objects of research.

Such indicators of diesel fuel quality, as fractional composition, density, sulfur content was determined experimentally. Also cetane index was calculated. The fractional composition of diesel fuel was determined in accordance with USS 2177-99 "Petroleum products. Methods for determination of distillation characteristics" [1]. The results are shown in Table 1.

Determination of the fuel density was carried

out in accordance with USS 3900-85 "Petroleum and petroleum products. Methods for determination of density" [2]. Determination of sulfur content was carried out in accordance with USS 32139-2013 "Petroleum and petroleum products. Determination of sulfur content by method of energy dispersive X-ray fluorescence spectrometry" [3]. The viscosity was determined in accordance with USS 33-2000 "Petroleum products. Transparent and opaque liquids. Determination of kinematic viscosity and calculation of dynamic viscosity" [4]. The results of the studies are presented in Table 2.

According to [5], the cetane number can be calculated as a cetane index. The cetane index is the approximate value of the cetane number of distillate diesel fuel without cetane improver additives, calculated on the basis of fuel density and its fractional composition.

The values of the cetane indices calculated by [6] for the four samples are given in Table 3.

Table 1. Fractional composition of straight-run diesel fuel

Sample number	IBP	FC _{10%}	FC _{20%}	FC _{30%}	FC _{40%}	FC _{50%}
	Temperature, °C					
1	147	182	205	243	255	301
2	163	191	205	218	234	249
3	160	189	200	216	232	248
4	149	190	211	229	248	262
Sample number	FC _{60%}	FC _{70%}	FC _{80%}	FC _{90%}	FC _{95%}	
1	326	333	342	359	360	
2	263	281	298	320	330	
3	265	284	304	338	342	
4	276	292	309	332	343	

Table 2. Straight-run diesel fuel properties

Sample number	Density at 20 °C, g/cc ³	Kinematic viscosity, mm ² /s	Sulfur content, ppm
1	0.829	2.934	2809
2	0.842	4.124	25
3	0.832	3.815	2420
4	0.825	4.227	711

Table 3. Straight-run diesel fuel cetane index values

Sample number	Cetane index, points
1	60.5
2	45.6
3	48.7
4	54.7

According to the results of the tests, only the sample number 2 meets the requirements of USS 305-2013 "Diesel fuel. Technical Specifications"

References

1. USS 2177-99 "Petroleum products. Methods for determination of distillation characteristics".
2. USS 3900-85 "Petroleum and petroleum products. Methods for determination of density".
3. USS 32139-2013 "Petroleum and petroleum products. Determination of sulfur content by method of energy dispersive X-ray fluorescence spectrometry".
4. USS 33-2000 "Petroleum products. Transparent and opaque liquids. Determination of kinematic viscosity and calculation of dynamic viscosity".
5. USS R ISO 8178-5-2009 "Reciprocating internal combustion engines. Exhaust emission measurement. Part 5. Test fuels".
6. USS 27768-88 "Diesel fuel. Determination of cetane index by calculation method".
7. USS 305-2013 "Diesel fuel. Technical Specifications".

NICKEL COATINGS OBTAINED FROM NON-AQUEOUS ELECTROLYTES FOR HIGHLY SOLUBLE PCMS

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In last decade a significant interest in the application of phase change materials (PCMs) systems has been growing, since latent heat storage systems can provide high storage capacity and isothermal behaviors [1]. However, all PCMs can react with aqueous solutions meaning the porous shell material is not good barrier for protection of PCM core from being dissolved in aqueous solution. Thus, changing of solvent [2, 3] makes it possible to obtain metal shell on the salt surface. This work proposes the technique of encapsulating the PCM core in a metal structure shell (macroencapsulation).

Sodium nitrate has been chosen as the PCM (Sociedad Química y Minera de Chile). The procedure of obtaining the core-shell structure was as follows: Sodium nitrate was first coated with hydrophobic layer, then with graphite and, finally, with copper from standart sulphate bath ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ 200 g/dm³, H_2SO_4 100 g/dm³). Top nickel layer was electrodeposited using aqueous and ethanol bathes. The main compounds of electrolytes were $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ (200 g/dm³), HCl (0,11 mol/dm³). The density of ethanol was 0.8 g/cm³. Electrodeposition was performed at 50 °C using a current density of 2.5 A/dm².

Cathodic polarizations curves in non-aqueous and aqueous solvents were obtained by linear polar-

[7] for all properties that have been investigated, and can be used as commercial diesel fuel.

ization with potential scan rate of 0.005 V/s. Linear Tafel ranges ($\eta = a + b \log i$) of polarization curves corresponded to the charge transfer were used as a rate-determining step of Ni^{2+} reduction. The slopes of the linear regions were 0.12±0.001 V/dec and 0.10±0.001 V/dec for the non-aqueous and aqueous bathes, respectively. The determined slopes values differed slightly from the theoretical value (0.12 V/dec) and indicates electrochemical stage as being the limiting one. Nickel electrodeposition onto copper substrate in presence of different solvents does not significantly change the b value indicating the charge transfer reaction is not controlled by the type of solvent.

It was found by the thermokinetic method that in the overpotential range from 0.1 to 0.4 V the process is limited by the electrochemical stage. There was a tendency of decreasing the effective activation energy at overpotential of 0.4 V by 40 kJ/mol when the aqueous solvent is replaced by a non-aqueous. In the overpotential region of 0.5–1.5 V, the value of the activation energy depends on the change of the potential, which may indicate diffusion as the limiting stage.

It is established that the current efficiency gradually decreases with increasing of the current density. Current efficiency in non-aqueous bath was