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THE INFLUENCE OF MAGNETIC FIELD ON THE ACTIVITY OF THE ADSORBENTS IN THE PROCESSES OF DEAROMATISATION OF DIESEL FRACTION

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The process of dearomatisation of straight-run diesel fraction with the help of the adsorbent of cationite KU-2-8 and natural aluminosilicates A4 was investigated. It was revealed that the degree of dearomatisation of diesel fraction with a usage of industrial cationite KU-2-8 constituted 31%, while this value for the adsorbent A4 corresponded to 28%. What is more, application of the magnetic field with the range of force from 15 to 100 milli Tesla increases the degree of dearomatisation of diesel fraction by about 49 to 51.8%, respectively.

Keywords: *diesel fuel, dearomatisation, adsorptive dearomatisation, magnetic field, adsorbent*

In the last decade, there are severe requirements in terms of quality of the motor fuels. According to the European standard EN 590:2010, the concentration of compounds containing sulfur should not exceed 10 ppm. There are a number of reasons associated with the strict ecological requirements related to not only the restricted amount of compounds containing sulfur in modern diesel fuels, but also aromatic hydrocarbons (polycycloarenes in particular), for example the decrease of the amount of polycycloaromatics in diesel fuels reduces the carcinogenic threat of exhaust gases-formation of carcinogenic and mutagenic chemical compounds (benzopyrene, dibenzanthracene, nitro and N-nitroso derivatives of arenes) [1].

The increase of the amount of arenes during the combustion of diesel fraction contributes to the formation of carbon oxide and soot (when the content of arenes increases from 15 to 27 mass%, the amount of soot in the composition of exhaust gases rises 5 times) [2]. Moreover, the presence of polycycloarenes is considered to be undesirable: the addition of 10 mass% of dimethyl naphthalene leads to the increase of particulate matters in the content of exhaust gases by about 13%, whilst the addition of only 2 mass% phenanthrene rises their amount by 30% [3]. Carcinogenic activity of exhaust gases increases due to the adsorption of carcinogenic compounds by soot particles [4];

The high content of arenes in diesel fraction contributes to the increased concentration of nitrogen oxides in the composition of exhaust gases, because the reinforced carbonization worsens heat extraction from the walls of the engine which results in the enlargement of maximal temperature in the flame front [5];

The magnification of the content of arenes leads to the drop of cetane number of diesel fuels and results in complications during the launch of engines, damages its details, and increases the concentration of NO_x, and CO_2 in exhaust gases [6].

Several hydrogenation processes (hydropurification, hydroforming, hydrodearomatisation) are applied in order to decrease the content of sulfur and aromatic containing oil fractions. As a matter of fact, these processes are conducted with a usage of aluminonikeltungsten or aluminocobaltmolybdenum catalysts at the temperature range of 350-450℃, at the feed rate of 1-3 h^{-1} and a pressure range 3,0-7,0 MPa (occasionally up to 10 MPa). Depending on the condition of the process and properties of initial fraction it is possible to achieve different degree of desulfurization and dearomatisation. These conventional techniques (hydropurification and hydrocracking) of dearomatisation of diesel fuels which are conducted under the conditions of high temperatures and pressures require the use of expensive catalysts and hydrogen.

Table 1

Physical and chemical properties of straight-run diesel fuel before and after the adsorption and magnetic influence

Physical and chemical properties	Straight-run diesel fraction				
	Before adsorption	After adsorption with A4	After magnetic field and adorption with A4	After adsorption with KU-2	After magnnetic field and adsirption with KU-2
Density at 20°C, kg/m^3	0.8496	0.8487	0.8468	0.8440	0.8432
Total sulfur content, mass%	0.09	0.09	0.09	0.1222	0.1191
Pour point, ºC	- 36	-32	-30	-32	-31
Cloud point, ºC	-25	-23	-22	-20	-22
Iodine number, g J_2/g	1.83	2.65	4.9	3.27	4.77
Content of aromatic hydrocarbons mass%	16.4	11.8	7.9	11.3	8.4
Molecular weigth, g/mol	227	212	209	210	210

Currently, the alternative ways of purification of diesel fuels from aromatics are the processes of extractive and adsorptive dearomatisation of diesel fractions.

It is worth noting that in the development of the technologies concerned with adsorptive dearomatisation of diesel fuels the important role plays the appropriate selection of adsorbent.

Aromatic hydrocarbons are able to be adsorbed on specially selected adsorbents rather than paraffinic and naphthenic hydrocarbons, and exactly this is the way of their extraction from oil products.

Since the regeneration process of regeneration is considered to be complicated, the problem of catalyst selection is still estimated to be actual.

In recent years, it is likely to observe the rise in interest to low energy influence with the help of which it is feasible to reconstruct the structure of substances. As an external source which affects the structure of compounds including oil disperse systems, various fields can be used such as electric, electromagnetic, magnetic, vibrational, and acoustic [7-10].

The energy of the magnetic field is considered to be one of the effective, economic, and allowable types of energy. Magnetic fields are created with apparatuses called magetotron and magnetic activators which in turn influence on the non-ferromagnetic substances having diverse physical properties and which are presented in different aggregate states [11-13].

Current work was dedicated to the dearomatisation of the straight-run diesel fuel with the method of adsorption under the influence of magnetic field. Reagent A4 was used as an adsorbent which was prepared at the Institute of Petrochemical Processes named after Y. Mammadaliyev from zeolite-containing rocks of local deposits and commercial catalyst KU-2. X-ray fluorescence analysis of the breed was conducted, which revealed that the nature of magnetic receptivity was caused by the presence of 9.84% Fe_2O_3.

Studies were conducted using a magnetic induction of 15 to 100 milli Tesla, which corresponds to the magnetic intensity of 150 to 1000 Oersted.

Physical and chemical properties of diesel fuel before and after the usage of adsorbent A4, adsorbent KU-2 and magnetic field influence are represented in table 1.

Experiments have shown that the amount of the aromatic hydrocarbons in the content of diesel fraction have decreased by 4.6 mass% (degree of dearomatisation was 28%) when it was passed through the adsorbent A4. However, in case of passing the diesel fuel through the magnetic field and adsorbent A4, the degree of dearomatisation increased up to 51.8% while the content of left aromatics constituted 7.9 mass%. When the diesel fuel is passed through the industrial adsorbent KU-2 the degree of dearomatisation was 31% which further increased up to 48.7% after the influence of magnetic field.

Thus, adsorbent A4, which was prepared by Institute of Petrochemical Processes named after Y. Mammadaliyev, exhibited high activity which is identical to the industrial adsorbent KU-2. The influence of magnetic field either on adsorbent A4 and adsorbent KU-2 contributes to the approximately 2 times decrease of aromatic content.

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DİZEL FRAKSİYASININ AROMATİKSİZLƏŞDİRİLMƏ PROSESİNDƏ MAQNİT SAHƏSİNİN ADSORBENTLƏRİN AKTİVLİYİNƏ TƏSİRİ

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İlkin emal dizel fraksiyasının KU-2-8 kationitdən və təbii alümosilikatlardan adsorbent kimi istifadə etməklə aromatiksizləşdirmə prosesi tətbiq edilmişdir. Aşkar edilmişdir ki, sənaye kationiti KU-2-8 istifadə etməklə dizel fraksiyasının aromatiksizləşdirilmə dərəcəsi 31%, təbii alümosilikatlar əsasında olan A-4 adsorbentindən istifadə etdikdə isə 28% təşkil edir. Dizel fraksiyasına 15-100 mlT güclü maqnit sahəsi təsirində aromatiksizləşdirilmə dərəcəsi müvafiq olaraq 49 və 51.8% təşkil edir.

Açar sözlər: *dizel yanacağı, aromatiksizləşdirmə, adsorbent, kationit, alümosilikat, seolit*

ВЛИЯНИЕ МАГНИТНОГО ПОЛЯ НА АКТИВНОСТИ АДСОРБЕНТОВ В ПРОЦЕССАХ ДЕАРОМАТИЗАЦИИ ДИЗЕЛЬНОЙ ФРАКЦИИ

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Исследован процесс деароматизации прямогонной дизельной фракции с применением в качестве адсорбентов катионита КУ-2-8 и природных алюмосиликатов. Выявлено, что степень деароматизации дизельной фракции в результате использования промышленного адсорбента КУ-2-8 составляет 31%, с использованием адсорбента А4 на основе природных алюмосиликатов – 28%. При воздействии на дизельную фракцию магнитным полем силой 15 до 100 милли Тесла степень деароматизации увеличивается соответственно до 49 и 51,8%, соответственно.

Ключевые слова: *дизельное топливо, деароматизация, адсорбционная деароматизация, магнитное поле, адсорбент*