Processes of petrochemistry and oil-refining, *2014, vol. 15, №3 (59), p.228-231.*

НЕФТ ЕМАЛЫ
OIL REFINING
НЕФТЕПЕРЕРАБОТКА

UDC **665652**

ALKYLATION OF FRACTION OF TURBINE OIL BY DECENE-1 OVER ZEOLITE-CONTAINING CATALYSTS

F.I. Samedova, G.A. Guseinova, A.I. Guliev, S.Yu. Rashidova, I.A. Gadzhieva

Yu.G.Mamedaliev Institute of Petrochemical Processes of Azerbaijan National Academy of Sciences,
AZ 1025, Baku, Khojaly ave, 30
e-mail: lab.21@mail.ru.
Received:09.06.2014.

It has been shown the possibility of improvement of viscosity-temperature properties of low-index fraction of turbine oil in the process of its alkylation by decene-1 over zeolite-containing catalysts Zeocar-2 and Zeocar-600. The viscosity index increased by 8-14 p. without essential change of congelation temperature, which remained on a level minus 40÷minus 38^{o} C

Key words: *alkylation, decene-1, turbine oil, zeolite-containing catalyst, viscosity index*

Base oils from Azerbaijan oils are differed by unsatisfactory viscosity-temperature properties (low viscosity index). Therefore the waxy oils with high viscosity index from Azerbaijan oils can be obtained only by reconstruction of structure of hydrocarbons. A basic direction of improvement of quality of base oils is the use of process for their preparation changing a chemical composition aside formation of isoparaffin and naphthene hydrocaerbons.

One of the ways of action on chemical composition of oily fractions is the process of catalytic hydrocracking an application of which excludes a carrying out of the selective purification process [1]. However, this process is continued at higher pressures to 15-20MPa and order temperatures 450-480^{o}C in the presence of hydrogen. Depending on conditions of hydrocracking along with oils the gasoline, reactive and diesel fuels are prepared. An altenative for this process is the alkylation process which is carried out at lesser values of temperature and pressure.

It is known the alkylation process of low octane gasolines by the lowest α-olefins on $AlCl_3$ for improvement of their octane numbers [2]. The possibility of change of structure of hydrocarbons due to increase of isoparaffin share has been shown.

For the first time the alkylation of oily fractions by ethylene and α-olefins has been carried out on $AlCl_3$ [3]. The authors have showed that in the alkylation process it takes place a change of hydrocarbon composition of oily fraction with formation of large quantity of paraffin-naphthene hydrocarbons with naphthenes by less cyclicity and high content of isoparaffins.

The alkylation reaction is accompanied by the side reactions of cracking, oligomerization, aromatization, disproportionation, isomerization, dehydrocyclization, etc., as a result of which a formation of hydrocarbons of various structure takes place. In determined combination of hy-

drocarbons a change of properties of oils such as viscosity, viscosity index, congelation temperature takes place. There fore it is important a selection of catalyst and reaction conditions able to carry out the reaction in necessary direction with formation of hydrocarbons providing required properties of oils.

The alkylation process was carried out on zeolite-containing catalysts Zeocar-2 and Zeocar -600, differing with content of rare-earth elements, which are present in Zeocar-600 in a quantity no less 2.0 % mass [4].

For alkylation the fraction of turbine oil T-22 with initial boiling 350^{o}C was used. Alkylation was carried out by decene-1 in the following conditions: reaction temperature – 60.100,150^{o}C; volume ratio oily fraction:olefin – 1:1; reaction time – 1h; volume feeding rate of oil and olefins – 0.5 and 1.0 h^{-1}.

The alkylation reaction was carried out in a reactor by volume 250ml with stationary layer of catalyst. The preparation of the catalyst to the work was carried out in a reactor. In this case a reactor with catalysts was heated to 500-550^{o}C and maintained for 5 h, periodically blowing with nitrogen.

Feeding of oil and olefins to a reactor was carried out alternatively, firstly oil, then olefin and also in mixture – oil+olefin. In separate feeding of turbine oil and olefin it was initially loaded the oil to a reactor, heated to the necessary temperature, the heating was switched off and was began the olefin feeding with necessary volume rate. In feeding of oil mixture to a reactor it was firstly heated reactor with catalyst to test temperature, then fed the mixture with given volume rate at disconnected heating of reactor. In the first case a temperature rise by 20-25^{o}C for first 10 min occurred. In the second case for the same time interval a temperature rise was 10-15^{o}C. Based on the results of experiments one can say that in the initial period of time the various reactions depending on components feeding are prevail. At circulation of mixture in the system the temperature in a reactor decreased to necessary level, which then was maintained constant by means of regulator.

The initial boiling temperature and fractional composition of alkylates prepared at various temperatures on Zeocar-2 and Zeocar-600 during oil alkylation by decene-1 with volume rate 1.0 and 0.5h^{-1} are presented in Tables 1 and 2. The initial boiling temperature of alkylates (Table 1) prepared on Zeocar-2 and Zeocar-600 are in the close ranges and are 176-178^{o}C and 192-194^{o}C respectively at alkylation temperatures 60, 100^{o}C and 150, 100^{o}C (in joint introduction of oil and olefin). The boiling temperature of decene -1 – 170.6^{o}C, and the initial boiling temperature of initial oil – 350^{o}C. It is evident that the oil and olefin undergo certain changes and is the most noticeable at 150^{o}C and 100^{o}C in joint components feeding (Table 2).

Table 1. Initial boiling temperature of alkylates prepared at various temperature

Initial boiling temperature of alkylates,^{o}C				
60°C	100°C	100°C (oil+olefin)		150°C
Zeocar-2				
178	178	192[x)]	194	192
Zeocar-600				
178	176	192[x)]	194	194

Table 2. Fractional composition of alkylates prepared at various temperature on Zeocar-2 and Zeocar-600

Boiling ranges, °C	Yield of fractions, % mass.				
	60°C	100°C	100°C (oil+olefin)		150°C
Zeocar-2					
N.a..-200	21.30	34.76	6.38[x)]	7.34	8.02
200-350	2.26	2.22	55.97[x)]	44.28	37.24
>350	76.44	63.02	37.65[x)]	48.38	54.74
Zeocar-600					
N.a..-200	8.24	13.66	14.17[x)]	13.46	15.44
200-350	7.53	9.15	19.64[x)]	13.20	20.99
>350	84.23	77.19	66.19[x)]	73.34	65.57

x) – alkylation has been carried out at volume feeding rate of mixture 0.5 h^{-1}

A fractional composition of alkylates prepared at 100°C with volume feeding rate of mixture of oil and olefin 0.5h^{-1} in alkylation is changed in a larger extent. A yield of oily fraction in this case is less on Zeocar-2. In this case the alkylation reactions by decene-1 of low molecular paraffinic hydrocarbons of oily fraction are prevail. Therefore it is observed a high yield of fraction boiling in the ranges of 200-350°C, and lesser yield of fraction higher 350°C. But on Zeocar-600 an alkylation of more high-molecular hydrocarbons of oily fraction takes place. In this case a yield of fraction higher 350°C is increased. It has been determined that at temperature rise of alkylation from 60 to 150°C a yield of fraction boiling higher 350°C, on both catalysts is decreased, and in a large extent on Zeocar-2. A feeding of components to a reactor shows an essential influence on fractional composition. At simultaneous feeding of oil and olefin with volume rate 1 h^{-1} in comparison with separate and carrying out of alkylation on Zeocar-2 at 100°C a yield of fraction of n.a.-200°C is decreased from 34.76 to 7.34%, and a yield of fraction 200-350°C on the contrary is increased from 2.22 to 44.28%. At volume feeding rate of mixture 0.5 h^{-1} a yield of this fraction is 55.97%. On Zeocar-600 it is observed other picture, approximately the same content of fractions of n.a.-200°C in alkylates prepared at temperatures 100 and 150°C. In this case a yield of oily fraction higher 350°C is considerably greater in alkylates prepared on Zeocar-600 at all temperatures.

Basic properties of fractions of turbine oil and alkylates boiling higher 350°C, prepared at various temperatures of alkylation on Zeocar-2 and Zeocar-600 are presented in Table 3.

Table 3. Basic physical-chemical properties of fractions of turbine oil and alkylates boiling higher 350°C, prepared at various temperature on the catalysts Zeocar-2 and Zeocar-600

Indices	Fractions of turbine oil T-22	Fractions of alkylates boiling higher 350°C							
		Zeocar-2				Zeocar-600			
		60°C	100 °C	100 °C olefin+oil	150 °C	60 °C	100 °C	100 °C olefin+oil	150 °C
Kinematic viscosity, mm^2/s, at 40°C	27.82	30.69	31.92	31.33	29.30	30.28	31.32	30.59	29.90
50 °C	4.38	4.61	4.67	4.72	4.56	4.60	4.72	4.65	4.58
Viscosity index	31	34	34	40	38	37	40	45	41
Congelation temperature, °C	-40	-40	-40	-40	-40	-40	-40	-38	-40
Flash temperature in open crucible, °C	185	>180	>180	>180	>180	>180	>180	>180	>180

As is seen from prepared results the highest growth of viscosity index is observed in oily fraction isolated from alkylate differing with feeding of components during its preparation, viz. in joint feeding of oil and decene -1. In this case a viscosity index increased by 14p. It is also necessary to note that the oily fractions isolated from all alkylates are differed with more level of viscosity in comparison with initial oil.

Thus, the carried out alkylation of turbine oil by decene-1 on the zeolite-containing catalysts Zeocar-2 and Zeocar-600 showed the possibility of improvement of its viscosity-temperature properties without essential influence on congelation temperature.

REFERENCES

1. *Tsvetkov O.N.* Perspectives of Russian oil production. //World of oil products, 2011, №4, p. 3-8
2. *Samedova F.I.* Development of investigations of academician Yu.G.Mamedaliev in the field of alkylation. /Lectures of Azerbaijan National Academy of Sciences, 2009, vol. LXV CILD, №4, p. 109-118
3. *Samedova F.I., Gasanova R.Z.* Non-traditional methods of preparation of petroleum oils. Baku: Elm, 1999, 100 p.
4. *Samedova F.I., Guseinova G.A., Kuliev A.I., Rashidova S.Yu.* Alkylation of petroleum oil fractions by olefins over zeolite-containing catalysts. /Материали за X Международна научна практична конференция, «Бъдещите изследвания», 17-25 февруари, 2014, vol. 42, Sophia, «БялГРАД-БГ» ООД, p.56-58