

# Process of Alkylating of Oily Fractions with Catalytic Cracking Gases

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## Mini Review

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## Abstract

Possibility of improvement of viscosity-temperature properties of distillate fractions of oils of two levels of viscosity is shown in the process of alkylating with catalytic cracking gases on Zeokar-600 and Omnikat-210 P zeolite catalysts. The viscosity index at alkylating of the oil fraction increases from 79 to 146 and 104 and from 32 to 75 and 53 accordingly on the Zeokar-600 and Omnikat-210P catalysts.

**Keywords:** Oil distillate fractions; Alkylation; Catalytic cracking gases; Zeokar-600; Omnikat-210 P; Viscosity index

## Introduction

The process of alkylating is used mainly for the receipt of high-antiknock components of petrol's. As an alkylating agent use ethylene, propylene, butene. From individual aromatic hydrocarbons alkylating benzene, toluene, p-xylene, pseudocumene, expose to, and also mixtures of hydrocarbons are products of the oil processing, as for example, low-octane petrol's of the catalytic cracking. From paraffin hydrocarbons most attention is spared to alkylating of i-butane. Application of zeolite catalysts instead of liquid acid in the processes of alkylating in traditional and supercritical terms allows to increase quality of the got alkylates and their selectivity [1-4].

The process of alkylating is also used for the improvement of viscosity-temperature and other properties of mineral oils. Base oils from Azerbaijani oils differ in unsatisfactory viscosity-temperature properties (by the subzero viscosity index). Oils with the high viscosity index from oils of Azerbaijan it may be to get only by means of alteration of structure of hydrocarbons. Basic direction of improvement of these

properties is the use for their receipt of processes changing chemical composition toward formation of hydrocarbons with the higher viscosity index. The saturation of oily fractions isoparaffin hydrocarbons allows to improve their rheological properties, decrease evaporation, increase thermal oxidative stability, and also row of operating indexes. Therefore alkylating is one of methods of increase of isoparaffin hydrocarbons due to converting of paraffins of normal structure into isoparaffin. For the improvement of viscosity-temperature properties of distillate oily fractions the process of alkylating is investigational the condensed gases of the catalytic cracking. Last year's gases of the catalytic cracking find all greater application in the processes of oligomerization and alkylating for the receipt of components of fuels and oils.

In our researches gases of catalytic cracking were used as an alkylating agent at alkylating of the distillate oily fractions conducted with the purpose of improvement of their viscosity-temperature properties (viscosity index). Depending on the processed raw material on the options of the catalytic cracking quantitative composition of going

out hydrocarbon gases is different. From composition of gases, and also the indexes viscosity and viscosity index change from the terms of alkylating of oily fractions and applied catalyst. The reaction of alkylating is accompanied by the by-reactions of cracking, oligomerization, aromatization, disproportionation, isomerization, as a result of that there is formation of hydrocarbons of different structure.

## Experimental

Alkylating was conducted on setting of batch-type with a reactor by volume of 250 mL [5]. The serve of

gases was carried out by means of piston liquid pump allowing to regulate the expense of gases depending on their correlation with oily fraction. Alkylating was conducted in the interval of temperatures from 50 to 150°C, pressure in a reactor 0.4-0.7 MPa, pressure of serve of gas 0.25-0.70 MPa, by volume correlation oily fraction: gases 1: 1, 1: 2 and 1: 3. Time of reaction 1-2 hours. Catalysts - Zeokar-600 and Omnikat-210 P.

Alkylating distillate oily fractions exposed to with the viscosity index 79 and 32. Basic physical and chemical properties are driven to the Table 1.

Properties	Distillate Oils	
	Standard 1	Standard 2
Kinematic viscosity (mm <sup>2</sup> /s) at: 40°C	9.85	27.82
100°C	2.54	4.38
Viscosity index	79	32
Temperature of flash, °C	152	194
Density at 20°C, kg/m <sup>3</sup>	871.2	898.4

**Table 1:** Basic physical and chemical properties of standards of distillate oils.

The values of kinematic viscosity were determined according to GOST 33-2000. The calculation of the viscosity index by kinematic viscosity was carried out in accordance with GOST 25371-97. At alkylating of oily fractions on the catalysts of Zeokar 600 and Omnikat 210 P used gases with different maintenance of olefins. For alkylating of Standard 1 with kinematics viscosity of 9.85 mm<sup>2</sup>/s with at 40°C and by the viscosity index 79 on the catalysts of Zeokar 600 and Omnikat 210 P used gases with total maintenance of olefins (vol %) 47.3 and 51.4 accordingly. Alkylating of Standard 2 with kinematic viscosity of 27.8 mm<sup>2</sup>/s with and by the viscosity index 32 on Zeokar 600 conducted gases of the catalytic cracking with total maintenance of olefins (vol %) 57.28, and on

Omnikat 210 P - 47.4 [5,6]. The viscosity-temperature properties and density of alkylates obtained on Zeokar 600 and Omnikat 210 P catalysts under optimal conditions are presented in Table 2.

Those at that there was a most increase of viscosity index at alkylating are certain optimal terms [5-7]. For Standard 1 on the catalysts of Zeokar 600 is a temperature of 100°C and Omnikat 210 P is a temperature of 50°C, correlation of oily fraction: gases 1: 2. For Standard 2 on the catalysts of Zeokar 600 is a temperature of 50°C, correlation of oily fraction: gases 1: 1 and 1: 2 and Omnikat 210 P - temperature of 100°C, correlation of oily fraction: gases 1: 1.

Properties	Alkylates			
	Standard 1		Standard 2	
	Zeokar-600	Omnikat-210 P	Zeokar-600	Omnikat-210 P
Kinematic viscosity (mm <sup>2</sup> /s) at: 40°C	9.24	10.13	30.9	35.7
100°C	2.75	2.71	4.95	5.13
Viscosity index	146	104	75	53
Density at 20°C, kg/m <sup>3</sup>	864.7	871.4	899.7	902

**Table 2:** Basic physical and chemical properties of alkylates.

## Results and Discussion

As be obvious from a table 2 not only of viscosity index but also kinematics viscosities and densities of alkylates

changed. Thus toward the increase of all indexes, except viscosity at 40°C and closeness at the first standard got on the catalyst of Seokar 600. Presumably on the catalyst of Seokar 600 at the temperature of 100°C little viscid oil

had not only tacking of propylene and butane links to aromatic and naphthenes hydrocarbons but also lengthening of chain let of paraffin hydrocarbons or formation of new hydrocarbons in the process of oligomerization. Therefore there was reduction of viscosity at 40°C. The in this case predominating reaction of process was an oligomerization.

Alkylating of more viscous distillate fraction passed in other direction. As spectral researches showed IR, NMR and UV-methods the structure of molecules, touching a structure and number of lateral chains, and also amount of aromatic hydrocarbons with benzene, naphthalene and by phenanthrene structures, changes in aromatic and naphthenes hydrocarbons of this fraction [6].

Chromatographic determination of gas composition before and after alkylating of oil (Standard 2) showed reduction of concentration of propylene and all olefins with conversion of 95-97 and 78-85% accordingly [8]. Maximal conversion of olefins hydrocarbons made 85.2 and 81.2% at alkylating of this oil on the catalyst of Seokar 600 under constraint 0.6 MPa, to the temperature of 50°C and correlation oil : gases 1: 2 and 1: 1 accordingly. Thus pressure there was maximal conversion of propylene. At alkylating of the same oil on the catalyst of Omnikat 210 P maximal conversion of olefin hydrocarbons made 72-75 vol %. The viscosity indexes of the alkylates got on these catalysts and corresponding compositions of gases increased as compared to an initial distillate on 38 and 21 point.

Maximal conversion of propylene and olefin hydrocarbons at alkylating of more easy fraction of oil with the higher index of viscosity on the catalyst of Zeokar-600 was 90.0 and 75 .0 (vol %) accordingly. On the catalyst of Omnikat 210 P these indexes considerably below.

As researches showed, to most transformations in the process of alkylating of oils propylene undergoes with different viscosity and viscosity index, in less degree butane 1, trans- and cis-butene-2. In off-gas after alkylating there was a number of again well-educated components of both paraffin and olefin structure in different concentrations. The viscosity index increased in a greater degree just in case of maximal conversion of olefin hydrocarbons entering in the complement of gases of the catalytic cracking. It is necessary also to mark that in investigational terms on the catalyst of Zeokar-600

alkylating does not take place iso-butane butenes entering in the complement of gases of the catalytic cracking. Iso-butane is concentrated in off-gas, that can be used in the process of alkylating by his butenes for the receipt of components of high-antiknock petrols.

## Conclusions

Researches of process of alkylating of oily fractions on zeolite catalysts showed, that the increase of viscosity index in a greater degree took place in case of maximal conversion of olefin hydrocarbons entering in the complement of gases of the catalytic cracking and at their maximal maintenance. A catalyst here plays a substantial role also. In this case there is formation of more deputized alkyl naphthenes and alkyl aromatic hydrocarbons with more long alkyl chain, having a higher index of viscosity.

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