HYDROCATALYTIC PROCESSING OF MEDIUM DISTILATED FRACTIONS FROM MIXTURE OILS OF KAZAKHSTAN

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ABSTRACT

This article presents the results of the study physico-chemical properties of the initial vacuum distillate Karashyganak, Tengiz, Kalamkask and Karazhanbas oil and the obtained hydrogenated feed is separated in the process hydrogenated cleaning of vacuum gas oil at industrial alumino-nickel-molybdansilicate catalyst. The influence of the parameters of the main technological factors temperature, pressure and volumetric feed rate on the yield and quality of the target product-hydrogenate. Hydrocatalytic refining of vacuum gas oil under hydrogen pressure allows removing undesirable impurities from distillate fractions, to reduce their tendency to the formation of deposits and precipitation, as well as to reduce corrosion aggressiveness. The resulting hydrotreated vacuum gas oil will be used as a valuable raw material for the catalytic cracking process. Significantly increases the lifetime of the catalysts, to improve the quality and increase the yield of target products-liquefied gas, butane butylenes fraction, and high-octane component of automobile gas.Hydrotreated vacuum gas oil will be used as a valuable raw material for the catalytic cracking process at existing refineries of the Republic of Kazakhstan.

Key words: kerosene-gas oil fraction, vacuum distillate, hydrogenate, hydrotreating, catalyst, technological factors, temperature, pressure, feed rate.

INTRODUCTION

The development of rational options for processing various fractions of oil and gas condensates of new promising fields of our country can effectively solve the problem of meeting the needs of the country in high-quality motor and boiler fuels, lubricating oils, petroleum coke and raw materials for petrochemical synthesis.

One of the most important directions in the development of the oil refining industry of the Republic of Kazakhstan is the production of high-quality environmentally friendly motor fuels and lubricating oils by hydrocatalytic processing of residual, high-boiling fractions of oil. The shortage of crude oil leads to its more qualified processing through catalytic processes and careful preparation of feedstock catalytic cracking, by Hydrotreating of sulfur compounds. It is known that the hydrotreatment of raw materials significantly contributes to the improvement of quality and increase the yield of target products [1-3].

Physical and chemical characteristics of the initial vacuum distillates obtained from the oil fields of Western Kazakhstan Karashyganak, Tengiz, Kalamkas, Karazhanbas are given in table 1. Physical and chemical characteristics of the hydrotreated vacuum distillate obtained from the oil fields of Western Kazakhstan Karashyganak, Tengiz, Kalamkas, Karazhanbas are shown in table 1.

Table 1. Physical and chemical characteristics of the initial vacuum distillates.

Indicator	*Initial characteristics of vacuum distillates of oil fields of Western Kazakhstan*				*Characteristics of vacuum distillates from oil mixture*
	Karashyganak	Tengiz	Kalamkas	Karazhanbas	
Density at 20 ^{O}C, кg/m^3	879.0	887.0	890.1	917.8	892.3
Sulfur content, % wt.	1.16	1.10	1.98	1.65	1.45
Pour point, ^{O}C	30	28	-4	-17	-1
coking ability, % wt.	0.37	0.10	0.39	0.30	0.33
Ash content, % wt	0.02	0.015	0.045	0.052	0.031

Lowest density has vacuum distillate Karachaganak oil. The highest density has a vacuum distillate oil field Karazhambas. Vacuum distillates are characterized by a significant content of sulfur compounds (1.1-2.0% by weight.) and high pour point. From the experimental data obtained, it is observed that the vacuum distillates of the studied oils differ markedly in quality.

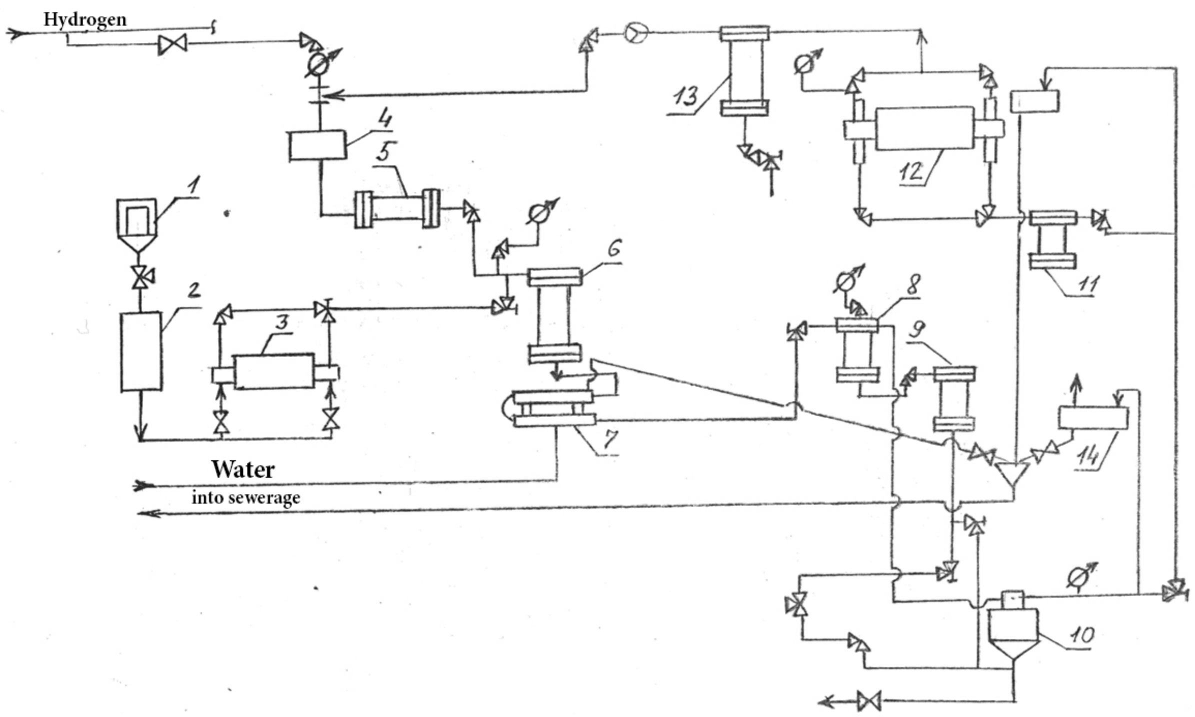
MATERIAL AND METHODS

The efficiency of the process of hydrotreatment of distillate fractions of crude oil largely depends on the activity and selectivity of the catalyst used and the conditions of the technological process, i.e. on the choice of the optimal parameters of the main influencing factors.

Catalytic refining of vacuum gas oil under hydrogen pressure allows to remove undesirable impurities from distillate fractions fully, to reduce their tendency to the formation of deposits and precipitation, as well as to reduce corrosion aggressiveness.

It is known that preliminary Hydrotreating of raw materials of the catalytic cracking process significantly improves the service life of catalysts, improves the quality and increase the yield of target products - gas and gasoline. [2]

The study of the process of Hydrotreating vacuum distillates was carried out on a dense installation under hydrogen pressure (Fig.1) in the presence of industrial aluminonikelmolibdensilicate (ANMS) catalyst at temperatures: 360, 380, 400, 420^{0}C, pressures: 3, 4, 5, 6 MPa and volumetric feed rates: 0,7; 1,0; 1,25; 1,5; 2,0 b-1. Schematic flow diagram of a dense Hydrotreating unit sees Fig. 1. The unit consists of the following units: raw pump, reactor with electric heating, gas separation system equipment.



1-meter; 2-raw pump; 3-raw material heater; 4-filter; 5-gas heater; 6-reactor; 7-refrigerator; 8-high-pressure separator; 9-low-pressure separator;10-kapleotboynik; 11-receiver; 12-circulation gas pump; 13-oil separator

Fig. 1. Schematic flow diagram of a dense Hydrotreating unit.

The reactor (6) is a cylindrical thick-walled vessel with an internal diameter of 51 mm, a catalyst capacity of 500 cm^3 and is provided with electric heating. The lid is screwed in a nipple for the gas feed, hydrogen and air pressure gauges. Through the pipe in the bottom cover products are discharged into the refrigerator coil type with water cooling. High (8) and low (9) pressure separators are used to separate gas from liquid products. Temperature control is automatic and recorded on the potentiometer. The reactor (6) was loaded with a certain amount of catalyst - 100 cm^3, which corresponds to the ratio of the layer height to its diameter. To ensure uniform distribution of raw materials, the upper part of the free space above the catalyst was filled with crushed porcelain particles.

The feedstock was loaded into a measuring cylinder. Feed of raw materials to the reactor (6) was carried out by pump (2) through the heater of raw materials (3). There, hydrogen is also supplied from the buffer tanks. The volume of feedstock was counted to reduce the level of liquid in the measuring cylinder. The pressure in the reactor (6) was determined by the pressure gauge. Raw materials, passing through the catalyst bed, in the form of a steam mixture enter the refrigerator (6) and are cooled. From the refrigerator, a mixture of catalysate and hydrogen-containing gas enters the high-pressure gas separator (8), where liquid and gaseous products are separated. The liquid product enters the low-pressure separator (9) through the valve, and then merges into the receiver. The gaseous reaction products from the high-pressure gas separator are fed into the droplet tank (10), where an additional capture of the droplet liquid entrained by the gases occurs. In the low-pressure separator, liquid droplets suspended in the gaseous part of the catalyst are released.

RESULT OF DISCUSSION

For the determination of optimal parameters of conducting the process of Hydrotreating of vacuum distillates for the industrial alumonickelsilicate catalyst conducted a series of experiments to study the kinetic regularities of the process. The study of the effect of temperature on the process of Hydrotreating vacuum distillates was carried out at a pressure of 4.0 MPa and a volumetric feed rate of 1 h^{-1}. The results of the study show that as the temperature of the process increases, the degree of hydro-desulfurization of the initial vacuum distillates increases.

Table 2. Physico-chemical characterization hydrotreated vacuum distillate from Netesov fields in Western Kazakhstan.

Process conditions			ρ_4^{20}, кg/m^3	ν_{20}, mm^2/s	Sulfur content, % wt.	Fractional composition, ^{0}C					pour point, ^{0}C
Temperature,^{0}C	Pressure, MPa	Feed rate, h^{-1}				п.к.	10%	50%	90%	k.k.	
360	4	1	879.8	15.9	0.187	358	383	418	461	495	27
380	3	1	877.8	15.7	0.112	356	382	418	462	493	26
380	4	0.7	879.4	13.6	0.087	357	379	416	460	492	26
380	4	1	880.5	13.8	0.092	352	382	418	458	472	27
1	2	3	4	5	6	7	8	9	10	11	12
380	4	1.25	878.0	14.3	0.096	350	380	419	459	496	27
380	4	1.5	876.7	14.4	0.114	358	389	419	458	496	28
380	4	2	877.1	14.6	0.168	361	392	426	472	497	29
380	5	0.7	880.6	13.5	0.082	353	380	416	462	491	26
380	5	1	879.9	13.2	0.085	353	382	417	458	492	25
380	5	1.25	880.3	13.3	0.093	350	387	416	462	494	26
380	5	1.5	878.3	13.6	0.098	350	388	419	468	496	26
380	6	0.7	879.4	11.8	0.081	358	388	419	469	495	23
380	6	1	877.8	12.5	0.084	362	390	422	473	489	23
380	6	1.25	876.8	12.6	0.087	363	394	429	471	489	24
380	6	1.5	876.7	13.8	0.095	363	396	421	472	496	27
400	4	1	879.5	13.3	0.080	349	379	413	464	488	23
420	4	1	875.1	11.5	0.073	347	376	409	465	484	21

At a temperature of 420^{0}C, the speed of the process of Hydrotreating vacuum distillates reaches the maximum value, i.e., with increasing temperature, the speed of the process increases, however, it should be noted that this increases the side reactions of cracking, as evidenced by a decrease in density, a decrease in the boiling point of the samples, hydrotreated at a more rigid regime. The temperature increase from 360 to 420^{0}C significantly affects the vacuum distillate of the West Kazakhstan oil mixture - the desulfurization depth of this distillate increases by 16%. Under the same conditions, other qualitative characteristics (pour point, viscosity and fractional composition) improve with increasing depth of vacuum distillate desulfurization. The influence of pressure on the process of vacuum distillates Hydrotreating was investigated at a temperature of 380^0C, the volume feed rate of 1.0 h-1.From the data obtained, it follows that for hydrogenates the pressure effect is significant in the pressure range of 3-5 MPa, a further increase in pressure does not significantly affect the depth of hydrodesulphurization, so it is advisable to carry out the process at a pressure of 3-5 MPa.

Study of the effect of the volumetric feed rate of raw materials to a depth of Hydrotreating of vacuum gas oils is carried out at a temperature of 380^0C and a pressure of 4 MPa. With a decrease in the volume feed rate from 2.0 h-1 to 0.7 h-1, the depth of water desulfurization of vacuum distillates from a mixture of Karashyganak, Tengiz and Karazhambas oils increases from 79-81% to 89-91%. The reduction in volumetric feed rate of raw materials for deep hydrodesulphurization of vacuum distillate calamosche oil affects slightly. Since the bulk feed rate is directly related to the performance of the Hydrotreating unit, it is advisable to maintain the volumetric speed of 1.0 h-1, taking into account the fact that in this case a sufficient degree of Hydrotreating is achieved - 87-93%. Analysis of the hydrogenated feed is separated shows that the viscosity of the products of hydrotreatment decreases with increased volumetric feed rate of raw materials, changes in temperature and pressure does not affect on the data quality indicators.

CONCLUSION

Thus, in the process of hydrocatalytic refining of the vacuum distillate, physical and chemical parameters are significantly improved, sulfur, nitrogen and oxygen compounds are reduced in the composition of the vacuum gas oil. The resulting hydrogenate from a mixture of West Kazakhstan oils can serve as the highest quality raw material for the catalytic cracking process at existing refineries of the Republic of Kazakhstan.

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