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HYDROGENATION PROCESSES IN THE PROCESSING OF OIL AND OIL PRODUCTS IN INDUSTRY

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Annotatsiya

Ushbu maqolada neft va gazning fraksion tarkibi, ularni qayta ishlashga tayyorlash texnologiyasi, katalitik, termik, gidrogenizatsiya jarayonlari, yuqori oktanli benzin fraksiyalarini ishlab chiqarish, uglerodli gazlarni qayta ishlash, gazlarni fraksiyalarga ajratish texnologiyalari va qurilmalari, vodorod ishlab chiqarish texnologiyasi, aromatik uglevodorodlarni va neftli bitumlarni ishlab chiqarishning texnologik jarayonlari keltirib o'tilgan.

Annotation

In this article, the fractional composition of oil and gas, technology of preparing them for processing, catalytic, thermal, hydrogenation processes, production of high-octane gasoline fractions, processing of carbon gases, technologies and devices for separating gases into fractions, hydrogen production technology, aromatic hydrocarbons and oil bitumen technological processes of production are mentioned.

Абстрактный

В данной статье рассмотрен фракционный состав нефти и газа, технология подготовки их к переработке, каталитические, термические, процессы гидрирования, производство высокооктановых бензиновых фракций, переработка углекислых газов, технологии и устройства разделения газов на фракции, получение водорода. технология, технологические процессы производства ароматических углеводородов и нефтяных битумов.

Kalit So'Zlar

Katalizator, gidrotozalash, gidrokreking, gidrodealkillash, gidrogenlash, gidroizomerlash, termogidrokatalitik, riforming, izomerlanish.

Key Words

Catalyst, hydrorefining, hydrocracking, hydrodealkylation, hydrogenation, hydroisomerization, thermohydrocatalytic, reforming, isomerization.

Ключевые Слова

Катализатор, гидроочистка, гидрокрекинг, гидродеалкилирование, гидрирование, гидроизомеризация, термогидрокаталитический, риформинг, изомеризация.

INTRODUCTION: Production of high-quality products in modern oil refining technology is a multi-stage technology. In most cases, preparation and finishing works are carried out along with the main processes. Preparation of technological processes includes the following: desalination of oil before refining, separation of short- boiling fractions from distillates of wide fractional composition according to the limit, hydro-treatment of gasoline fractions before catalytic reforming, hydro-desulfurization of gasoil raw materials for catalytic cracking, before absorption separation kerosene distillate hydrotreating etc.[1]

Processing processes of crude oil, which take place at high temperature and pressure in the presence of a catalyst and in a hydrogen environment, are called hydrogenization or thermohydrocatalytic processes.

The role of hydrogen in hydrogenation processes is an important distinguishing feature of these processes compared to gasoline reforming and isomerization of light hydrocarbons. If the role of hydrogen in reforming and isomerization is to reduce the formation of coke in the catalyst, then in hydrogenation processes, hydrogen participates in the main hydrogenation reactions of unsaturated, naphthenic, aromatic and heteroatomic compounds.

In the technical literature, the term " *hydrogenation*" is used in various processes. *These are hydrotreating, hydroenrichment, hydrodesulfurization, hydrodeparaffinization, hydroisomerization, hydrodearomatization, hydrogenation, hydrocracking, hydroconversion, hydrodemetallation, etc.,* as shown in Figure 1 . In fact, all these processes can be divided into two groups: *hydrotreating and hydrocracking* . Everything is clear: hydrotreating is a hydrogenation process that helps to clean oil fractions or residues from harmful additives such as sulfur, nitrogen, oxygen, unsaturated and polycyclic aromatic hydrocarbons, heavy metals, and hydrocracking is not only hydrogenation is a process that helps to clean oil fractions from harmful additives, as well as to break down and destroy hydrocarbons. But in hydrotreating, the destruction of hydrocarbons also occurs, but in a smaller amount. Therefore, if the destruction (conversion) of the initial raw material is less than 10% (mas), such a hydrogenation process is called hydrotreating. If the conversion is 10-50% (mas), then such a process is called light hydrocracking, if it is more than 50% (mas) - deep hydrocracking (see the scheme below).

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Hydrotreating processes, in turn, are divided into hydrotreating of distillates, oil residues, and hydrogenation of distillates of secondary origin.

Hydrorefining of oil residues differs from hydrorefining of distillates in that, along with hydrorefining of sulfur, nitrogen, oxygen, the process of demetallation of raw materials takes place, that is, cleaning of raw materials from nickel, vanadium and other similar heavy metals [2].]

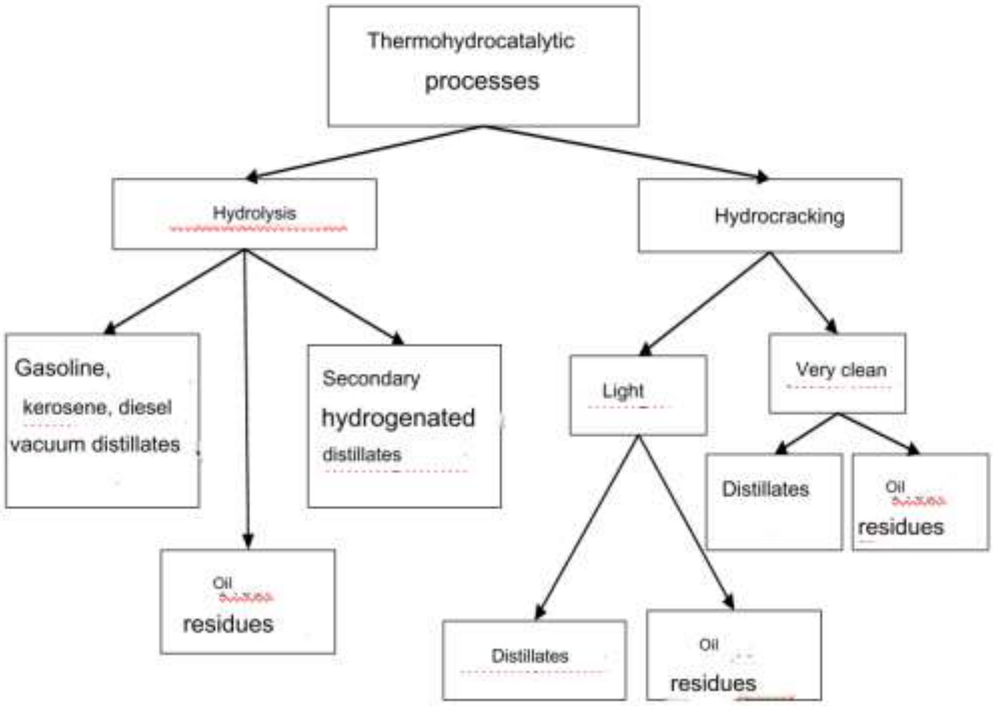

Figure 1. Conducting a thermodynamic process .

Distillates of secondary origin include gasoline, kerosene, diesel and vacuum fractions of thermal cracking, visbreaking, coking, pyrolysis, catalytic cracking processes under pressure, that is, also in processes that receive a large amount of unsaturated and aromatic hydrocarbons. The hydrogenation of secondary distillates differs from the hydrotreating of distilled distillates in that the heat effect of the reaction in the hydrogenation of secondary products containing a large amount of unsaturated hydrocarbons (the reaction of unsaturated hydrocarbons is considered exothermic) and in the catalyst layer sudden changes in temperature increase. Distillates and petroleum residues can be supported as light hydrocracking. Light hydrocracking can include hydrodeparaffinization of diesel and vacuum distillates, as well as hydroisomerization of high-paraffin raw materials.[2]

Deep hydrocracking can be carried out on distillate feedstock or oil residues. Depending on the location of the catalyst in the reactor, deep hydrocracking is divided into hydrocracking in the fixed bed of the catalyst, in the suspended bed of the catalyst, and in the catalyst moving along with the feedstock.[1]

hydrotreating, hydrocracking, hydrodealkylation, hydrogenation and hydroisomerization methods of hydrogenation processes are widely used in the oil refining industry . By applying these processes, it is possible to increase the quality and production volume of oil products. Hydrogenation processes became widely used in the oil refining industry after World War II. Initially, hydrotreating of gasoline and diesel fuel from catalytic reforming was developed, and later, hydrocracking of oil distillates began to be carried out.

In recent years, the use of hydroisomerization processes, which allows obtaining special fuel and oil components, has gained an important place. Alkylation processes are also widely used in obtaining raw materials for petroleum products.

Gasoline fractions are subjected to hydrotreating and hydrodesulfurization as raw materials for catalytic reforming devices. In this case, pretreatment improves the main parameters of the reforming process, mainly the level of aromaticity of the raw materials, the octane number of the obtained gasoline, and the service life of the catalyst.

The goal of hydrotreating kerosene and diesel fractions is to obtain ready-made distillates with sulfur content up to the required standard norms and thermally stable, improved combustion properties. At the same time, the corrosion activity of the fuel is reduced and the formation of various deposits during its storage is reduced.

The main product in the hydrotreating of gasoline fractions is stable hydrogenizate, the yield of which is 90-99% (mass). The amount of sulfur in hydrogenizate does not exceed 0.002% (mass).

In the hydrorefining of kerosene distillates, the 130-240 and 140-230 ^{0} C fractions obtained from the correct extraction of oil are considered as raw materials. The hydrotized paraffin fraction is the main product of the process, and its yield can reach 96-97% (wt.). In addition, small amounts of low-octane gasoline fraction, hydrocarbon gases and hydrogen sulfide are also obtained.

Chemical reactions in the hydrotreating of gasoline, kerosene and gasoil fractions.

Hydrotreating processes of oil fractions in industry usually use aluminum cobalt molybdenum, aluminum molybdenum and other catalysts 350-400 It is carried out at a temperature of ^{0} C, a pressure of 30-50 atm and a molar ratio of hydrogen from 5 to 10 1 depending on the raw material.

Sulfur is stored in oil and oil refining products in the form of elemental sulfur, hydrogen sulfide, mercaptans, aliphatic and aromatic sulfides, cyclic sulfides, and thiophenes. Disulfides are usually formed by the oxidation of mercaptans. Elemental sulfur is also mainly a product of hydrogen sulfide oxidation. Hydrogenolysis reactions of sulfur compounds that occur in catalytic hydrotreating processes are listed below.

Mercaptans: $R - SH + H_2 \rightarrow RH + H_2S$

Disulfides: $R - S - S - R + 3H_2 \rightarrow 2RH + 2H_2S$

Sulfides: $R - S - R + 2H_2 \rightarrow RH - RH + H_2S$

Thiophenes:

Thiophanes:

Hydrogenolysis reactions of sulfur compounds are characterized by the breaking of the carbon-sulfur bond and saturation with free valent hydrogen.

In addition to hydrotreating of sulfur compounds, a certain amount of olefinic - hydrocarbons, hydrogen saturation of nitrogenous and oxygen-retaining compounds, as well as the formation of organometallic compound compounds takes place.

Our research on catalytic hydrogenation of sulfur compounds under hydrogen pressure showed that the degree of transformation of mercaptans of different structures during hydrogenation in the presence of a catalyst (molybdenum with sulfur) at a temperature of 230 ^{0}C and a pressure of 30 atm is not the same. Sulfide bonds are more difficult to break than mercaptans. The strength of sulfur compounds is carried out in the following order: mercaptan < disulfide < sulfide < thiophene. It was found that the rate of desulfurization hydrogenolysis decreases with the increase in the molecular weight of sulfur compounds. Accordingly, it was found in the experiments that hydrogenation in the desulfurization of lignin distillates is carried out in a slightly milder mode than in the purification of heavy distillates. [3,4]

RESULT: Along with the hydrogenation of sulfur compounds, the process of isomerization of paraffin and naphthenic hydrocarbons under the conditions of hydrogenolysis of desulfurization was also determined. It was proved that this reaction depends on the nature of the catalyst. During the hydrotreating process, a certain amount of cleavage of metal organic compounds occurs, and the metals are deposited on the catalyst in the process. Therefore, after a certain time, the activity of the catalyst decreases, as shown in Table 1.

The hydrotreating process is carried out in aluminum-cobalt-molybdenum (Al - Co -Mo) or aluminum-nickel-molybdenum (Al - Ni - Mo) catalysts under

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different conditions. The conditions for conducting the procedure are listed in the table below:

Table 1

No	Indicators	Gasoline fraction	Kerosene ...on	Distillates of diesel
1 .	Catalysts	Al – Co – Mo Al – Ni –	Al – Co – Mo ...i – Mo	Al – Co – Mo Al – Ni
2 2 .	Temperature, ^{0}C	380-420	350-360	350-440
3 3 .	Pressure, MPa	2.5 – 5.0	7.0	3.0 – 4.0
44 .	Volumetric rate of transfer ...y materials, hour-1	1-5	5-10	4-6
55 .	Circulation rate of ...gen storage gas, m ^{3} /m ^{3} ...aterial	100 - 600	300-400	300-400

Production of low-sulfur diesel fuel from high-sulfur petroleum distillates is one of the main steps in the scope of hydrotreating processes. Kerosene-gasoil fractions with boiling temperatures of 180-330, 180-360 and 240-360 ^{0} C were used as starting raw materials . The yield of stabilized diesel fuel was 97% (wt.) and the sulfur content was 0.2% (wt.). Low-octane gasoline (octane), hydrocarbon gases, hydrogen sulfide, and hydrogen storage gas are byproducts of the process.

Distillates from secondary processing (gasoils obtained by coking and visbreaking) were rarely included in hydrotreating. The hydrogen storage gas used in the process was obtained from a special laboratory device, and it was determined that the hydrogen content in it is 60-95% (by volume).

CONCLUSION: In conclusion, we can say that the following catalysts were selected for the process of isomerization of paraffin and naphthenic hydrocarbons under the conditions of hydrogenolysis of sulfur compounds simultaneously with hydrogenation of sulfur compounds : aluminum-cobalt-molybdenum (Al - Co - Mo) , aluminum-nickel-molybdenum (Al – Ni –Mo) catalysts ' catalytic activity and operating conditions were studied.

LIST OF USED LITERATURE

1.Ахметов С А. Технология глубокой переработки нефти и газа: Учебное пособие для вузов. — Уфа: Гилем, 2002. — 672 С

2.Баннов П. Г. Процессы переработки нефти: В 3 т. — М.: Изд-во ЦИНТИХимнефтьемаш, 2000—2003. — Ч. I, 2000. — 224 С; Ч. II, 2002. — 551 С;

Ч. III, 2003. — 504 С

3.Бекиров Т. М. Первичная переработка природных газов.— М.: Химия, 1987.— 256 С

4.Богданов Н.Д., Переверзев А.Н. Депарафинизация нефтьяных продуктов. М: Химия, 1978, 248 С

5. Бардик, Д. Л. Нефтьехимия [Текст] / Д. Л. Бардик, У. Л. Леффлер; пер. с англ. – М.: Олимп-Бизнес, 2003. – 416 С: ил.

6. Дусткобилов, Э. Н., Каршиев, М. Т., Неъматов, Х. И., & Бойтемиров, О. Э. (2019). СЕРОВОДОРОДНЫЕ ЗАГРЯЗНЕНИЯ ОКРУЖАЮЩЕЙ СРЕДЫ И СПОСОБЫ ИХ УТИЛИЗАЦИИ. *Международный академический вестник*, (5), 67-69.

7. Каршиев, М. Т., Дусткобилов, Э. Н., Неъматов, Х. И., & Бойтемиров, О. Э. (2019). Селективное окисление сероводорода кислородом воздуха. *Международный академический вестник*, (5), 70-73.

8. Каршиев, М. Т., Неъматов, Х. И., Бойтемиров, О. Э., & Дусткобилов, Э. Н. (2019). ИССЛЕДОВАНИЕ ФУНКЦИОНАЛЬНЫХ СВОЙСТВ СИНТЕЗИРУЕМЫХ АЛЮМО-НИКЕЛЬ-МОЛИБДЕНОВЫХ КАТАЛИЗАТОРОВ ГИДРООЧИСТКИ. *Международный академический вестник*, (5), 73-79.

9. Ziyamukhamedova, U., Rakhmatov, E., & Nafasov, J. (2021, April). Optimization of the composition and properties of heterocomposite materials for coatings obtained by the activation-heliotechnological method. In *Journal of Physics: Conference Series* (Vol. 1889, No. 2, p. 022056). IOP Publishing.

10. Ziyamukhamedova, U., Djumabaev, A., Urinov, B., & Almatayev, T. (2021). Features of structural adaptability of polymer composite coatings. In *E3S Web of Conferences* (Vol. 264, p. 05011). EDP Sciences.

11. Bozorov, O. N., Rakhmatov, E. A., Dustkobilov, E. N., & Ziyamukhamedova, U. A. (2020). Creation and application of corrosion-resistant coatings on the basis of modified local angrene kaolins and epoxy compounds. *Journal of critical reviews*, *7*(16), 2945-2950.

12. Amperometric titration of palladium (II) and platinum (IV) ions in individual solutions of vinylpyrimidine

13. Бозоров, О. Н., Рахматов, Э. А., Дустқобилов, Э. Н., & Зиямухамедова, У. А. (2020). Модификацияланган маҳаллий ангрен каолинлари ва эпоксид компаундлари асосида коррозиябардош қопламалар яратиш ва уларни амалда қўллаш. *Инновацион технологиялар*, (3 (39)), 48-54.

14. Boboniyozovich, R. K., Dilmurodovna, D. S., Dzhabborovna, I. H., Nurmamatovich, D. E., & Abdikhafizovich, R. E. (2019). Amperometric titration of mercury (II) with mphcmdedtc-a nitrogen-and-sulfur-containing reagent. *European science review*, (3-4), 129-132.