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Processing of Oil Residues

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Abstract

At present, the global oil refining industry has a wide range of installations that deepen oil refining, as well as refining processes to improve the quality of oil fractions. One of the main directions in the development of oil refining technology in industrialized countries is the widespread development of new processes that improve the environmental characteristics of motor fuels. In recent years, refineries around the world have mastered technologies that make it possible to reduce the content of aromatic and olefinic hydrocarbons in motor gasolines, such as hydrogenation and alkylation of benzene-containing fractions, esterification and oligomerization of olefin-containing fractions, as well as technologies aimed at removing sulfur and aromatic hydrocarbons from diesel fuels, mainly by hydrogenation.

Keywords: *oil, processing, technology, innovation, method, scheme, coke.*

INTRODUCTION

Along with traditional technologies, intensive research is being carried out all over the world to further improve the processes and schemes for processing oil residues. The priority direction is to include in these schemes the process of gasification of oil residues, coke, asphalt from deasphalting processes, etc., as well as the development of energy-technological schemes that make it possible to meet the own needs of an oil refinery in electricity and water vapor[1]. The processes of gasification of oil residues can also be aimed at obtaining hydrogen, which is consumed by an oil refinery in increasing volumes, as well as in order to obtain synthesis gas (CO + H2) for its further processing into synthetic petroleum fuels, methanol and other products. Technology using the gasification process allows for residue-free oil processing.

MATERIALS AND METHODS

Similar processes are under development, and some of them are the first industrial plants under construction. Schemes are also being developed that provide for a combination of solvent DE asphalting processes with delayed coking, which makes it possible to increase the yield of liquid products and reduce the yield of coke[2].

Fundamentally new approaches to the organization of multi-stage processing of oil residual raw materials are of considerable interest. The need to create various modifications and combine the schemes of the processes of thermal conversion of oil residual feedstock is due to significant resources of hydrocarbon feedstock with a weighted fractional composition, an increased content of metals, sulfur, and nitrogen and resinous-asphaltene compounds. Taking into account the conducted

[1] Antonov M. L. // World of oil products.– 2019.– No. 5.– P. 6.
[2] Galiev R. G., Khavkin V. A., Danilov A. M. // Mir oil products.– 2019.– No. 2.– P. 3.

studies, combined schemes, including the stages of thermolysis, coking, and fractionation, are promising from the point of view of implementation.

RESULTS AND DISCUSSION

These schemes can significantly increase the specific yield of light distillates or, conversely, increase the yield of petroleum coke, most often fuel grades. The advantages of such schemes are technological flexibility in relation to the range of products obtained, low pressure, low recirculation coefficients, or non-recirculation technologies with processing of raw materials in one pass.

Fuel petroleum coke, which is usually obtained in the form of grains, is a valuable product used in various industries and successfully competes with coal. A strong market for petroleum fuel coke exists because of its relatively low price compared to coal or fuel oil. The increased concentration of sulfur, reaching in some cases 5-6%, makes some grades of fuel coke less preferable. High sulfur petroleum coke is used as a fuel, for example in the operation of steam boilers and auxiliary generators.

If necessary, such schemes can also include the stages of preparation of raw materials, for example, desalting and dehydration, demetallization and demercaptanization, and preliminary fractionation to concentrate the heaviest part of the processed residues. Qualified processing of oil residues allows solving environmental problems at the same time. A typical scheme of the process of processing oil residues, including the process of delayed coking, is shown in fig. 1.

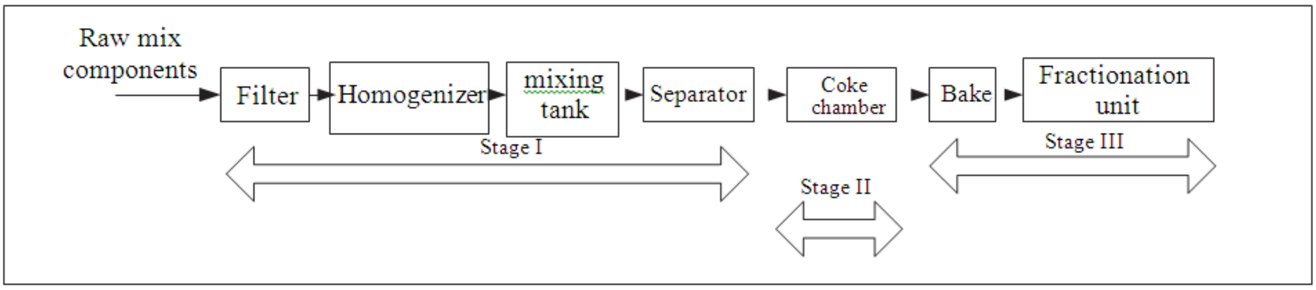

Fig.1. Scheme of the process of processing oil residues, combined with the process of delayed coking[3]

The raw material is fed through a special mesh-filter into the disperser, from where it enters the mixing tank. The homogenized raw material from the reservoir is pumped to the separator, where the lightest hydrocarbon phase in the gaseous state is separated from the initial mixture. For better separation, a slight vacuum is created in the separator. The gases released in the separator are accumulated in a special receiver. The bottom product of the separator is pumped into the coke chamber, where the cracked residue is simultaneously supplied after the separation of the coking products from the distillation column. The coking products from the reactor enter the distillation column, from which distillate fractions and the residue are separated, which enter through the tubular heater for mixing with the coking feedstock. After the process, the coke is unloaded from the reactor and sent to the storage site.

A further development of the considered combined schemes, including the coking process, is the preliminary preparation of the original oil residual feedstock, including mixed feedstock, by thermolysis. In this case, thermolysis is understood as the process of thermal conversion of

[3] Garifzyanov G. G., Garifzyanova G. G. // Chemistry and technology of fuels and oils. - No. 4. - 2006. - P. 24.

petroleum feedstock, in which the reaction products remain in the reaction mass and participate in thermal transformations. This can be achieved by sealing the reactor and preventing the removal of thermal transformation products from the reaction mass. We carried out the thermolysis of the residual raw material in the presence of nanocarbon. The thermolyzed raw material was further subjected to the process of coking, and the resulting distillates were separated by fractionation.

Samples of waste diesel oil and fuel oil from West Siberian oil were used as raw materials. Experiments have shown the possibility of controlling the yield and quality of the products obtained over a wide range by changing the process parameters, in particular, the duration of thermolysis, as well as the concentration of nanocarbon in the feedstock[4].

Changes in the quantitative indicators of the thermal conversion processes of various raw material compositions should be associated with structural transformations occurring in the reaction mass during its heat treatment. The oil is not a structured system, practically does not contain tar-asphaltene compounds and can be considered as a solution of high-molecular hydrocarbon compounds in low-molecular ones. Resinous-asphaltene compounds present in fuel oil contribute to the formation of aggregative combinations of complex composition, interacting with each other through peripheral regions - solvate shells. Changing the conditions for the existence of such systems leads to the intensification of these interactions or, conversely, to their weakening. Thus, aggregative combinations during rearrangement can either release a part of the immobilized liquid phase into the surrounding space, or, conversely, capture it.

CONCLUSION

These features of raw materials systems have a significant impact on the processes occurring in them under thermal influences. It is obvious that the heat treatment of fuel oil will lead to the formation of a continuous structural framework, which becomes stronger as the intensity and duration of thermal exposure increase, and heating the oil to the temperatures of the onset of thermal decomposition processes will promote the transformation of high-molecular components into low-molecular ones with a large release of gas and extremely low the content of structured components in the residual cracking products. The introduction of nanofibers into the system and their dispersion fundamentally changes the structural organization of the resulting raw material compositions. In this case, both in fuel oil and in oil, an own phase of nanofibers is formed, consisting of the smallest dispersed particles. When such systems are heated, each particle will be the center on which thermal cracking of the nearby components of the raw material takes place. With this consideration, the mechanism of transformations in both systems can become similar. However, it is obvious that in the case of fuel oil, a larger amount of bound coke particles will be obtained, and in the case of thermolysis of oil, small disparate coke particles will be formed to a greater extent, which are not connected to each other due to the reactive inertness of the nanofiber.

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