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MODERN METHODS OF PRODUCING PETROLEUM BITUMEN

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Abstract

Today, the demand for petroleum bitumen in the world is growing day by day. Because the increase in the volume of construction of new modern structures and roads has caused an increase in demand for these construction bitumen. This article presents an in-depth theoretical analysis of modern and traditional methods for producing construction bitumen based on petroleum raw materials.

Keywords: *oil, oil residues, bitumen, tar, distillate, paraffinic hydrocarbons, aromatic hydrocarbons, naphthenes, polymers, modifiers*

Introduction

The main consumers of bitumen in our country and abroad are road, industrial and civil construction. More than 90.0% of the total bitumen production is spent on their needs. The raw materials for bitumen production are tars of primary oil distillation and other products of secondary processes of processing oil residues (extracts of oil production, extracts of the deasphalting process, cracking residues, etc.), in which high-molecular aromatic compounds, resins and asphaltenes are concentrated (Kemalov A. F., 2003).

Objects and methods of research

Bitumen is obtained by processing residual petroleum products in three main processes used in combination with each other or separately: centering oil residues by distilling them in vacuum in the presence of water vapor or inert gas (residual bitumen); oxidation with air oxygen of various oil residues (fuel oil, tar, semi-tar, deasphalting asphalts, selective oil purification extracts cracking residues or mixtures thereof) at a temperature of 180–300 °C (oxidized bitumen); compounding (mixing) of various oil residues with distillates and with oxidized or residual bitumen (Luksha O. V. Budadien, Opanasenko O. N., Krutko N. P., Loboda Yu. V., 2006).

The production of high-quality bitumen is influenced by the correct selection of the sequence of processes in the general technological scheme of oil refining of various nature (Mullahmetov N. R., Kemalov A. F., Kemalov R. A., Kostromin R. N., 2010).

When using TNF of oils with a high content of resinous-asphaltene substances and aromatic hydrocarbons, the technology provides for an oxidation process that contributes to the formation of an additional

amount of structure – forming components-asphaltenes.

Methods for obtaining residual bitumen are based on the concentration of the residue – tar by deep selection of oil fractions from fuel oil in a vacuum column. At the same time, in the lower part of it, ready-made bitumen is obtained without oxidation. For the production of residual bitumen, raw materials with the highest possible content of asphalt-resinous substances are needed; the higher the ratio of asphaltenes: the better the properties and structure of bitumen, the less they are exposed to aging during operation.

Results and their discussion

In Uzbekistan, the main method for producing bitumen with various properties is the oxidation of heavy oil residues with air oxygen.

The composition and physical and chemical properties of commercial bitumen are affected by the technological conditions of the oxidation process. The main factors affecting the tar oxidation process are: the nature of the raw material, the initial softening temperature of the tar, the content of oils, paraffin and naphthenic compounds in it, the oxidation temperature, the flow rate of air supplied for oxidation, the contact surface, the duration of oxidation, the pressure in the reaction zone, the level of the liquid phase in the reactor, etc. (Priyanto S., 2001). The higher the ratio of asphaltenes to resins in oil and the lower the content of solid paraffins, the better the quality of bitumen obtained from them and the simpler the technology of their production.

Obviously, under conditions of bitumen oxidation, the second direction will be preferable, although in mild conditions the first path is also possible. The transition from asphaltenes to carbenes and carbides is noticeably observed during the oxidation of high-resinousmalt at temperatures above 300 °C (Kudryavtseva S. V., 2008; Thompson D. K., 1974).

According to many scientistsфазном окислении нефтяных остат, the accumulation of oxygen-containing products and acids does not always occur during the liquid-phase oxidation of oil residues with air oxygenкислородсодержа, which is usually observed during the oxidation of hydrogenseводородов.

According to the dataof (Kauchukovye modifikatory 1974; Aigul A. I., Linar I. K., 2010), the accumulation of low-molecular oxygen-containing compounds occurs at the beginning of the process and their amount is small: 0.02–0.03%. Other researchers (Islamutdinova A. A., 2010) observed the accumulation of oxygen throughout oxidation. Mostof the oxygen that enters the reactionis released as water. Thus, the role of oxygen in the oxidation of oil residues is mainly reduced to the role of a dehydrogenating agent.

The authors found (Thompson D. K., 1974) that paraffin-naphthenic hydrocarbons are the most resistant to oxidation, and they remain mostlyном, unconverted under oxidation conditions. E in which works reduction. The authors of (Islamutdinova A. A. 2010; Hayrudinov, I. R., Sharifullin, A. A. and Karimov, I. A., 2000) explain the decrease in the concentration of paraffin-naphthenic hydrocarbons observed in (Islamutdinova A. A. 2010; Hayrudinov, I. R., Sharifullin, A. A. and Karimov, I. A., 2000) some studies by distilling the most volatile components.

It is known from the authors work (Shirkunov A. S. 2007) that the oxidation of a mixture of hydrocarbons significantly differs in the rate and mechanism of oxidation of individual substances. In the presence of holonuclear arenes заметно снижается, а алкилированных аренов, the depth of chemical transformations of paraffin-naphthenic hydrocarbons is markedly reduced, while that of long-chain alkylated arenes increases, which was also confirmedin (Hayrudinov, I. R., Sharifullin, A. A. and Karimov, I. A., 2000; Shirkunov A. S., 2007).

The authors of (Khafizov E. R., 2003) present data on the relative oxidation rates at 80 °C of tars and individualhydrocarbons: cumene, decalin, octadecane, and dodecane. The tar oxidation ratewas 0.009 relativeto cumin oxidation, the rate of which is taken as 1.Such low valuesof the relative tar oxidation rate can be explained by the fact that the direction and depth of the process, as well as the nature of the interaction of oxygen with the components, are determined both bythe temperature of the process and by the group compositionof the tar.

Conclusions

Thus, when considering bitumen oxidation, the nature of the feedstock so strongly influences the nature of chemical transformations that it is necessary to select the optimal conditions for each type of raw material separately: temperature, air consumption, etc.

As already noted, TNF of high-paraffin oils is a poor raw material for bitumen production using traditional technology. However, from low-sulfur, high-paraffin oils, TNOs, it is possible to obtain road bitumen by changing the conventional technology. If the generally accepted technological scheme for the production of road bitumen is based on the sequential implementation of the processes of vacuum distillation of fuel oil and subsequent oxidation of the resulting tar to bitumen, then the reverse sequence of processes can be used: air oxidation of a part of fuel oil and vacuum distillation of a mixture of oxidized and non-oxidized fuel oil to bitumen.

However, the steadily increasing requirements for the quality and performance of petroleum bitumen cannot be met by the choice of raw materials alone. Thus, the introduction of new technologies in the processing of residual oil components, based on the activation of raw materials due to physical and chemical exposure, allows us to obtain high-quality road bitumen.

A large number of researchers solve the problem of improving the qualityof bitumen by adding a small number of modifiers, which makes it possible to obtain both materials for roadconstruction andspecial roofing, anti-corrosion, sealing, insulation and other materials. In recent years, there has been a tendency to actively involve various additives in the bitumen production directly in the oxidation process in order to give it the required operational qualities. Thefollowing chapter discusses the oxidation of bitumen in the presence of various additives.

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