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PRODUCTION OF PETROLEUM ROAD BITUMEN BASED ON MODIFIED WEIGHTED TARS

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Abstract

The reduction of crude oil reserves in the world requires the development and implementation of technologies to increase the depth of oil refining. In this regard, oil refineries are reconstructing the vacuum distillation units of fuel oil in order to maximize the selection of vacuum gas oils, which are valuable raw materials for secondary oil refining processes.

Keywords: *oil, bitumen, tar, oxidation, hydrocarbon, paraffin*

Today, technological progress cannot be imagined without the development of motor transport and the construction of high-speed highways. In this regard, petroleum bitumen as a commercial petroleum product and a binder for the preparation of asphalt concrete is in demand in the national economy of each country.

Petroleum (artificial) bitumen obtained by processing petroleum raw materials is widely used in road construction. Artificial (technical) bitumen – residual refined products of oil, coal, and shale. They are similar in composition to natural bitumen. Natural bitumen is a viscous resinous substance formed from heavy oil fractions as a result of prolonged weathering. It occurs in the form of stratified vein deposits, as well as lakes in places where oil naturally reaches the earth's surface (Makhmudov M.Zh., Khaitov R. R., Narmetova G. R., 2014).

The first designation of bitumen comes from the word "jatu" (Sanskrit), which meant resin released from some trees, which eventually transformed into "Gvitymen" (resinous, sticky), and in Latin, it was simplified to "bitumen" and eventually passed into all European dictionaries (Makhmudov M.Zh., Khalilov A. Kh., Khaitov R. R., Narmetova G. R., 2017).

The use of natural bitumen (asphalt) has been known since the dawn of civilization. The oldest structure using natural asphalt -bitumen-bearing rock was discovered in India (Makhmudov M.Zh., Yomgurov S. A., 2023). It is known that natural bitumen – asphalt was used as an adhesive material in 2500–3000 BC by the people who inhabited the Euphrates Valley. As a construction site

Bitumen was used by the Babylonians (700–500 BC) to build the inner and outer walls of Babylon. During the reign of Semiramis (about 700 BC), a tunnel was built under the Euphrates in Babylon, about 1 km long, made of burnt bricks coated with bitumen. Asphalt was also used in the construction of the famous hanging

gardens of Semiramis (Makhmudov M.Zh., Khalilov A.Kh., Khaitov R. R., Narmetova G. R. 2017; Makhmudov M.Zh., Yomgurov S. A. 2023). In ancient Egypt 5,000 years ago, the floor and walls of grain storage barns were covered with asphalt.

In 400–500 BC, fortress walls were built of bricks in Media, bonded with bitumen. The first sections of the Great Wall of China were built on bitumen. Bitumen and asphalt were used for the construction of buildings and towers, water and drainage channels, tunnels, and in medicine for the mummification of corpses, etc. (Dzhamolovich M. M., Ugli Y. S. A., 2024). In the 19 th century, the streets of all cities of the world were paved with stones, and it was only in the period 1832–1835 that the experience of paving city streets and sidewalks of Paris with asphalt was mentioned. Later, in 1835–1840 Bitumen was used in the construction of roads in London, Vienna, Lyon, Philadelphia and other cities (Makhmudov M., Nematov H., Rizayev S. 2023). In connection with the discovery of deposits of bitumen-bearing rocks in France, Switzerland, Germany, in 1700–1800.

In Western Europe, work begins on their use in the construction of floors., sidewalks and waterproofing. In 1835, the first sidewalks were laid in Paris, then in London, three years later in Philadelphia (Murtazaev F. I., Makhmudov M. Zh., Naubeev T. Kh., 2021). Since the middle of the 19th century, in France, the USA, Switzerland and other countries, road surfaces have been made from bitumen-mineral mixtures. For example, the first asphalt concrete coating was first used in France to cover the sidewalks of the Royal Bridge in Paris. In the Russian Empire, the first asphalt pavement was carried out in 1866 in St. Petersburg, and in 1869 in Moscow. In Kronstadt using Hanoverian bituminous rock, although by that time several deposits of bitumen-containing rocks had already been discovered in Russia. The first of them (bituminous limestones) was discovered in Syzran in 1724, and in 1871 an asphalt mastic manufacturing plant began operating in this city. In the USA, cast asphalt prepared using natural bitumen was first used in 1876 (Makhmudov M. Zh., Yomgurov S. A., 2023).

The composition of bitumen is characterized by its elemental and group chemical composition.

Elemental composition of bitumen (% by weight): carbon – 80–85; hydrogen – 8–12.5; oxygen – 0.2–4; sulfur – 0.5–10; nitrogen – 0.2–0.4. The content of some metals in asphalt oil concentrates (such as Arlanskaya) is (% by weight): V – 0.22; Ni; –0.115; Fe – 0.110; Ca – 0.054, etc. The average molecular weight of bitumen does not exceed 700–800 k.e (Makhmudov M. J., Yuldashev T. R., 2023).

Given the wide variety of individual chemical compounds that make up bitumen, data on their group chemical composition is usually used to determine their chemical composition.

The group chemical composition of bitumen provides for the division of all the various individual chemical compounds included in bitumen into three main groups: asphaltenes, resins and oils (maltenes).

Oil is divided into three groups according to its suitability for bitumen production (Maxmudov M. J., Ne'matov X.I., 2023; Llewellyn, P. L. et al., 2008):

1. Highly resinous low-paraffin, resinous low-paraffin, high-resinous paraffin. The composition of such oils corresponds to the condition $A + C - 2.5N \geq 8$, where A is the content of asphaltenes, C is the content of resins, and P is the content of paraffins.

2. Resinous paraffinous, low–resinous low-paraffinous, the composition of which meets the condition $A + C - 2.5$ P, ranges from 0 to 8 with $A + C$ more than 6.

3. Three types of oil unsuitable for bitumen production: resinous high–paraffin, low-tar paraffin and low-tar high-paraffin, the composition of which meets the condition $A + C - 2.5$ P, ranges from 0 to 8 with $A + C$ less than 6, and also if $A + C - 2.5$ P less than 0.

Heavy resinous low-paraffin oils are the best raw materials for the production of road bitumen.

The presence of de-asphalting asphalts and cracking residues in its composition has a negative impact on the quality of crude oil.

The main goal of forming the qualitative characteristics of raw materials is aimed at forming nanostructured bitumen from it. As is known, oxidation reactions of heavy oil residues occur with the formation of micelle as-

phaltene nanoaggregates that grow into cluster nanoaggregate structures. The properties of the resulting bitumen binders depend on how the nanoclusters interact with each other, the size of the asphaltene clusters and the rate of formation of the mesh framework of the clusters of asphaltene nanoaggregates.

The decisive factors in choosing a technology are temperature, time, and rate of oxidation reaction.

Professor F. G. Unger (Maxmudov M. J., Ne'matov X.I., 2023) pointed out that "the size and structure of each colloidal particle depend on the equilibrium of the kinetic motion energies of the molecules and the potential of their pair interaction. The conditions of the technological process of formation, existence and destruction of supramolecular structures (associative combinations, micelles, complex structural units, macromolecules) of petroleum dispersed systems of resinous-asphaltene substances determine the structure and physico-chemical properties of bitumen.

Bitumen systems are thermodynamically mobile systems in which hemolytic transitions (of diamagnetic molecules to paramagnetic and vice versa) are continuously carried out and it is paramagnetic molecules and hemolytic processes that cause the rearrangement of the supramolecular structures of petroleum dispersed systems, i.e. they determine the behavior of the system as a whole and the conditions for the formation of the structure when the external conditions of the technological process change.

Analysis of numerous data from various instrumental research methods and their comparison indicate that heavy carbonaceous molecules or individual carbon atoms combine into large structures such as associates, polymers or crystal lattices due to spin excitation and spin polarization through the influence of solvent and temperature."

This allowed us to conclude that there may be an equilibrium dynamics of the colloidal state of such complex objects as bitumen, and to formulate requirements for the parameters of technological effects on petroleum dispersed systems in order to obtain bitumen binders with specified properties.

The main production methods for viscous road bitumen are as follows (Artemova I. I., Kandaurov S.Yu., Bachalov I. S. et al., 2010):

1. Concentration of residual oil fractions by distilling them in vacuum in the presence of water vapor (obtaining residual bitumen).

2. Air oxidation of oil residues (fuel oil, tar, etc.), which makes it possible to obtain oxidized bitumen.

3. Mixing (compounding) of liquid oil residues with viscous residual or oxidized bitumen, solid natural bitumen (asphaltites, gilsonites).

Today bitumen production is emerging as a full-fledged segment of the oil refining industry. The introduction of new technologies in the processing of residual oil components based on the activation of raw materials due to physical and chemical effects using modern equipment, including devices using cavitation effects, ultrasonic and electromagnetic fields, etc., makes it possible to obtain high-quality road bitumen from most oils previously considered unsuitable for bitumen production.

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