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PRODUCTION OF BITUMEN FROM OILY WASTE

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Abstract:

In order to create environmentally friendly low-waste technologies for the disposal of oil sludge, a technology has been developed for their processing by its vacuum distillation and oxidation to obtain an oxidized secondary product similar in characteristics to standard road bitumen.

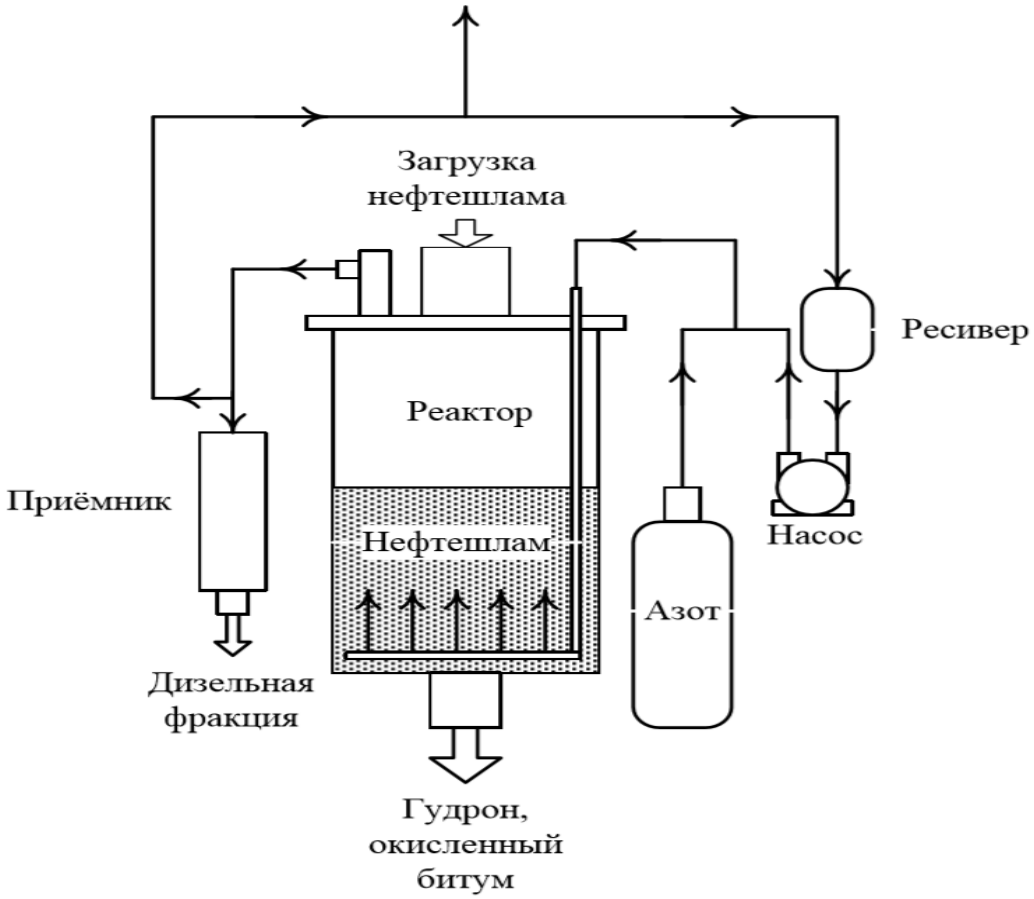
Keywords: oil sludge, tar, vacuum distillation, oxidation, oxidized road bitumen.

Introduction

The constant increase in the volume of oily waste (NSO) generation as a result of the production activities of oil production and refineries determines the relevance of the search for new and optimization of existing technologies for the effective disposal of this type of waste, which is currently one of the most urgent tasks in Russia in the field of environmental protection [1]. Oil sludge is a three-phase system, the composition and properties of which vary widely depending on the location and method of their formation. The change in the composition of such complex multicomponent disperse systems over time significantly complicates the development of uniform methods for their utilization [2]. At present, various technologies for the utilization of NSO are becoming widespread, they are mainly based on such processes of separation of water and organic phases as sedimentation, filtration, and incineration [3]. For oil-contaminated soils, the method of biodegradation of the hydrocarbon component has become the most common [4]. Each of these processes has limits of applicability, primarily

due to the composition of the waste to be disposed of. In [5] it is reported that it is possible to use oil in road construction.

Thus, the analysis of world experience and patent studies have shown that there is a need to develop an integrated low-waste technology for processing NSO with the maximum use of their resource potential by obtaining valuable secondary oil products, such as diesel fraction hydrocarbons and road bitumen.



Rice. 1. Oil Sludge Processing Schematic Diagram

Experimental part. Simulation of the processing process was carried out as follows. The oil sludge was preheated to a viscous state, filtered and placed in the reactor through the feed neck until it was filled to 1/3 to 1/2 of the volume, depending on the water content of the treated sludge. The weight of the load was 2-4 kg, depending on the composition of the waste. In the case of atmospheric distillation, the oil sludge was heated in the reactor to the temperature of azeotropic distillation of water: 107°C-155°C (depending on the composition of the oil sludge), and then the diesel fraction was collected at 160°C-178°C. Atmospheric distillation was carried out at a temperature from room temperature to 340°C. During vacuum distillation, the sludge was pre-dewatered according to the method described in [8], after which the air was removed from the reactor by vacuuming to a residual pressure of 8-10 mmHg during the heating process. Heating was carried out until the distillate stopped flowing into the receiver (on average up to

300 °C). After the distillation was completed, either the apparatus was unloaded or the tar was subsequently oxidized to obtain bitumen. Oxidation was carried out with oxygen in the air, for this purpose the reactor was reheated to a temperature of 260°C and air was supplied through a bubble spiral in the amount of 3.2 l/min for 12 hours. Bitumen samples were taken at reference points at oxidation times of 4, 8 and 12 hours for subsequent analysis of the group composition. Results and discussion. Comprehensive geoecological studies of oily waste storage facilities [6] have shown that most of the storage facilities have a three-layer structure: the upper layer is represented by heavy oil with a small content of mechanical impurities and water, the middle layer is a water-oil emulsion with a predominance of the aqueous phase, and the lower layer ("bottom sludge") is characterized by a high content of heavy organic compounds and mechanical impurities, in most cases being elements natural soils. In this work, the objects of research are the characteristic bottom and top oil sludge from the largest oil sludge reservoirs of the Samara region, since the problem of utilization of the middle layer is the subject of improvement of technologies for the treatment of oil-contaminated waters and, probably, can be solved by the use of the developed methods in the field of chemical water treatment. In addition, the resource value of these wastes is low due to the relatively low content of oil and oil products. The results of experiments on atmospheric distillation and azeotropic dewatering of oil sludge are presented in Table 1. 1, for the subsequent vacuum distillation of oil sludge samples – in Table 1. 2. Analysis of these data revealed a number of trends, as follows.

Table 1. Results of atmospheric distillation of oil sludge samples

Sludge Sample	Fraction content, %		
	Cubic residue	Aqueous fraction	Diesel fraction
1 IN	46	37	15
2 D	56	23	18
1 IN	45	31	23
2 V	46	36	27

Table 2. Results of Vacuum Distillation of Dewatered Oil Sludge Samples

Sludge Sample	Fraction content %	
	Cubic residue	Diesel fraction
1 IN	60	38
2 D	63	33
1 IN	44	42
2 V	49	51

Analysis of these data shows that the needle penetration depths at 25°C and 0°C, as well as the softening point along the ring and ball, meet the requirements for standard bitumen BND 90/130, but the extensibility values are insufficient to ensure compliance with the requirements of the standard. This determines the relevance of the search for methods of modification or compounding of secondary bitumen, as well as the prospects of research in the field of creating

methods for managing the group composition of heavy oil residues obtained from oily waste. Conclusions: within the framework of exploratory studies on the creation of a method for obtaining secondary bitumen based on oily waste, the principal possibility of obtaining oil road bitumen has been shown, the optimization of the proposed method within the framework of further research will ensure the compliance of secondary binders with the current technical requirements.

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