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Production of construction materials based on drilled cuttings for the road industry

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Abstract

This paper discusses the drilled cuttings treatment technologies. It also considers the main adverse effects of drilling waste on the environment. The main advantages of drilling sludge processing into building products are given. The main methods of oil waste management practices currently used in international practice are analyzed. Some technologies of raw oil refinery in obtaining by- product are considered. Their main advantages and disadvantages associated with the peculiarities of the technological process and the method on which it is based are described. The possibility of obtaining construction material, expanded clay and other materials using drilling cuttings is also assessed. An experiment to obtain a building stone is given and the possibility of its use is evaluated. The conclusions are based on obtained properties of the manufactured material.

Keywords: Drill cuttings, oil production wastes, waste processing, secondary material resources;

1. Introduction

One of the urgent problems of modern ecology is to reduce the level of danger when dealing with certain types of waste. Drilling sludges is such type of hazardous waste and it is a stable water-oil suspensions, the solid part of which consists of spalls and borehole surface, attritus of the drilling module and casing, clay minerals [8]. Due to the content of toxic components of drilling fluids, petroleum hydrocarbons, as well as heavy metals, drill cuttings have a harmful effect on the environment and human health, the main factor for which is their toxicity.

The negative impact of drill cuttings is determined by the following factors:

- toxicological effects on human beings and the environment;
- petroleum hydrocarbons accumulate in plant tissues and animal organs;
- heavy metals contained in drill cuttings (mercury, cadmium, lead, arsenic, zinc, etc.) pollute the hydrosphere and change the physicochemical parameters of water
-complex harmful effect on the soil.

Processing of drilling sludge (DS) into construction material allows us to solve two problems at once. First of all, to neutralize drill cuttings that can have a significant negative impact both on the environment and human health, primarily due to their toxicity. Secondly, to obtain construction material with different properties - dense with high durability or porous, which in turn allows to save due to the lack of the need to purchase another building material and because of the need for additional itelnyh costs for the construction of graves that still affect the ecological safety.

The literature describes various approaches to reducing the harmful effects of drill cuttings. To date, the main and most frequently used method of cuttings handling is their burial in sludge pits. To implement this method, drill cuttings are brought into natural ravines and specially dug trenches, with the purpose of their burial. This method has several disadvantages. First, drill cuttings continue to constitute a hazard for the environment, though to only a lesser extent. Secondly, the possibility of further use of drill cuttings as a secondary material resource remains unrealized.

In order to realize this possibility, in recent times, preference is given to methods for processing drill cuttings that suggest its further use. For example, the use of filter shells (geocontainer processing). The essence of this method lies in the dehydration of drill cuttings in geo-containers. Geocontainers are shells made of filtering textile materials, that allows to perform the processing of sludge in one technological unit. The complex processes occurring in geocontainers are mainly determined by the influence of two forces: the force of the hydrostatic pressure of the sludge layer and the capillary force of the suction of the liquid in the interpore space. The processed cuttings acquire the strength properties of soil-like materials [4]. This method has both advantages and disadvantages. The advantage of processing drill cuttings using geocontainers is the lack of capital workshops for mechanical dewatering, low material and energy costs. The disadvantage is the complexity of the processes occurring during the dewatering of drill cuttings in the filter container, and the difficulty in their management.

The second method of utilization of drilling sludge is their processing into a bourolite mixture in sludge pits directly on the territory of the pad sites [3]. The use of drill cuttings as the main component of the burolite mixture is implemented using cement, sand and carbamide penoizol. Based on the degree of moisture used drill cuttings composition of the mixture may vary. With the addition of components to the drill cuttings, the mass of the mixture will increase, but the volume will remain unchanged. The material obtained during the implementation of this method is used for dumping the foundations of the pad sites, strengthening the slopes of roads and reclaiming sludge barns [3]. The disadvantages of the method include the occurrence of the formation of a large volume of product, which is not used due to low consumer properties.

The third example of the processing of drill cuttings is its use as a component of the mass for the production of expanded clay and catalytic granulated materials. Expanded clay is often used to obtain expanded clay-concrete blocks. Catalytic materials are promising for use in the technology of deep wastewater treatment from dissolved organic matter and in oil sludge processing technology to speed up the composting process [1].

Thus, the analysis of methods of neutralization showed that the most promising is a method of processing drilling sludge into the finished product. One of the most rational ways of processing sludge can be considered their use as a raw material for the construction industry, which, as you know, belongs to large-scale and multi-tonnage production [2].

The purpose of the work is to determine the possibility of using drill cuttings as a component of the mixture to obtain a material suitable for road construction.

2. Experiment

The object of the study is drilling mud, which is formed at the Surgutneftegaz field. Pre-waste was dried, then it was mixed with the sand of the Tuganskoye deposit and I-grade cement (25.5 B), 30% and 15% by weight, respectively, and in subsequently adding the 5% diatomite and grinding in a ball mill with water. The result is a workable mass. After placement into the mold, the samples were hardened in a bath with a hydraulic shutter for 48 hours.

Physic-mechanical characteristics were determined on samples of size 70 × 70 × 70 mm. The results of measurements of the main properties (table 1) showed that the average density is 800 kg / m^3, compressive strength of 2 MPa. These characteristics indicate a relatively low strength and the need to adjust the composition. At the same time, the strength of the samples obtained corresponds to the minimum possible tensile strength of the material used for road construction, in particular on field roads, for making strong bumps, in accordance with GOST 23558-94.

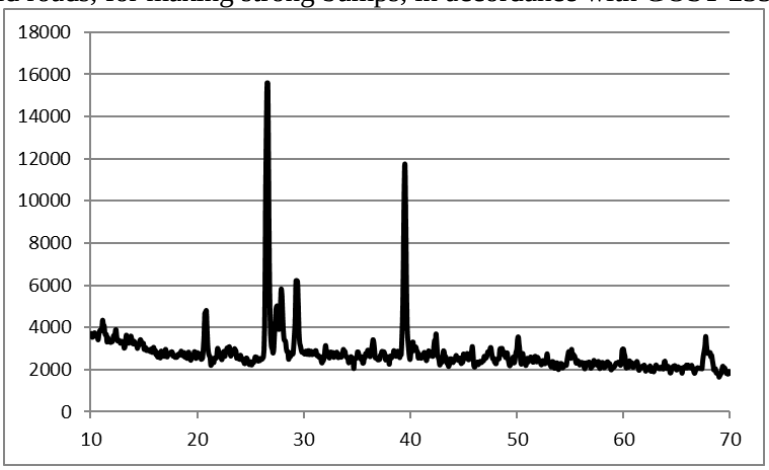

Figure 1 Radiograph of the original drill cuttings

Table 1

The composition of the initial mixture and the main characteristics of the samples

The composition of the initial mixture,%				Amount of water,%	Compressive strength, MPa	Density, kg / m^3
drill cuttings	sand	cement	diatomite		σ, MPa	ρ, kg / m^3
50	30	15	5	76	2	800

3. Conclusion

At this stage of research, it is fundamentally established that, on the basis of drill cuttings, it is possible to obtain a material that, despite its low strength, can be used to build additional layers of pavement bases. Further research will be aimed at developing a mixture with a greater performance capability, by changing its composition.

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