Drill Cuttings Control System in Oil and Gas Companies

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Abstract. The problem of ensuring environmental safety in the handling of drilling waste oil production is relevant throughout the world, but is particularly acute in Russia in almost every oil-producing region. The importance of the problem is determined not only by a significant amount, but also by the negative impact of oil waste on virtually all components of the natural environment. As a result of their impact, there is a significant change in the natural state of the geoecological environment, a decrease in the natural protection of groundwater, activation of geochemical and geomechanical processes, and a change in the natural microbiocenosis. The threatening growth of hazardous oil waste accumulated annually in the absence of the necessary scale of their utilization leads to the seizure of land resources for long periods. At the same time, oil waste belongs to the secondary material resources and by its chemical composition and useful properties can be used in the national economy instead of primary raw materials.

1. Introduction

1.1. Definition. Sources of education. Classification
According to the definition of the Industry Standard OST 51.01-06-85, drill cuttings are crushed drill contaminated with mud residues. This is a type of waste generated during the drilling of oil and gas wells.

Drilled rock contains components of the spent drilling mud and rock that forms the incision (sandstone, clay, etc.).

Drilling waste are formed as follows. In the process of drilling, drilling fluid is injected into the well, which lubricates and cools the tool, brings the drilled rock to the surface, compensates for the downhole pressure, reduces the intensity of formation and strengthens the walls of the well. As a result, drilling wastewater, spent drilling mud and contaminated drill cuttings (drill cuttings) are formed on the surface. All these three components of drilling waste in various proportions contain water, par-
ticles of drill cuttings, oil and components of drilling mud. Oil enters the drilling waste during the passage of oil-bearing formations and when using it in the drilling mud. The highest danger to environmental objects is represented by production and technological drilling waste, which is accumulated and stored directly on the drilling site. In their composition, they contain a wide range of pollutants of mineral and organic nature, represented by materials and chemicals used for the preparation and processing of drilling fluids.

Up to 68 kg of polluting organics per 1 m$^3$ of waste, not counting oil and oil products and pollutants of mineral nature.

Two concepts are distinguished in drilling – «drill cuttings» and «drill cuttings». In the process of deepening a well, in the bottomhole a drill is formed. When hydrotransport flushing fluid from the bottom of the well to the surface of the rock under the influence of man-made factors (for example, mixing with drilling mud) turns into drill cuttings.

Well drilling is carried out in sedimentary deposits, in which clayey rocks are the most common. Their share is 65-80%. Drilled particles of clay or rock cement bound together with clay cement in the process of hydrotransport from the bottom of the well to the surface are soaked with washing fluid filtrate and swell. The duration of the rock particles in the drilling fluid with a well depth increases and can reach several hours. The longer they are in the washing liquid, the stronger their swelling. Adhesive attachment of particles, mainly of colloidal size, from the washing liquid to the particles of the solid phase occurs.

The change in the physicochemical properties of the particles of the drilling rock during their transformation into drill cuttings is affected by the impregnation of the washing liquid with the dispersion medium. The pores and cracks of the rock particles are filled with the dispersion medium of the washing liquid, the surface of the clay particles is modified, and substances of different nature are adsorbed on the outer and inner surfaces of the drill cutting particles from the component composition of the washing liquid.

2. Actuality and scientific value
The mineralogical composition of the drill cuttings is determined by the lithologic composition of the drilled rocks and may change significantly as the well deepens. The granulometric composition of the drill cuttings is determined by the type and diameter of the rock cutting tool, the mechanical properties of the rock, the drilling mode, and the properties of the drilling fluid and varies widely.

Drilling sludge is predominantly solid drilling waste, along with drill cuttings, includes all chemical compounds used to prepare drilling fluids, its potential polluting effect on the environment is mainly due to toxic, mostly low hazard, properties of drilling mud components, as a rule, having IV hazard class, reservoir fluids and to a lesser extent drilled rock, which constitutes the bulk of the waste. The chlorides and sulphates contained in the sludge, less petroleum products, and even less other pollutants can have the greatest potential impact on the environment.

Minor total oil pollution of drilling waste, including the solid phase of drilling waste, occurs when wells pass oblique-horizontal sections directly into the body of the oil-bearing formation and averages around 200 mg/kg.

Drilling sludge is a fluid pasty mass, dark gray with a metallic shade of color, oily to the touch and having a mixed smell. The density of drill cuttings is determined by the density of drilling mud, drill cuttings and humidity.

Gross composition of drill cuttings: drill cutting – 75-85%; organic matter – 5-10%; water soluble salts – 5-10%; weighting and bentonite – 5-10%.

The main component of drill cuttings – drill cuttings consist of clay particles and to a lesser extent sand, which determine its mechanical properties. When drying (about 20% moisture), the sludge is solid, solid pieces. With further drying, the pieces crack and crumble. Humidification leads to rapid softening of the lumps or powder and the transition of the mass to a viscous-plastic, and then a fluid state.

The granulometric composition, in which the overwhelming majority of particles (92-96% by weight) have particle sizes from 10 to 500 microns, the larger ones correspond to the drill cuttings, and
the smaller ones to bentonites. The particle size distribution curve has two maxima. One maximum falls on particles of 20-30 µm in size, the other at 200-300 µm. The pH value, as a rule, corresponds to an alkaline environment and is 8.5-10.5. Drilling sludge received for processing to improve (restore) the physicochemical structure of soils and safety for the environment, must meet the following initial or technologically acceptable parameters and characteristics at the input (input control) in the production process, regardless of the basic method of drilling or their combinations among themselves (granary drilling, using temporary slurry accumulators or pitless drilling) adopted at the oil and gas field of the company.

Drilling wells is carried out mostly in sediment, in which the most common are clayey rocks. Their share is 65-80 %. Drilled particles of clay or rock cement bonded with clay cement in the process of hydrotransport from the bottom of the well to the surface are soaked with washing fluid filtrate and swell. The duration of the rock particles in the drilling fluid with a well depth increases and can reach several hours. The longer they are in the washing liquid, the greater their swelling. Adhesive attachment occurs in solid phase particles of predominantly colloidal size from the washing liquid.

The change in the physicochemical properties of the particles of the drilling rock during their transformation into drill cuttings is affected by the impregnation of the washing liquid with the dispersion medium. The pores and cracks of the rock particles are filled with the dispersion medium of the washing liquid, the surface of the clay particles is modified, and substances of various nature are adsorbed on the outer and inner surfaces of the drill cutting particles from the dispersive medium of the washing liquid.

The mineralogical composition of the drill cuttings is determined by the lithologic composition of the drilled rocks and may change significantly as the well deepens. The chemical composition of drill cuttings depends on both its mineral composition and the properties of the drilling fluid. The granulometric composition of the drill cuttings is determined by the type and diameter of the rock cutting tool, the mechanical properties of the rock, the drilling mode, and the properties of the drilling fluid and the efficiency of its cleaning.

To solve the problems of the use of waste drilling mud and drilling sludge, their classification according to certain qualitative and quantitative characteristics is important. The most significant features are:

- State of aggregation;
- Component composition;
- Physicochemical properties.

3. Tasks

According to the state of aggregation, this waste can be systematized as liquid (flowable), semi-liquid (pasty) and solid. In this case, the main feature of their assignment to a particular type in this systematization is the content of the solid and liquid phases. So, when the content of the solid phase is up to 35%, the waste retains its mobility and fluidity and belongs to liquid waste (waste drilling mud). When the content of the solid phase is from 35 to 85 %, the waste has a pasty appearance and refers to semi-liquid (this is a waste drilling mud with cuttings). And finally, when the content of the liquid in the composition of the waste is less than 15 %, they should be classified as solid waste (drilled rock or drill cuttings).

By component waste drilling should be systematized as clay, carbonate, and halide-sulphate. This systematization mainly refers to solid and semi-liquid wastes. Clay includes wastes, the solid phase of which is represented by rocks of the clay fraction (clays, mudstones, marls). Carbonate is a waste, the solid phase of which consists mainly of carbonate rocks (limestone, dolomite). Halide sulphate wastes contain a solid phase consisting mainly of rock salt, gypsum and anhydrite. Such systematization allows us to evaluate the suitability of these wastes as secondary raw materials for their utilization.

When drilling wells, the task of cleaning sludge from environmentally hazardous drilling waste is the most urgent.

The most hazardous to the environment are liquid drilling waste (mainly drilling waste water), since they are the most mobile and easily accumulating pollutant waste. At the same time, as raw ma-
terials for the regeneration of their active components, the drilling waste water is «lean» and is a dilute solution of a harmful substance with a concentration, as a rule, up to 0.1-1.0 % and, with rare exception, up to 2.5 %. The required depth of extraction of pollutants from drilling waste water is 0.01-0.03 % of the environmentally safe level determined by the standards for both discharge and disposal in the drilling cycle. As you can see, the neutralization system of drilling waste water refers to the technology, more complex, time-consuming, energy-intensive and expensive than conventional technology. Full utilization of more concentrated suspensions (waste drilling mud) or sludge masses by regenerating and extracting valuable components from them (weighting agent, clay powder, certain chemical reagents, etc.) in field conditions is also economically unprofitable due to the complexity and cumbersome of technological processes. Drilling rigs today are not equipped with special equipment for solving these problems.

As a rule, such liquids have a hydrocarbon base, and the components added to them have greater mobility when released into water and soil (surfactants – surfactants, diesel fuel, etc.). Also, during drilling, the drill cuttings is saturated with oil during drilling. The solid wastes generated during drilling and production include:

- Solid phase of drilling fluids;
- Drill cuttings;
- Soil contaminated with occasional oil spills.

The contaminating properties of drilling fluids are quite significant in connection with the content in them, first of all, of organic components and salts that are toxic to biota. Waste drilling mud is characterized by the following phase composition (in% of the solution volume):

- Water – 75-90 (representing produced water produced together with oil, diluted with precipitation);
- Solid phase – 11-25;
- Oil and oil products – 7-14.

The index of chemical oxygen demand of this solution ranges from 1000-8000 mg/l, the mineralization of its aqueous phase is 1.5-3.0 g/l, pH 7.8-8.2.

4. Theoretical part

4.1. Arrangement of drilling sludge pits

The preparation of the land for preparation of work is carried out both on the territory of the sludge barn and on the territory adjacent to the sludge barn and the pad site, in the zone of temporary allotment of land.

Sludge barn – the main object of disposal of drilling waste, made in the form of an earthen pit and designed to collect drilling waste (drilling sludge, spent drilling mud, drilling waste water). The size and volume of sludge pits varies and mainly depends on the number of drilled wells on the well pad.

The volume of cuttings from one well is equal to the volume of the wellbore. When designing, the volume of drill cuttings is taken to take more than the volume of cuttings by 20 %.

Four factors can be distinguished, contributing to an increase in the volume of drill cuttings compared to drill cuttings:

- Decompression of sludge particles as a result of a decrease in the effect of external pressure on them;
- Formation and expansion of cracks;
- Swelling of clay particles that form sludge;
- Adhesive sticking to the surface of the sludge particles of colloidal size from the washing liquid.

Recycling is carried out in sludge pits with a pre-pumped liquid phase – an emulsion of wastewater from cuttings when drilling production wells. The presence of residues of the liquid phase of drilling waste in an amount not exceeding 5 % of the volume of drilling mud is allowed.

In a slurry barn with a pre-pumped liquid phase of drilling waste – an emulsion of wastewater with cuttings during the drilling of production wells – the area of the sludge barn is divided into process cells by cutting strips for ease of handling and production.
The division into cells is performed by the method of transverse filling of sandy cutting strips 4-6 meters wide to the level of the (almost) day surface of the territory adjacent to the sludge barn. Sleep cutting strips should form cells, where the distance between the midlines of the cutting strips should be about 14.0 m, for the purpose of technological convenience of work (to enable excavation and mixing) with an excavator with a standard boom of raw materials and inserts depth and at any point of the cell (Figure 1).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Scheme (in section) of the location of the cutting strips in a sludge pit or temporary sludge collector in the processing of drilling waste: 1 – ground; 2 – waterproofing.}
\end{figure}

Thus, the distance between the side of the sludge barn and the cutting strip or between two cutting strips should be 8 m. The cutting strips are constructed from sandy (sandy) soil at the place of production or from imported quarry sand. For the production of this type of work used excavators, dump trucks, bulldozers.

Cutting strips in a slurry barn are made by displacing a solid phase of drilling waste with a moving soil, and to avoid formation of a slime layer in the cutting strip, an excavator shovel with soil simultaneously pushes the drill cuttings out and pours the soil onto the vacated space.

When leveling the cutting strip in the slurry barn, the work can also be done by a bulldozer. For the arrangement of the cutting strips, imported mineral soil is used – sand, extracted by hydro-washing or dry-cutting methods, from quarries specially designated for the construction of deposits by the company – subsoil user; the development of quarries is performed, as a rule, by one of the specialized enterprises.

Temporary fences around the sludge barn for unhindered access to equipment are removed, all unused building materials are exported and transferred to enterprises – owners or specialized enterprises. The environmental protection embankment around the production (technological) site or cluster site is strengthened or restored, if such a need has been identified during engineering and environmental surveys.

Mineral soils are used as soils. The soil is delivered to the sites by dump trucks and unloaded near the site of the fortification works. The embankment is strengthened by a bulldozer and/or an excavator.

Then, the necessary technological platforms for the installation of equipment, storage of sand, the placement of a temporary economic unit, and inter-replacement parking of equipment are identified and planned.

5. Practical value and results

5.1. Drilling waste handling technologies

At the present stage, oil production is accompanied by the formation of drill cuttings. Its disposal can be carried out in three directions: burial, neutralization and use of drill cuttings, each of which is char-
acterized by positive and negative sides. These areas of disposal are alternatives for the treatment of drill cuttings and are discussed below.

Each of the alternative ways of handling drill cuttings has its positive and negative sides.

The zero option for handling drill cuttings is to leave waste in waste disposal facilities, arranged in the form of a sludge barn on a well pad. Refusal from oil production is not considered, since the oil and gas industry is one of the main sources of replenishment of the budget of the Russian Federation. The growth of hydrocarbon production is ensured by intensive development and an increase in drilling volumes.

5.2. Burial of drilling sludge in drilling sludge pits
Waste disposal – isolation of waste not subject to further use in special storage facilities in order to prevent the ingress of harmful substances into the environment.

Leaving drilling sludge in a drilling sludge barn is the easiest way to handle waste and does not require any material costs to purchase equipment.

In the process of drilling oil producing, exploration, exploratory wells, drilling waste is generated, which is carried to the day surface from the well and placed in the waste disposal facility – in the drilling slurry barn arranged in accordance with the design documentation developed and approved in the established manner.

Slurry barns are filled with drilling waste: oil sludge, liquid oil, bituminous oil, drilling and cementing solutions, drilling wastewater and sludge, formation water, well testing products, materials for the preparation and chemical treatment of drilling and cement slurry, fuels and lubricants, storm sewage.

The percentage ratio between these components can be the most diverse, depending on the geological conditions, the technical condition of the equipment, the production culture, etc.

Drilling sludge is placed in equipped waste disposal facilities – sludge barns.

The most common way to restore the natural environment after the end of the life of the sludge barn is as follows. Barns are freed from the liquid phase, which is sent to the system for collecting and treating oil and then using it in the system for maintaining reservoir pressure. The remaining sludge is covered with mineral soil. The described method of eliminating sludge pits has a number of drawbacks, one of which is the possibility of keeping sufficiently high concentrations of hydrocarbons, anionic surfactants, easily soluble salts and other toxic substances in the drilling mud.

Conclusions about the effectiveness of the disposal of drill cuttings:
1) There is a risk of contaminants from drilling cuttings in the adjacent environment;
2) Unfavorable water-physical properties of drill cuttings cause mechanical instability of the surface on which they are buried without prior treatment, therefore the land plot cannot be used for its main purpose.

5.3. Neutralization of drill cuttings and subsequent disposal of neutralized waste in the drilling sludge pit
One of the ways to dispose of drill cuttings that are distributed, is their disposal.

Waste disposal is the treatment of waste, including the incineration and disinfection of waste in specialized facilities, in order to prevent the harmful effects of waste on human health and the environment.

The goal of waste disposal is to reduce their hazardous properties and (or) reduce waste.

Today, the disposal of hazardous waste can be carried out by thermal, physico-chemical, chemical and other methods.

There are several ways to neutralize drill cuttings, each of which can be effectively used depending on the conditions and prerequisites that exist in the oil producing enterprise.

Thermal method of disposal of drill cuttings
Thermal method of disposal of drill cuttings is to burn the sludge in a special process equipment (furnaces), followed by the receipt of secondary waste. In order to completely decompose undesirable gases of combustion in the furnaces of calcination (combustion), it is necessary to use high temperatures (about 850-2200 °C). An alternative solution to the thermal method of disposal of drill cuttings is
the incineration of waste in a temperature range not higher than 100 °C, during which the oil fractions are condensed and then collected for use as an energy resource.

Thermal technologies for waste disposal are being introduced into the production areas related to waste management. Thermal disposal of drill cuttings requires expensive equipment, especially when it comes to foreign models. The equipment for thermal disposal of drill cuttings must be appropriate permits, and must also be obtained permission to release pollutants into the atmospheric air. Analysis of existing installations for thermal disposal of drill cuttings showed that as a result of heat treatment, the main secondary waste is: inert waste (sand, «inert soil», ash, etc.), water, liquid petroleum products, and products of burning oil fractions, released into the air. The resulting secondary solid product of combustion – «inert waste» in the chemical composition may contain heavy metals, which requires:

1) Availability of equipment and technologies for their extraction;
2) Additional material costs for their extraction or restrictions on the use of generated waste.

The gaseous products of the combustion of petroleum fractions may also contain heavy metals, which requires the presence of gas cleaning equipment.

**Chemical disposal of drill cuttings**

Chemical disposal of drill cuttings is based on the introduction of chemical reagents, the reaction properties of which reduce the hazardous properties of drill cuttings.

The basis of the most common technological solutions for chemical disposal of drill cuttings is washing the mass of drill cuttings with the use of surfactants, followed by cleaning the liquid from oil-containing substances and recycling water into non-productive horizons of the subsoil. For washing mud from oil, cold or hot water or water with special additives is used. This method is used to quickly clean up newly formed pollution or clean the deep layers of drill cuttings from oil pollution of any prescription.

One of the methods that ensure the dispersion of oil and improve the contact of oil-oxidizing microorganisms with pollutants is the introduction of technical detergents into the cuttings. Soil bacteria mainly inhabit the aqueous phase, and technical detergents, causing dispersion of petroleum hydrocarbons, provide the greatest contact surface area per unit mass and, accordingly, higher activity of microorganisms-destructors of oil. In addition, the treatment of oil-polluted drill cuttings technical detergents helps reduce their hydrophobicity.

The efficiency of disposal of the mass of drill cuttings by washing with surfactants and technical detergents, followed by purification of the liquid from oil-containing substances and disposal of water in the non-productive horizons of the subsoil is very low.

Drilling sludge is placed in drilling sludge barns, representing a trench with a depth of 2 to 6 m. Due to the large capacity of drilling sludge in depth, it is very difficult and inefficient to flush the drilling sludge with the use of chemical reagents: the mixing and penetration of the reagents into the depth is difficult. In this case, the chemical decontamination procedure requires multiple chemical treatment, a long time to obtain positive results of neutralization of toxic components of drill cuttings.

The use of chemical decontamination technology is also associated with the formation of waste, represented by wash water from a sludge pits containing oil products, surfactants, technical detergents. For the disposal of liquid waste, wells must be in place for pumping the pumped liquid and permitting documents.

**Physico-chemical disposal of drill cuttings**

One of the most common methods of disposal of drill cuttings is a physico-chemical method, which is based on the process of solidification (curing) of waste. Sludge neutralization is carried out by mixing in certain proportions with a sorbent and cement. As a result of this treatment, the organic substances present in the sludge are bound by the injected sorbents. In this case, the heavy metal cations contained in the sludge are converted into insoluble hydroxides. The subsequent solidification of the neutralized waste, which occurs as a result of the processes of hydration of the cement introduced into the system, leads to an even stronger binding of neutralized toxic compounds and the prevention of their subsequent dissolution under the influence of the environment.

**Biological disposal of drill cuttings**
The biological method consists in introducing biological products containing microorganisms, under the action of which the hydrocarbons of oil and oil products are oxidized to environmentally neutral compounds. The biological product can be a dry or dissolved form, depending on the type of preparation.

Biological methods are based on:

- The stimulating effect of native soil microorganisms by introducing nutrient, oxygen-containing and/or other components into the soil, which are usually added to the soil by spraying their aqueous solutions or by plowing;
- The use of biologics containing an association of specific bacterial cultures and the intensification of their vital activity.

Conclusions about the effectiveness of the disposal of drill cuttings:

- Formation of neutralized waste that cannot be applied anywhere;
- Lack of technical documentation for the neutralization process, developed and approved in accordance with the procedure established by the legislation of the Russian Federation;
- High resource intensity and cost;
- Generation of secondary waste.

Drilling sludge is placed in deep pits in conditions of high water cut, lack of access of oxygen, microorganisms, incl. oil-oxidizing, which does not allow to effectively use the mechanisms of degradation of petroleum products to environmentally friendly substances with the help of microorganisms. The introduction of biological preparations to a greater depth (1-5 m) will lead to their death or their slowed down activity, and, therefore, biodegradation of oil products will not occur, especially in the deep horizons of the sludge. Removing the drilling sludge from the sludge pits to the site for further disposal by biological methods is a costly measure that requires organizing the waste disposal facility and, therefore, obtaining permits for this facility in accordance with current regulatory legal documents in the field of waste management. In addition, the period of biological activity of biological products is limited by the temperature regime of the region. Therefore, the use of biological methods is impractical in relation to drill cuttings placed in sludge pits.

Conclusions about the effectiveness of the disposal of drill cuttings:

- Formation of neutralized waste that cannot be applied anywhere;
- Lack of technical documentation for the neutralization process, developed and approved in accordance with the procedure established by the legislation of the Russian Federation;
- High resource consumption and cost;
- Generation of secondary waste.

5.4. Use of drill cuttings (processing of drill cuttings into products for various purposes)

The use of waste - the use of waste for the production of goods (products), works, services or for energy.

Waste utilization is an activity related to waste disposal, including waste appearing at the last stage of the life cycle of any object, aimed at the production of secondary marketable products, performance of work (services) or energy generation taking into account material and energy saving, environmental requirements and security.

The use of drill cuttings is their processing, focused on obtaining secondary products – soils that can be used:

1) for construction;
2) as a fertile soil.

In practice, drilling sludge processing methods are combined, they are based on drilling sludge treatment methods used in decontamination, on the basis of which special technologies are developed for the final disposal product. The most commonly used technology is solidification, which makes it possible to dispose of drill cuttings. At the same time, the cleaned drill cuttings are mixed in certain proportions with a special sorbent and cement. As a result, toxic substances remaining in the sludge are bound by a sorbent and, during the process of cementing, become insoluble under any environmental
influences. In general, the methods of processing drilling sludge make it widely used in construction. The list of materials for the manufacture of which it is possible to use drill cuttings is as follows:

- Small-sized building products (curbs, paving slabs, cinder blocks);
- Binder mixtures used for the construction of road bases;
- Granular aggregate used in the production of concrete.

Technological solutions for cuttings processing, widely used.

**Recycling drill cuttings into the burolite mixture**

The technology of processing (use) of drilling sludge into the burolite mixture directly in the sludge pits on the territory of the pad sites. For processing used drilling sludge hazard class 4-5. Recycling of drilling sludge is designed directly in the sludge pits on the territory of the pad sites.

The following components are used to process (use) drill cuttings into a burolite mixture:

- Drill cuttings 35-70 %;
- Cement grade 400 in the amount of 10-20 % by weight of drill cuttings;
- Sand in the amount of 10-20 % of the volume of drill cuttings;
- Carbamide penoizol 10-25 % of the volume of drill cuttings.

In winter, at low air temperatures, if necessary, calcium chloride is added in the amount of 2 % by weight of drill cuttings.

The ratio of components depends on the degree of moisture of the original drill cuttings. Adding ingredients to the drill cuttings results in an increase in mass without a change in volume.

Burolithic mixture is designed to strengthen the slopes of roads, embankments of bushes, dumping the grounds of the pad sites and reclamation of sludge barns.

However, to this day do not stop the trials on the legality of the use of bourolite as a building material. Order No. 456 of Rostekhnadzor dated June 4, 2010 recognized that the burolite mixture is an environmentally hazardous material. The final direction of the use of the bouritol mixture is specified with the Customer and is consistent with environmental authorities.

**Processing of drilling sludge into the soil for the recultivation of disturbed land and increase soil fertility**

The processing of drill cuttings into soil for recultivation and fertility improvement is the process of mixing drill cuttings with peat in predetermined proportions. For the production of soil used all types of peat with a mass fraction of moisture not more than 60 %. Chalk, dolomitic flour, lime, dolomitic clay, and similar materials are used as structuring additives. As an additive that increases the fertility of the soil, humic acids are used, obtained by chemical treatment of peat. The ratio: drill cuttings / sand / peat varies in the range of 1 / 0.3-1 / 1-2, respectively.

**Processing of cuttings in a mixture of ground slime**

Ground slurry mixtures are also obtained by mixing drill cuttings with peat. The use of a mixture of ground sludge prepared on the basis of drilling waste is allowed upon confirmation of the hazard class of drill cuttings (IV or III) and the mixture (IV or V) based on biotesting.

The soil slurry mixture is a homogeneous soil-like mixture from a fluid-plastic to a friable consistency depending on the moisture content of the feedstock. Humidity freshly prepared mixture should be in the range of 40-70 %.

Conclusions about the effectiveness of processing drilling sludge into the product:

- The formation of a large amount of product that cannot be used anywhere because of low consumer properties;
- Lack of technical documentation for the neutralization process, developed and approved in accordance with the procedure established by the legislation of the Russian Federation;
- High resource consumption and cost.

Technologies for processing drilling sludge into products have become widespread as a direction for the disposal of drill cuttings. The main technological solutions for drilling sludge processing are focused on obtaining products used as a building material: to strengthen the slopes of infield roads, slopes of cluster pads.
One of the most common technologies for the processing of drill cuttings into products is the use of solidification with the formation of, for example, the «bourolite mixture» products. The use of curing technology is aimed at eliminating the negative effects of toxic components of drill cuttings by their special absorbing additives. Such an additive, for example, is carbamide penozol, which is used in the processing of brown sludge to absorb water and transfer pollutants to a stationary state. In some European countries, for example, in the UK, the use of carbamide foam is permitted subject to strict rules for the safe handling of toxic building materials. Violation of the technology of the material can lead to a sharply negative result. The cause of potential danger is an excess of formaldehyde, released during the polymerization of urea-formaldehyde foam, which creates possible risks associated with a negative impact on environmental components.

Criteria for selection of drilling waste treatment technology

Ecological substantiation of equipment, technology, materials is prepared during certification and development of project documentation to determine the nature and level of environmental impact, the equipment and technology used, as well as materials and substances used in the production, for which there are no measurements, and should include:
1) Resource-intensive and resource-saving technologies;
2) Technical indicators characterizing the level of environmental impact of products and materials used on the environment;
3) Principles and schemes of technological processes;
4) Data on the compliance of technologies with the existing requirements of low waste and non-waste specific technological processes;
5) Data on accidents of technological schemes and individual productions when using specific types of resources (energy, natural) and materials;
6) Specific indicators of consumption of natural resources per unit of output;
7) Reasonable conclusions on the methods of utilization or liquidation of products after mining;
8) Reasonable conclusions on the environmental impact assessment of the applied technical means and technologies, as well as the materials used and the resulting products;
9) Means and methods of control for assessing the environmental impact of technologies planned for implementation.
10) The characteristic levels of noise, vibration, electromagnetic and ionizing radiation, their compliance with the remote control;
11) Assessment of the effectiveness of measures for the prevention of emergency situations in specific environmental conditions when applying the recommended technologies;
12) An assessment of the environmental safety of the elimination of equipment and proposed technologies (if necessary).

6. Conclusions

The system for handling drill cuttings should include the following stages: formation, separate accumulation and collection, transportation, processing, disposal and disposal of non-utilized residues in the environment. In the current practice of most Russian enterprises, the handling of oil waste is reduced to their joint collection, transportation and temporary placement of qualitatively different waste streams, which complicates their further use.

As the analysis of the state of the problem has shown, the management of drill cuttings should include: minimization of their formation, environmentally friendly handling, their maximum division into groups already at the stage of formation to ensure the possibility of using the most rational methods of disposal or neutralization of each group of waste, the development of economically affordable and technically feasible technologies for involving waste into resource circulation.

It is necessary to develop methodological approaches that allow solving the problem of neutralizing and disposing of drill cuttings not by traditional destructive methods, but by methods of increasing consumer properties, cleaning from excess impurities and components, concentration, dehydration and other enrichment methods using waste in related areas of production.
Such approaches to the involvement of waste in the resource turnover should form the basis of the drilling waste management strategy and the corresponding technical solutions.

The results of the analysis of the existing practice of handling drill cuttings allow us to state that there is no comprehensive solution to the problem of disposal of waste from oil production, liquidation and reclamation of their disposal in the country.

This allows us to conclude that the development of scientific and practical foundations of resource-saving technologies for the neutralization and disposal of drill cuttings to ensure the environmental safety of natural geosystems is an important systemic task, which requires the development of new conceptual approaches and environmental and technical solutions.

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