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Improvement Possibilities of the Ways of the Bore Mud Sesalinization

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Abstract. During the development of the oil and gas complex in conditions of Western Siberia the acute problem raises with the bore mud recultivation. The amount of mud storage pits in Khanty-Mansiisk autonomous district reaches three thousand, analogous situation is also in YNAO. The bore muds have negative physical and chemical properties, such as ash structure, high dispersion, absence of airing, weak filtration, swelling ability, hydrophilic nature, high alkalinity and toxicity. The indicated properties are stipulated by the presence of water-soluble salts in the original soils and addition of caustic soda and soda ash into the bore muds and the following introduction of sodium into absorbing complex. The studies showed that this problem can be solved at the expense of use of phosphogypsumcoagulant which is chemical waste in combination of magnetic water. This contributes to the increase of filterability by 3-5.8 times and flow-outs of water-soluble salts. This phenomenon will allow us to create favorable conditions for the cultures- phytoameliorants during the following recultivation.

1. Introduction

Currently, active production of hydrocarbons is connected with large volumes of bore muds accumulation. It's enough to note that in conditions of KhMAD the number of non-reclaimed mud pits reaches three thousand. And analogous situation is in YNAO and some other regions. It's worth noting that the bore muds have negative physical and chemical properties which they inherit from the deep seated drill cuttings and acquired at the expense of inclusion of the series of components into the bore muds.

The necessity of scientifically grounded recultivation of lands disturbed as the result of the exploring and production of hydrocarbons is noted in the works [1, 2].

On YNAO territory the underlying rocks of the whole cryogenic stratum have certain content of water-soluble salts. Their salt content is identical to the modern sea type of salinization with the prevalence of NaCl. The sea water is characterized by constant chemical content developed during the whole geological time. Salinization mostly determines physical, thermophysical, mechanical and physical-chemical properties of the soils. The salts content and high moisture provide highdeformability, decrease of durability, pronounced plastic properties for the finely-dispersed soils. The content of water extracts of frozen and cooled soils in the groups of cations and anions obeys to the patterns $Na^+ \geq Ca^{2+} > Mg^{2+}$, $Cl^- \geq HCO_3^- > SO_4^{2-}$, typical for the sea genesis soils, reaction of water extracts is mainly alkalescent [3].

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The scientists note that the material and chemical reagents consumption for the well construction is on average (t): Alta-Mud 17,6; carboxymethyl cellulose - 2,01;ATMP - 0,17;uniflok - 0,059; caustic soda - 0,2; soda ash - 0,05 [4].

The use of caustic and soda ash in drilling fluids enhances the processes of alkalization (the introduction of sodium into the absorbing complex), dispersity, low filterabilityand airing, increased hydrophilic nature, lack of structure, high alkalinity, accumulation and retention of other water-soluble salts [5].

It is important to note that the addition of biopolymer components in the drilling fluids in combination with the above mentioned properties leads to a state of syneresis. In this case, the dispersed fractions and high molecular substances undergo changes in terms of volume reduction and compaction under the storage [6]. In natural conditions on the saline soils, in the presence of humus high-molecular compounds, a dense solonetz horizon is formed, saturated with sodium salts, with a dispersed fraction and with exchangeable sodium. Given the lack of moisture, this process has been going on for many years. This phenomenon occurs much faster in the mud pits [7, 8].

The high content of salts in the bore muds leads to the inhibition of plants. This is manifested by increase of the osmotic pressure of the aqueous solution above the critical values, the toxic effect of individual ions on plants, the disturbance of plant nutrition conditions, and also by the deterioration of the water-physical properties of the bore mud [5].

The studies aimed at improving of the bore mud basic properties have shown that this problem can be solved using a number of coagulants (gypsum, phosphogypsum, carnallite, sulfuric iron and aluminum, etc.). For the subsequent recultivaiton, it is more expedient to use the waste of the chemical industry, i.e., phosphogypsum. Its application is solved by the issue of the provision of plants with phosphorus in the first stage of reclamation. The problem with nitrogen is solved due to the use of biologicals of rhizotorphin fixing nitrogen atmosphere in the culture of leguminous phyto-meliorants [9].

Taking into account the short vegetation period in the conditions of the Far North, the processes of filtration and outflow of shifting salts are inhibited by cryospheric phenomena. To increase the outflow of salts, we have attempted to use magnetic water together with a coagulant on the bore mud.

At the present time it's proved that magnetic water increases water solubility of many salts, sometimes by several dozens of times. Therefore, magnetic water is widely used in medicine, metallurgy and for the purposes of melioration, particularly, for the flushing of saline lands. In the magnetic water the process of coagulation of solid fine particles accelerates by 2-4 times depending on the density of magnetic field and speed of water flow. At the same time the durability of aggregates stuck together increases that is rather important, for example, during the construction works [10].

Study goal: to improve the bore muds properties at the expense of increase of water soluble salts outflow from the bore mud at the initial stage of recultivation.

Study objectives: to study the filterability of the bore muds under the complex use of coagulants and magnetic water.

2. Materials and Methods

Study methodology. The study objects are the bore muds of Uvatskiy area of the Tyumen region. The determination of water extracts content for the salted soils and grounds was carried out according to OST46-52-76. Filterability of bulk samples of the bore mud in combination with the coagulant and magnetic water were stated by the tube method.

Of the five samples of mudpits, three had a salinization chemistry by the anionic chloride-soda composition and two soda-chloride.The chloride salinization is typical of the original soils. The addition of caustic and soda ash to the bore mud changes the initial chemistry of the drill cuttings and alkalizes them. In the double name of salinization chemistry, the second qualitative indicator "soda" characterizes the dominance of this anion in the composition of salts. According to the cationic type, the boremuds are referred to calcium-sodium, which also indicates the predominance of sodium and

the intensifying of salinization processes here. The solonetzicity index is determined by the amount of exchangeable sodium introduced into the absorbing complex.

General content of salts in the given bore muds ranges from medium saline (0.15 – 0.3%) to alkaline earth – more than 0.7% according to the adopted classification of soils [11].

We used the chemical industry waste – phosphogypsum as a coagulant. Its efficiency on the solonetz soils have beenprovided by the scientists of Western Siberia [4, 7, 12, 13]. In respect to the bore muds, the influence of phosphogypsum in different Russian regions wasn't studied.

Phosphogypsum is grayish-white crystallitic mass. Depending on the processing scheme of raw materials, phosphogypsum consists of dibasic or semi-aqueous calcium sulfate (dehydrate or hemihydrate), contains impurities of clay minerals, undecomposed phosphate and phosphoric acid. The chemical composition of phosphogypsum is determined by the type of raw material. For recultivation of saline soils and soils, it is advisable to use phosphogypsum dehydrate, since the hemihydrate, when stored, forms a strong monolith [14].

According to our data, the use of phosphogypsum for recultivation of the bore muds in the Tyumen region is quite promising not only from the point of view of recycling ofwaste products but also due to the properties of this product: high dispersion of the material, ensuring contact with drill cuttings, significant content of phosphorus impurities, acid reaction neutralizing the alkalinity of the bode mud [15-20]

As a working hypothesis for the acceleration of filtration and salts outflow from the bode mud in conditions of brief summer, there was suggested the possibility of use of coagulant and magnetic water. Sample of grinded bore mud was equal for all variants (40 g), sample of ameliorants were introduced into every tube increasingly with an interval of 0.2 g. Water column height of ordinary and magnetic water for every variant supported at the level of 5 cm.

Studies have shown that the absence of a coagulant didn't lead to the manifestation of a filterabilitywith both ordinary and magnetic water. The introduction of phosphogypsum in combination with ordinary water contributed to an increase in the capacity at a sample of 0.4 g. The main filtration threshold appeared when applying a sample of 0.8 g per 40 g of the bore mud. The subsequent increase in phosphogypsum doses did not increase or slightly affect the throughput of drill cuttings.

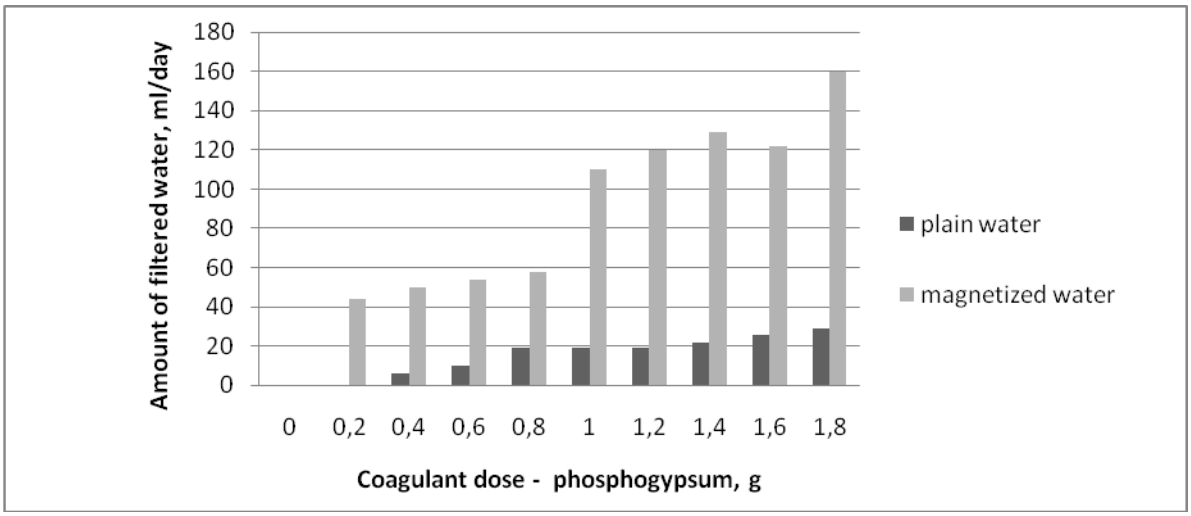


Figure 1. Influence of ordinary and magnetic water on the amount of filtrate under different sample of phosphogypsum in the tubes with the bore mud.

Use of magnetic water together with meliorant fundamentally improved filtration of the water in tubes. Even with 0.2 g sample of phosphogypsum, filtrate amount reached 44 ml a day. When using ordinary water in this variant, there was no filtration. It's important to note that the throughput capacity

increased by 3-44 times in comparison with action of ordinary water. During optimal sample of phosphogypsum of 0,8-1,0 per 40 g of soil, the filtration process increased by 3-5.8 times. In case of the mentioned meliorative effect, there is possibility of strengthening of salts flushing, including the products of exchange reactions (Na_2SO4)beyond the limits of the mud pit in case of their proper equipping for the reception of the filtrate.

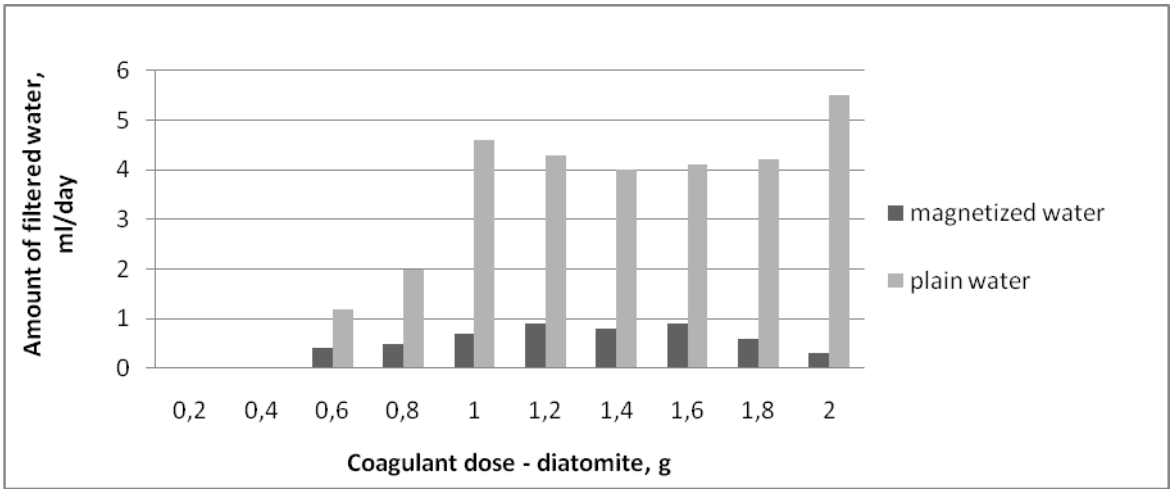


Figure 2. Influence of ordinary and magnetic water on the filtrate when using diatomite in tubes with the bore mud.

The use of natural diatomite as a coagulant on the bore muds did not show a positive meliorative effect when combined with magnetized water. On the contrary, its use was hampered by the filtration process of meliorated bore mud. This indicates that the manifestation of synergism for a specific coagulant and magnetic water requires empirical verification and theoretical justification. Calcium carbonate in the presence of soda in the bore mud contributes to the manifestation of a negative effect. It's important to note that the reserves of diatomite in the northern districts of the Tyumen region are estimated in billions of tons.

3. Conclusions

Thus, the studies have shown that the use of phosphogypsum with magnetic water on the bore muds contributes to the manifestation of high meliorative effect. This allows creating of favorable conditions for the desalination and the following recultivation. For the pumping of the flush water, the mud pit should be equipped with special container. Influence of the diatomite in combination with ordinary water is 2-3 less by the amount of filtrate. Use of magnetic water in this case didn’t lead to positive result.

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