Particularies of recultivation of bore muds on oil-gas fields of Tyumen region

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Abstract. The article reflects negative physical and chemical properties of the bore muds in respect to Tyumen region (high dispersion, swelling ability, ash structure, crust formation, low filterability, a high degree of salinization, alkalinity and toxicity). Indicated properties are mainly stipulated by the increased content of exchangeable sodium in the absorbing complex and by the presence of soda in aqueous solution. The source of absorbed sodium and soda in water extract is the use of caustic soda in the drilling mixture. It was found out that these negative properties are illuminated using coagulant in a form of phosphogypsum – waste of chemical industry. Necessity in the nitrogen for the bean cultures-phytomeliorants is provided at the expense of legume bacteria in a form of the rizotorphin formulation. It is worth noting that growing of legume bacteria in extremely salted breeding ground on the leguminous agar has allowed choosing the most salt resistant species among the numerous strains of Melilotus officinalis and medicago. The presence of phosphorus in phosphogypsum positively influences the productivity of leguminous crops in the beginning of recultivation.

1. Introduction

The authors determined that complex use of phosphogypsum, biopreparation rizotorphin and oil products, as well as peat, allows effective recultivation of bore muds in Tyumen region.

Due to the expansion of production volume, there is a concern about recultivation of the bore muds. It is known that they have series of very negative physical and chemical properties: high dispersion, hydrophilic nature, swelling ability, ash structure, crust formation, low filterability, a high degree of salinization, alkalinity and toxicity [1-2, 4-11]. Above-mentioned properties are connected with implementation of sodium in the absorbing complex. Its source is reagents used for the inclusion into content of the drilling mixture, caustic soda and sodium carbonate, as well as sodium salts secretion from geological sedimentary rocks.

Without additional intervention of a man, the bore muds are hard to subject to natural processes of stocking. For the development of natural succession in the northern conditions of Tyumen region, rather non-specific conditions develop on the bore muds. Natural vegetation grows here on the sour lands. At the same time, bore muds do not have beneficial microorganisms. The situation is such that in KhMAD it is demanded to recultivate up to 3000 mud pits. Analogous situation appears in YNAO, their number increases in the south of Tyumen region (Uvatskiy region).

The working hypothesis of these researches is based on the creation of favorable physical and chemical properties of the bore mud at the expense of application of coagulant phosphogypsum –

waste of chemical industry, elimination of sterility during the use of rizotorphin (legume bacteria of melilotus officinalis and medicago). The procedures carried out will allow obtaining optimal conditions for the growth and development of cultures-phytomeliorants.

The objective of the research is to develop the most effective methods of bore muds recultivation.

Tasks of researches: to study influence of toxicity of the salts on vital functions of legume bacteria, to choose the most salt resistant strains of legume bacteria for cultures-phytomeliorants, to study the effect of complex use of coagulants, legume bacteria and phytomeliorants on the response to recultivation of the bore muds.

2. Materials and methods.

The researched were carried out in three stages. The first stage included laboratory tests accompanied by growing of legume bacteria in breeding grounds on the leguminous agar of various chemism and degree of salinization, typical for the bore muds.

The second stage included tests on selection of the most active coagulant for the fundamental improvement of chemical and physical properties of the bore mud. These studies were carried out by the tubes method [3]. As coagulant-ameliorants, there were used natural minerals (gypsum, limestone, carnalite) and arisings (slags, phosphogypsum, cleaning of surface and artesian water). Filterability was studied during the constant weighing of bore mud and increasing weight of required coagulant. During the last stage, the authors studied the complex use of coagulant, biopreparations (legume bacteria, crude oil degraders) and phytomeliorant. The tests were carried out in Mitscherlich pot.

3. Results and Discussion.

Study of toxicity of salt breeding grounds on the leguminous agar with regard to specific legume bacteria of melilotus officinalis and medicago has shown that normal and hydrocarbon soda had the largest toxicity among all highly soluble salts (NaCl, Na_2SO_4, Na_2CO_3, $NaHCO_3$ etc.) This is stipulated by the fact that soda created increased alkalinity of this environment even under small concentrations. Neutral salts (chlorides and sulphates) are many times weaker than soda in terms of toxicity. Thus, the total death of clumps of legume bacteria melilotus officinalis and medicago in conditions of soda salinization took place under the 0.3-0.5% concentration and under neutral – 2% (fig. 1, 2). It follows thence that the main toxicity in the muds is stipulated by the adding of sodium carbonate and caustic soda to the drilling mixture, this leads to the increase of alkalinity of the medium up to 8-12 pH. The use of gypsum calcium or phosphogypsum in leguminous agar, saturated with soda, allows decreasing its toxicity and increasing the number of clumps of legume bacteria in Petri dish 5-7 times. This phenomenon indicates the obligatory use of calcium-containing ameliorant during the mastering of bore muds.

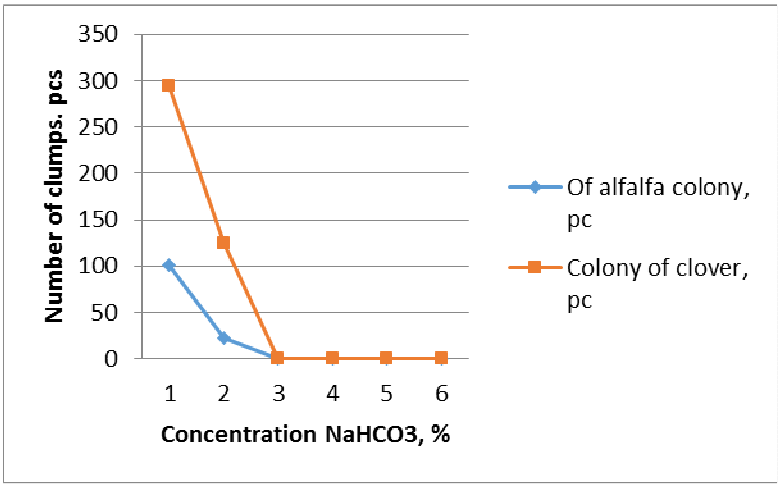

Figure 1. Change of the number of clumps of legume bacteria of melilotusofficinalis (HCP_{05}=13,00) and medicago (HCP_{05}=7,30) under the influence of salinization $NaHCO_3$

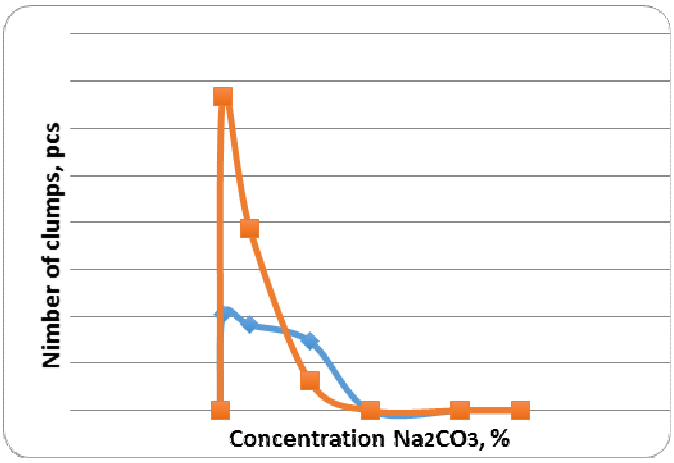

Figure 2. Change of the number of clumps of legume bacteria of melilotusofficinalis (HCP_{05}=13,00) and medicago (HCP_{05}=13,30) under the influence of salinization Na_2CO_3

Legume bacteria inoculation of the numerous presented strains on the extremely salted breeding grounds with leguminous agar has allowed us to reveal strains of melilotus officinalis and medicago with the largest resistance to salinization, 282 and 423, respectively. Inoculation of strains of these cultures on the salted media did not provide appearance of bacterial clumps on extremely salted mixtures, Determination of this pattern will allow using the most active and effective strains during the recultivation of bore muds.

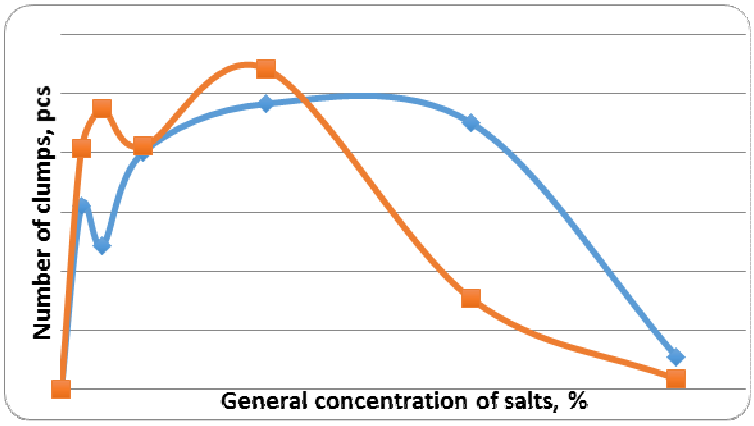

Figure 3. Change of the number of clumps of legume bacteria of medicago (HCP_{05}=15,40) and melilotus officinalis (HCP_{05}=14,40) due to the degree of chloride-sulfate salinization with gypsum

An important condition for the decrease of alkalinity and toxicity is selection of coagulant which will allow displacing exchangeable sodium from the absorbing complex of the bore mud and neutralize soda in aqueous solution. Of all studied natural and industrial coagulants, phosphogypsum proved itself more positively - phosphoric acid and phosphorous fertilizer production waste. In terms of Ural, phosphogypsum wastes are estimated at millions of tons. By its effect, it is analogous to natural gypsum, but it has certain advantage, which is phosphorus content up to 1.5-2%. This index is very important during the following recultivation of the bore muds that allows avoiding additional phosphorous fertilizers. In case of absence of phosphogypsum, coagulant filterability of the bore mud is equal to zero; it reaches maximum when up to 1-2% of bore mud is added to air-dry weight (fig. 4).

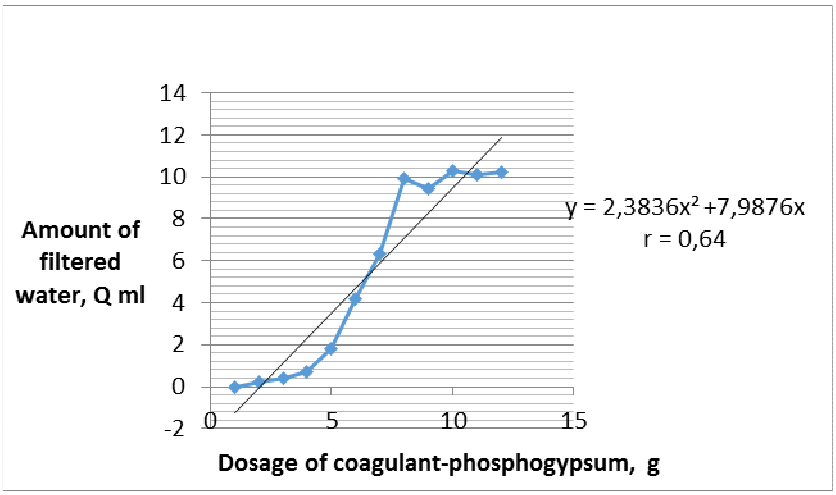

Figure 4. Filterability of the bore mud with phosphogypsum coagulant

Complex use for recultivation of the bore muds ameliorants-coagulants, bioformulations (rizotorphin and crude oil degraders), peat and cultures-phytomeliorants in vegetation trial has allowed us to determine efficiency of every method separately and in their combinations: 1. Drilling cuttings (control); 2. Drilling mud + rhizotorfin; 3. Drilling mud + rhizotorphin + oil destructor; 4. Drilling mud + phosphogypsum; 5. rilling mud + phosphogypsum + rhizotorfin; 6. Drilling mud + phosphogypsum + rhizotorphin + oil destructor; 7. Drilling mud + phosphogypsum + rhizotorphin + oil destructor + peat; 8. Drilling mud + rhizotorphin + oil destructor + peat. The studies showed that application of every method separately does not provide appropriate ameliorative effect due to preservation of other limiting factors: deficit of nitrogen, phosphorus, presence of oil, alkalinity, low filterability etc. Elimination of all above mentioned factors allows us to achieve maximum efficiency of green mass of melilotus officinalis in 2 years on average up to 203,5 - 224,5 g/vessel, with 73.2 in the control. Analogous results were received in the trials with medicago (fig. 5).

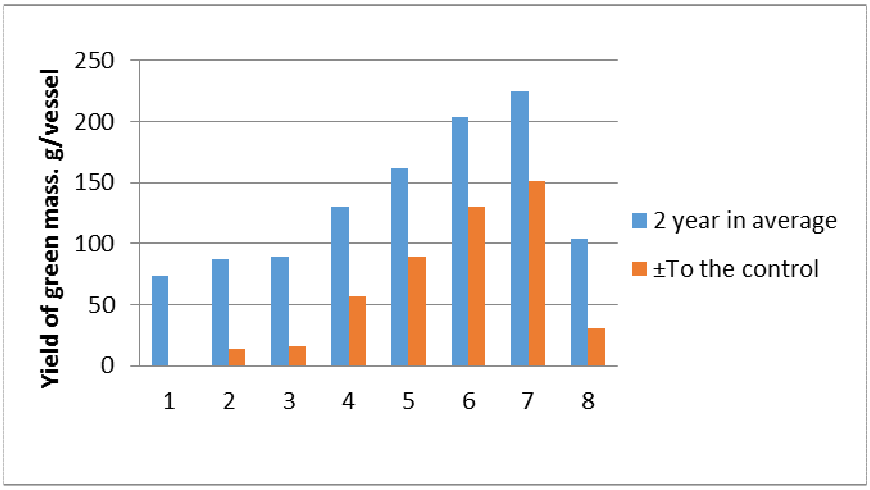

Figure 5. Influence of recultivation variants of the bore mud on the harvest of green mass of melilotus officinalis, g/vessel

4. Conclusion

Thus, biological recultivation of the bore mud in terms of Tyumen region can be reached with the complex using of salt resistant strains of legume bacteria, crude oil degrader, ameliorant-coagulant in a

form of phosphogypsum, peat and cultures-phytomeliorants. In case of absence of peat, the listed procedures can be also used in complex.

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