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Gas-Liquid Mixtures for Drilling Method (With Foam)

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Abstract: *In the current conditions of exploration, it is necessary to solve complex problems not only for the detection and assessment of ore deposits in new territories by conducting geological survey, prospecting and appraisal work by mobile field geological teams, but also tasks related to the production of exploration work in the most difficult conditions difficult to access. sites and lack of stable electricity and water supply. The indisputable advantages of using wellbore are the ability to drill wells in conditions of strong loss of drilling mud, a high degree of cleaning the bottom of the well from cuttings, lubricating and inhibiting properties. At the same time, there are a number of limitations for the widespread use of gas wells - these are difficulties in drilling unstable and fragile formations, as well as intensive mineralized water inflows. Taking into account modern requirements, the experience of the world's leading companies and our own developments, a schematic diagram of modern drilling technology with the use of gas wells was proposed. The use of gas-liquid mixtures at treatment facilities will intensify the process and increase drilling operations.*

Keywords:gas-liquid mixtures, polymer gel, kamgil, PAA, slimy liquids, PBMB-A type bentonite powder, soda ash, NQ and HQ complex and table salt.

INTRODUCTION

Basic concepts and areas of application of gas-liquid mixtures (gas-liquid mixtures (gas-liquid mixtures) have been used in world drilling practice as cleaning agents for about half a century. During this time, the technique and technology for the use of gas wells in drilling wells has received significant development, and the introduction of gas-liquid cleaning agents with low density and heat capacity contributed to a significant improvement in the technological processes of well drilling.

As domestic and foreign practice has shown, well drilling systems provide a significant increase in ROP and reduce the time spent on eliminating geological complications, which sharply increases the productivity and economy of drilling operations. Gas-liquid agents include mist, foam, and aerated liquid. They are multiphase dispersed systems, the physical and chemical properties of which depend on the volume ratio of the liquid and gaseous phases in the mixture, on the type and concentration in the liquid phase of surfactants (surfactants), foaming agents, chemical reagents, as well as stabilizing, inhibiting, lubricating and etc.

additives, which allows you to adjust these properties in a wider range of values than when using water-based drilling fluids. Thanks to this, their use is effective in the most unfavorable conditions for liquid flushing. So, only GZhS, having a low heat capacity, can completely avoid the difficulties of drilling wells in permafrost conditions.

The ability to control the density of wells allows you to regulate the backpressure on the reservoir, equalizing it, if necessary, with the pore pressure in the reservoir, and thus, to prevent or reduce to a minimum non-productive time spent on eliminating geological complications when drilling wells in conditions of partial or complete losses of drilling fluid. The ratio of phases in dispersed systems "liquid-air" during drilling is usually characterized by the degree of aeration as much, which is the ratio of the flow rates of gas Vr- and liquid Vzh at atmospheric pressure, i.e.

already = Vr / Vzh.

At as much as <50, the dispersed system is an aerated liquid, at as much as 50 ... 300, it is a foam, and at as much as> 300, it is a fog. For foams, the foam ratio ß is sometimes used. The foam ratio ß is estimated by the ratio of the foam volume Vcm to the volume of liquid Vzh in it, i.e.

ß = Vcm / Vzh.

In foreign practice, GJM is assessed by the Mitchell quality index (KP), which is the ratio of the gas volume Vr to the foam volume Vcm, determined at a specific pressure and temperature, i.e.

KP = Vg / VsM.

At KP from 0 to 0.52, the GLC exhibits the properties of a Newtonian fluid, and at KP from 0.52 to 0.99, the properties of a Bingham plastic fluid.

A significant difference in the properties of gas wells depending on the gas-containing mixture determines the specificity of their application in drilling practice.

METHODOLOGY

The main area of application of fog is drilling blast holes in open pits, exploration wells using pneumatic hammers, as well as engineering-geological and seismic wells. Foams are used in drilling practice as a very low density cleaning agent for cleaning wells from cuttings under lost circulation conditions,

for combating collapses arising during drilling with blowdown in water conditions, for workover of production wells, opening up layers with low reservoir pressure, drilling in permafrost. Aerated solutions are used for drilling both exploration and production wells in conditions of strong flooding, wall collapses, and absorption of drilling fluid.

The greatest effect from the use of GZhS is achieved in areas where permafrost is spread, in drained sections, in anhydrous, desert, high-mountainous and other regions where the delivery of aqueous solutions is associated with great difficulties and costs.

The area of rational application of GHM in drilling wells is constantly expanding, extending to a wide variety of geographic areas and mining and geological conditions. The technique and technology of using gas wells during well drilling is constantly being improved. New varieties of the method are emerging: pneumatic percussion drilling with foams, drilling with the use of gas-liquid percussion machines (GZHUM), drilling with fog and foam using double concentric drill pipes, etc.

Leading universities, specialized research organizations, pilot batches of new equipment from many industrial geological organizations in Russia and the CIS countries took part in the development of drilling techniques and technologies in exploration wells with bottomhole cleaning of gas wells together with VITR and its Irkutsk branch.

ANALYSIS AND RESULTS

Compressor booster devices (KDU) based on mud pumps for generating and injecting aerated solutions and foams into the well, foam generators (CCGT) for compressor feeding of foam and fog into shallow wells, various dosing devices were developed and introduced into the practice of exploration work. foam generators, wellhead sealants, foam breakers, check valves for equipping a drill string, compositions

foaming agents, devices for controlling the flow rate and quality of gas wells, recommendations on the technology of drilling wells with the use of gas wells both by a coreless method and with coring. A great deal of experience has been accumulated in drilling with the use of gas wells in various climatic and geological and technical conditions. Drilling was carried out in rocks of I-XI categories in terms of drillability, both continuous and annular face with the use of all types of rock cutting tools: various types of bits and carbide bits, diamond bits with natural and synthetic diamonds. For core sampling, single and double core pipes and SSK complexes were used.

The greatest depth of drilling with horizontal wells - 2600 m was achieved in one of the wells drilled in the Norilsk ore region. The technical and economic indicators of drilling with the use of hydraulic well-logging systems, depending on the specific geological and technical conditions, the depth of the well and the drilling method, were, of course, different, but they all significantly exceeded the indicators obtained when cleaning the bottom with various types of solutions. With the advent of the possibility of using gas wells, geological exploration received an effective method for improving the technological processes of drilling wells, which was already widely used in the industry in the second half of the 80s.

Properties and formulations of GZhS, Basic concepts of surfactant-foaming agents

The PAB molecule consists of a hydrophobic part and a residue capable of hydration - a hydrophilic group. Hydrophilic groups in the surfactant molecule can be carboxyl, sulfate, hydroxyl, sulfonate, polyester, repeating groups containing nitrogen and other elements. The hydrophobic part includes hydrocarbon radicals, aromatic, cyclic and mixed groups. A surfactant molecule can simultaneously consist of several hydrophilic and hydrophobic groups, the same or different from each other.

Due to this structure, surfactant molecules, when dissolved or dispersed in a liquid, are sorbed at the interface, exhibiting a number of defining properties: the ability to lower the surface tension at the liquid-gas and liquid-liquid interface, form molecular aggregates (micelles) at a certain concentration of the substance, and stabilize water-insoluble compounds.

Surfactants from the point of view of their dissociation in aqueous solutions are divided into anionic, cationic and nonionic, as well as amphoteric (ampholytic).

Anionic. The surface activity of these substances in solutions is due to anions. Anionic surfactants include alkali salts of fatty acids (soaps), alkyl sulfates, alkylaryl sulfonates of alkali metals, etc.

Cationic. The surface activity of these substances is determined by cations. This class of compounds includes amine salts, quaternary ammonium salts, alkyl pyridine salts.

Non-ionic. In aqueous solutions, these substances do not dissociate into ions. Their solubility depends on the affinity of functional groups for water, and their surface activity is due to the diphilic structure of the molecule. Such substances include oxyethylated fatty alcohols and acids, oxyethylated phenols, as well as oxyethylated amides, amines.

Amphoteric or ampholytic. These substances, depending on the pH of the solution, can exhibit anionic properties (alkaline medium) or cationic (acidic medium). Alkylamino acids, sulfite betaines, some polydimethylsiloxanes and some other substances have similar properties.

DISCUSSIONS

When studying the electrical conductivity of solutions of detergents, it was concluded that in their aqueous solutions, along with ions and molecules, there are large charged aggregates - micelles. The phenomenon of micelle formation is inherent in all groups of surfactants.

A change in the structure of the solution associated with the formation of micelles occurs when a certain concentration of the substance is reached, which is characteristic for each type of surfactant and is called the critical concentration of micelle formation (CMC). In the CMC region, the properties of surfactant solutions change dramatically: surface tension, electrical conductivity, density, and detergent effect.

Foaming agents are divided into two types by their ability to produce stable foams.

Foaming agents of the first kind. These are substances (lower alcohols, acids, aniline, cresols), the molecules of which in the volume of the solution and in the adsorption layer are in a molecularly dispersed state. Foams with first-class blowing agents disintegrate rapidly as they flow between the film liquid. The stability of the foams increases with increasing concentration of the foaming agent, reaching a maximum value until the saturation of the adsorption layer, and then drops to almost zero.

Foaming agents of the second kind (soaps, synthetic surfactants). These substances form colloidal systems in water, the foams of which are highly stable. The outflow of inter-film liquid in such metastable foams stops at a certain moment, and the foam frame can persist for a long time in the absence of the destructive effect of external factors (vibration, evaporation, dust). Such systems have a potential energy barrier that resists destruction and provides the system with a state of equilibrium.

CONCLUSION

The stabilization of the foaming agent films is due to the following factors: kinetic action, which is reduced to slowing down the thinning of the films, an increase in the structural and mechanical properties of the adsorption-solvation layers, and also by the thermodynamic factor (wedging pressure).

In a number of studies it was found that an increase in mixing and the degree of saturation with oxygen in the air of the sludge mixture is achieved by a combination of coarse-bubble and fine-bubble aeration.

This promotes the breakdown of activated sludge flakes into smaller fractions, increases the rate of supply of nutrients and oxygen to the microorganism. Due to intensive mixing, in which the activated sludge is in suspension, turbulization of the gas-liquid mixture is achieved, ensuring uniform distribution.

In addition, the results of the study and the calculations performed showed that the developed laboratory bench can be used to vary the gas content within a fairly wide range (from 0 to 87%). This fact increases the field of application of the installation and allows it to be considered universal, since the mixtures obtained on it can be used both to improve the quality of drilling operations.

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