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# Application of Insulating Gels in Highly Mineralized Petroleum Waters

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**Abstract:** It is known that oil reserves in any oil fields are limited. As a result of continuous oil extraction, the amount of oil in the fields decreases and the amount of water increases. As a result, the percentage of water in the oil liquid extracted from wells increases to 90-95%, and the volume percentage of oil decreases to 10-5%. Due to the costs of separating water and oil and cleaning them, some wells do not produce economic results despite the quantity of oil.

**Key words:**

It is known that oil reserves in any oil fields are limited. As a result of continuous oil extraction, the amount of oil in the fields decreases and the amount of water increases. As a result, the percentage of water in the oil liquid extracted from wells increases to 90-95%, and the volume percentage of oil decreases to 10-5%. Due to the costs of separating water and oil and cleaning them, some wells do not produce economic results despite the quantity of oil.

Using the proposed hydrogels, it is possible to increase the amount and percentage of extracted oil by blocking the water path in the productive layer of oil wells.

Hydrogel production in the world is more than 300 thousand tons per year. The main producers are USA, France, Japan, Germany, Turkey. The need for products in the domestic market of the republic is 35-40 thousand tons per year. Our republic has all conditions for hydrogel production. The main raw materials are GIPAN, PAA, KMC, cellulose, starch, dextrins [1-3]. According to the latest data of "Navoiyazot" production association, 7000-7500 tons of K-4, PAA-1500 tons, "Fergonazot" 2500 tons of K-4 are produced per year. If we take into account the possibility of using KMC (more than -100,000 t), cellulose (waste - lint), starch and the average working life of hydrogel is 3-4 years, raw materials for hydrogel production will not be a problem . Relevant tasks are the application of new technologies for oil production, which can significantly increase the level of oil production of already developed reservoirs,

Worldwide, interest in improved oil recovery methods is increasing year by year, and research is being conducted to find a science-based approach to selecting the most efficient oil recovery technologies. Recently, polyelectrolytes are being synthesized on the basis of gels. Some polyelectrolytes are valuable superabsorbents and are used in many fields. Such polyelectrolytes have a strong selective effect. For this reason, they are widely used as ionites.

The creation of rubber and other material compositions with hydrogels has further expanded the field of application of gels.

## Limitation of infiltration of formation water

Limiting the flow of water to the bottom of the used well is one of the most important problems in the system of measures to increase the efficiency of oil field development and increase oil production. In wells that use several productive layers at the same time, irrigation occurs unevenly - water passes through more permeable layers and intermediate layers.

In most cases, the flow of water through such layers is so strong that the well seems to be completely flooded. Under such conditions, uneven development of individual layers occurs. Groundwater damage to the normal operation of mines and wells is not small. It is drawn into the depth zone in the form of a cone and enters the well through the lower holes of the perforation interval of the operating column.

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Premature watering of the wells (not related to the full development of the reservoir) reduces the final oil production, leads to high costs of removing the bound water and processing the oil product.

The variety and complexity of oil well irrigation methods make the problem difficult to solve, which is exacerbated by the lack of reliable methods of determining the methods of water entry into the well. In the conditions of the complex geological structure of oil fields and formations, various forms of water flow are observed:

bottom water withdrawal (the formation of an irrigation cone);

due to the forward movement of water along the most permeable layers of a layer (the formation of flood tongues);

at the expense of primary irrigation of highly productive layers when two or more productive structures are combined into one development object;

in a ring of poor quality cement. In this case, the wells are filled with both water from the production reservoir and water from the upper and lower aquifers.

In recent years, the oil industry has increasingly focused on finding ways to limit the flow of water into the bottom of oil wells. Methods of restricting the flow of water into wells are divided into selective and non-selective depending on the nature of the effect of the injected water on the permeability of the oil-saturated part of the formation opened by perforation.

Selective isolation methods (SMI) are methods that use materials injected into the entire perforation of the layer. The resulting precipitate, gel or hardening agent increases the filtration resistance only in the water-saturated part of the formation, and clogging of the oil part of the formation does not occur. No need to re-pierce with SMI.

Taking into account the mechanism of formation of impermeable masses, five selective methods can be distinguished:

1. Selective insulation methods based on the formation of a waterproof mass that is soluble in oil and insoluble in aqueous media. It is recommended to use materials such as naphthalene, paraffin dissolved in aniline, creosol, acetone, alcohol or other supersaturated solutions of solid hydrocarbons in solvents. It uses viscous oils, emulsions and other petroleum products, insoluble salts and latex.

2. Selective isolation methods based on precipitation formation in water-saturated zones with the help of reagents poured into the reservoir. It is proposed to pump inorganic compounds such as $FeSO_4$, $M_2SiO_3$ (M - monovalent alkali metal), which react with each other in an aqueous medium, forming iron oxide hydrate and silica gel. A stronger mass is formed by organosilicon oligomers, which have a long-term effect.

3. Methods based on the interaction of reagents with formation water salts. It is based on methods of restricting the movement of water in the reservoir using high molecular compounds such as derivatives of polyvalent metals $Ca^{+2}$, $Mg^{+2}$, $Fe^{+2}$, etc., cellulose and acrylic acids. In contact with the above cations, several copolymers of polyacrylic and methacrylic acids with high hydrolysis precipitate from the solution. In the oil environment, they retain their original physical properties and thereby ensure the selectivity of the effect on the reservoir saturated with oil.

4. Methods based on the interaction of the reagent with the surface of rocks covered with oil. This group includes water flow restriction methods using partially hydrolyzed polyacrylamide (PAA), acrylamide monomers, hypanoformaldehyde mixture (HFS), and others. The mechanism of this method depends on the mineralization of water, the molecular weight of the polymer, the degree of hydrolysis and the permeability of the porous medium. The residual resistance value in the oil-saturated part of the rocks is lower than in the water-saturated part. This is explained by the affinity of polyacrylamide particles to organic oil compounds. In addition, as a result of the presence of hydrocarbon liquid at the interface, the conditions of adsorption and mechanical capture of polymer particles by rocks in the oil-saturated part of the formation deteriorate.

5. Methods based on hydrophobization of the rock surface of the depth zone using surfactants, carbonated liquids, polyorganosiloxanes and other chemical products. A common mechanism is hydrophobization of rocks, which leads to a decrease in the phase permeability of the rocks to water,

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as well as the formation of gas bubbles that easily disappear in the presence of oil. Nonselective isolation methods are methods that use screen-forming materials that do not degrade over time under reservoir conditions, regardless of whether the medium is saturated with oil, water, or gas. The main requirements for non-selective isolation methods are the precise selection of the cut-off interval for treated water and the exclusion of a decrease in the permeability of the effective oil-saturated part of the formation.

**The mechanism of water isolation is as follows:** due to the solubilizing effect of the micelles formed in the foam system (colloidal solution), the dispersion of clay substances, paraffin, asphalt-resin substances that close the collector and their subsequent removal during the development of the well cleaning the depth zone. Ushbu jarayonning asosiy natijasi past o'tkazuvchanlik interlayerlarini ishlab chiqishda ishtirok etishdir;

blocking of water movement paths as a result of sticking of gas bubbles to the surface of water-conducting channels and the formation of films from colloid-dispersed compounds;

isolation of high permeability zones of the productive layer, which is the main source of irrigation.

Areas of effective application of foam systems: low and medium layer pressure; production of unlimited watered products from wells; clearly expressed heterogeneity of interlayers; the presence of mud traces on the walls of the well; presence of clay cement in terrigenous rocks.

**Improving oil recovery methods**

Currently, dozens of different methods (primary, secondary, tertiary) of influencing oil fields and increasing the level of oil recovery are being studied and put into production practice. Modern methods of increasing oil recovery are based on flooding to one degree or another. Among them, four main groups can be distinguished:

- hydrodynamic methods - methods of cyclic flooding, changing the direction of filtration flows, creating high injection pressure, forcing liquid, as well as influencing the deep formation zone;
- physical-chemical methods - flooding using active compounds (surfactants, polymers, alkali, sulfuric acid, carbon dioxide, micellar solutions);
- gas methods - water-gas cyclic effect, replacement of oil with high-pressure gas;
- thermal methods - moving oil with heat carriers, processing in a steam cycle, burning in place, using water as a thermal solvent for oil.

The use of oil extraction methods is determined by geological and physical conditions. Known methods are characterized by different potentials for increasing oil production (from 2 to 35% of balance reserves) and different factors of their application. The following methods can be considered the most promising for deposits with low-viscosity oils developed using flooding: hydrodynamic; use of steam for deposits with carbon dioxide, water-gas mixtures, micellar solutions and high-viscosity oil; burning inside the reservoir. The remaining methods are mainly used to stimulate oil production and regulate the production process.

Modern methods of oil extraction have been widely used and tested since the 1970s. In general, physico-chemical methods of covering oil reserves account for 50% of the total application volume, thermal 40% and gas 10%. Practice has shown that the use of improved methods of oil recovery is 7-10 times more expensive than flooding. Therefore, their profitability is determined by the price of oil. However, taking into account the increasing demand for oil in the future and the tendency to save oil and improve the efficiency of its use in all areas of limited resources, intensive search for alternative sources of fuel and raw materials; oil recovery methods are widely used.

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