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Development of High-Viscosity Oil Fields with Unconventional Methods

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ABSTRACT: Some data is provided on the geological structure of deposits with high-viscosity oil and the conclusion of laboratory studies on the chemical composition of core samples from the Surkhandarya oil and gas region. According to these laboratory results, it is recommended that electrical exposure technology be used to increase the productivity coefficient of high viscosity oil well boreholes.

KEY WORDS: reservoir, high-viscosity oil, development, viscosity, temperature, electrical impact, pressure, effect, porosity.

I. INTRODUCTION

In recent decades, the human demand for petroleum products and for oil itself has increased significantly. Based on this, it is necessary to find the best way to select oil. Every year, new wells are drilled, new deposits with oil and gas reserves are discovered. Overall, the world's reserves of oil and gas fields are becoming less and less, but the development of deposits with high-viscosity oil remains not deeply studied. Our task in this article is to explain the details of the study and application of methods of exposure to high-viscosity oil deposits.
As you know, it is impossible to extract most of the oil from the subsurface. From the total stock of the product, using all possible methods to date, only 10% to 45% of them can be extracted. This is due to environmental factors and the physical properties of the product itself. [1]

A. EXTERNAL FACTORS.

The main external factors include the layers surrounding the reservoir, reservoir water, and the reservoir itself. They create pressure that exerts a dynamically uniform pressure on the product in the collector. In addition, the porosity and permeability of the reservoir are important. By chipping, the product will be contained in these porosities and during production and migration will move along the microchannels and cracks to the bottom-hole zone of the production well.

B. PHYSICAL PROPERTIES.

The main physical properties of the product are determined by the viscosity and density. But in addition, there are other physical properties that lie deeper on the basis of viscosity and density, explaining the aggregate states and their transitions (changes) under the influence of temperature and pressure, their components and concentrations (components of hydrocarbons).

The process of oil production is divided into 2 stages-natural and artificial. In the first stage, under the influence of the surrounding layers, which put pressure on the reservoir, or rather on the product inside them, the fountain method is obtained (extraction using the natural energy of the layers) the most effective method at the lowest cost maximum income. After the natural energy is exhausted, an artificial pressure is created by pumping water under the reservoir or gas into the gas cap. When this method also becomes ineffective (and this is because the rocks (layers) are not sealed and with the loss of the product, the balance is more and more disturbed. In addition, since water is a strong solvent and given that underground water has a current, the energy that is given by injection is carried away with the flow of water and into the remaining cracks and channels. Only a small part of the energy affects the product, and

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then in cases where the injected water is in sufficient concentration. Another problem is the problems and difficulties that arise due to the physical properties of the product, the main of which is the viscosity.

Viscosity – the ability to resist movement. When the product is in the porosities or moves through micro channels, it sticks to the walls, thus some part of the product remains in the porosities and in the channels (the higher the viscosity, the more remains), in addition, the product that adheres to the walls closes the passage and provides resistance. The viscosity depends on the composition of the product and the conditions of its occurrence.
The more heteroelements (sulfur, nitrogen, oxygen, etc.) in the product, the thicker and more viscous it is.

The more aromatic and naphthenic hydrocarbons, the greater the molecular weight and the greater the viscosity.

The viscosity depends on the temperature – the higher the temperature, the lower the viscosity. The value of the inverse viscosity is called-fluidity. Due to the viscosity of the product and reduced oil recovery. To solve this problem, the bottom-hole area is treated with chemical reagents, alkalis and acids, etc. They act as soap on the dirt on the surface of the body (separate and conduct dirt and oils from the state of viscosity to fluidity only in the form of separate fragments), and the product on the similarity of this dirt, chemical reagents and acids separate it from the walls of the channels turning it into separate small systems, and reagents surfactants that prevent sticking to the surface, thereby canceling the resistance to water pressure.

In addition to chemical, there are thermal effects on the formation. Mainly to increase the pressure and reduce the viscosity. By chipping under the influence of temperature and water, the product expands thereby increasing the pressure and with increasing temperature, the viscosity of the product decreases, and under pressure flows to the surface.

II. MATERIAL AND METHODS

All various objects and substances consist of molecules, and those in turn of atoms, which determine the physical and chemical properties of substances. Layers, for example, consist of a collection of numerous molecules, mainly those that are normally in a solid state. Therefore, the product itself consists of molecules, but with a more specific composition (hydrocarbons).

As is well known, all atoms are made up of protons, neutrons, and electrons. An electron rotates around a nucleus (a positively charged proton and an electro-neutral neutron), only hydrogen (the most important component in oil and gas) has a nucleus consisting of a single proton. As for hydrogen, this element is the main fuel or the fuel component.

The bond between the atoms in the molecules is due to the electromagnetic interaction, as is the bond between the electrons and the nucleus.

Temperature affects the electromagnetic coupling in substances (to their mutual attraction and repulsion). This can have the opposite effect. Using electricity to affect the temperature change. More precisely, using charges (positive and negative) of electricity. In fact, it will be a huge electromagnet, acting on the layers and the product, increasing the temperature and for one will act as a surfactant.

Let us explain the reason for the oil sticking to the walls of porosities, micro channels. When the temperature changes, the degree of viscosity changes, all the fault is the electrostatic charges of substances in our case of the product and the rock. In saturated hydrocarbons, due to the greater amount of hydrogen, there is less attractive interaction with the rock and more repulsive, this depends on the free charged particles and the various interactions between them. In addition, the molecules of saturated hydrocarbons are more active (in motion). In addition, paraffin's (with significantly more carbon) are heavier than and have an enhanced interaction with the rock (attraction). Due to the small amount of hydrogen (the main source of the movement of the hydrocarbon molecules), the repulsion is less. In addition, paraffin's interact with each other, which increases the need for pressure exponentially.

The best way to affect heavy hydrocarbon products is through temperature. The temperature increases the repulsive effect in the product (i.e., from the rock and from each other). Paraffin's in the same number, under the influence of temperature, the paraffin molecules begin to repel each other (the source of which is thermal energy), accelerating in motion, thereby passing into a fluid state. This does not mean that the interaction of attraction of charges weakens just the force of the interaction of repulsion becomes greater relative to external conditions. However, in the conditions of lying underground, the temperature and as high as the pressure, they are narrowly interrelated – the higher the temperature, the greater the pressure. Still, the product is difficult to get. It is all the fault of the pressure they are connected to each other by the chip. A product under high pressure will not change its state due to temperature (will change, but not sufficiently) if it is under pressure. To have an effect, you need to increase the temperature, which will violate the proportionality of pressure and temperature.

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In addition to the thermal effect, there is a more effective way – chemical effect. This is done by adding chemical reagents, acids and alkalis to the composition of the injected water. Their main task is to clear the channels from obstacles that hinder, or even block, the movement of the product. Chemical reagents, alkalis and acids affect the substance by electromagnetic interaction, which destroys its structure and gives it other physical properties.
It all depends on the charged particles and their concentration. As you know, charges with the same signs repel, and with different signs attract. Taking into account everything that concerns oil and its basis at the quantum level, it is possible to use the charges themselves directly to change the properties of the product and the reservoir, thereby increasing oil recovery.

A. INCREASING OIL RECOVERY BY EXPOSURE TO ELECTRICITY.

It is difficult to directly affect the charges directly inside the atom, and there are no technologies available in the industry for this yet. Nevertheless, the principle of operation itself can be used namely, to use the mutual attraction of different charges and the repulsion of the same ones. In fact, turn the field into an artificial magnet (layers), or apply the same principle on a smaller scale for one or a group of wells. To do this, you need to charge the rock (layer) surrounding the product with a certain charge (-) and then gradually charge the product with the same (-) charge. Then there will be their mutual influence (of the formation and the product) in the form of repulsion from each other. In fact, this will not manifest itself clearly, but the change will still be in the form of an increase in pressure, which is quite good, and the greater the quantitative volume of charges in the reservoir and the product, the greater the pressure and the greater the oil recovery. This is the most basic way to increase oil recovery using electricity. You can use a more advanced technology by charging the well (and together with the bottom hole zone of the well) with the opposite charge (+) creating an attractive force. This can reduce the production time at times and decently increase oil recovery.
Based on this principle, the following results can be obtained in the fields

- Increase in pressure.
- Cleaning of the bottom-hole area.
- Cleaning of micro channels.
- Effect on the viscosity.
- Savings during development.

B. ELECTROMAGNETIC IMPACT

Today, it is necessary to use non-standard methods of increasing oil recovery, characterized by increased manageability, energy efficiency and environmental friendliness, both at the late stages of development of fields with difficult to recover oil reserves, and at the early stages of development with physically determined difficult to recover reserves. For hard-to-recover oil reserves, due to geological features of occurrence, expressed in the macro-heterogeneity of reservoirs, multiple water-oil contacts, faults, tectonic screens, controlled physical impact on filtration processes will allow targeting areas with residual reserves. For fields with physically determined displacement difficulties caused by high oil viscosity, rheological properties, and a high proportion of micro capillaries, direct long-term action on fluids is required to stimulate filtration processes by reducing viscosity, shear gradient, and capillary forces.

Electromagnetic force (EMF) – the effect exerted by the vibrations of waves of different ranges in order to influence the oil-containing reservoir and reservoir fluid, to change their properties, which will affect the additional extraction of oil. The performed laboratory studies of scientists of the Tyumen Industrial Institute revealed that the impact of electromagnetic waves on the reservoir model and reservoir fluid significantly increases the parameters of the reservoir's filtration and reservoir properties and contributes to additional oil recovery. When the electrolyte (salt solution) was injected into the reservoir model, a multiple increase in the effect was observed. The salt solution increases the temperature in the productive reservoir under the influence of an electromagnetic field, because it is a good conductor of electric current. An increase in the thermal effect, especially in the near-bottom zone of the formation, provokes a decrease in the viscosity and purification of heavy hydrocarbons from the pore space of the formation under the influence of pressure. There is also an almost complete reduction in the filtration potentials of static electricity, which occur in oil-containing reservoirs and prevent the flow of oil. Being in the field of action of an alternating electric field, clusters of liquid hydrocarbon molecules begin to oscillate with a frequency that depends on the source, and electricity. This leads to a decrease in the viscosity of the oil, which contributes to an increase in production

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III. THEORY

Electrical processing is a fairly well known method of processing the bottom-hole zone. This method is not widely used due to its lack of knowledge, according to the cleavage after electrical treatment in some wells, the flow rate increased by two, and some decreased. The bottom-hole zone is treated with electric charges by connecting electric cables to the casing (to one casing + cable to the other -).

After connecting the cable and turning it on, the charges rush along the casing string, but because the cement conducts electricity, most of the charges go into the ground and the part that has reached the bottom zone rushes to the opposite charge and thus a kind of chain is obtained (columns, energy source, and earth). It is due to the loss of charges on the way to the bottom-hole zone in the ground, it takes some time for enough charges to accumulate in the bottom-hole zone and only after that, there will be an effect. However, in deep wells, it takes longer for the charges to reach the bottom hole, but the deeper the well, the more likely it is that the charges will go into the ground. The figure below shows a diagram of wells (operational with zero-phase connection and three wells with connected phases with voltage). Electromagnetic lines of electric charge circulation are shown from the surface. These charges will interact with the product and direct them to the production well.

However, more important is the layers themselves, since different layers have different chemical compositions that interact with electricity in different ways. Some layers pass electricity well, and some reflect and there are some that can hold a charge. For the application of electrical treatment, it is necessary to study the layers and their degree of interaction with electricity, i.e. to find out the result of chemical analyses of the laboratory on the composition of oil and the productive formation. Only after that, you can make the layout of the electrical treatment.

In this drawing shows the location of the wells - the black dots of the well, to which the cables (+ and -) are connected and they act as electrodes (conductors) to the productive reservoir.

Triangles – Producing wells, you can connect the zero phase to them, or you can connect nothing. Point wells with connected cables will begin to interact with each other and the product in this area begins to actively move and circulate. As a result, the circulating product passes through the bottom-hole zone (for this purpose, a point well is located in the center of the producing wells) and thus increases oil recovery. Depending on the breed, or rather on their degree of interaction with electric charges, the flow rate will increase from 20 % to 100%, or even more. Unfortunately, sometimes it can be the other way around due to the lack of knowledge of the rocks and their properties.

The very principle of electrical processing is the interaction of charged particles with the product and the rest of the matter between the columns and in the area of the bottom zone. In conventional electrical processing, as they say, an electrical cable is connected with one pole (+) to one column, and to the other (–) pole. You can give one example to this: to household soap on both sides, we prick two nails and connect to them, respectively, + and-wires connected to the power supply (electricity). After a while, the soap begins to melt from the inside, increasing the pressure, due to the electric charge that occurs between the nails and as a result, the soap explodes. The same principle applies to the electric robot, but on a larger scale. Due to the electric charge between the columns, the temperature and pressure gradually increase. In addition, as mentioned above, the columns, the product and the earth begin to act as a single mechanism, i.e. two wells work as one with a single bottom-hole zone. Under the influence of electricity, the product in a single bottom-hole zone goes into an excited state (more active). The hydrocarbons themselves may not conduct electricity, but still the temperature acts and the product is located in channels and porosities that interact with electric charges. In addition, the product contains a certain amount of metals. All this together increases oil recovery.

IV. CONCLUSION

Therefore, the high pressure and low temperature under the conditions of the product occurrence in deposits with a high salt content in the reservoir water and the physical and chemical properties of the product itself will provide the necessary coefficient of electrical conductivity and a parallel effect on the activation of heavy hydrocarbons.

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