High Viscosity Oil Development Technology

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Abstract: The development of hard-to-recover reserves is now becoming a prerequisite for a successful oil business. Nevertheless, there is still no consensus on what reserves should be classified in this category and what benefits should be received by oil industry workers during their development. At the same time, it is the improvement of the tax system that can spur the development of new technologies for the extraction of “complex” oil and ensure the profitability of its production.

Keywords: Well, formation, filtration, hydraulic fracturing, abnormally high pressure.

INTRODUCTION

Introduction. At present, a lot of attention is paid to the problem of development of non-traditional energy sources, which include shale hydrocarbons - oil, gas.

MATERIAL AND METHODS

According to domestic and foreign researchers [1-3], shale oil is found in layers of rocks inside the shale formation, abroad it is the Bakken formation [4], in Russia - Domannikov, Bazhenov's formation [5]. Significant their spread over the area in the context of the "main" oil and gas provinces, necessitates their large-scale production. In particular, according to some estimates, the prospects for production by 2030 should be about 70 million. t [6].

In the central part of the West-Siberian platform shale oil deposits are expected to be on an area of more than 1 million km2, which lie at depths of more than 2500 m (2500 - 3500 m), their thickness is about 30 to 50 m, reservoir temperatures range from 80 degrees Celsius to 100 degrees Celsius, plastic pressures exceed hydrostatic by 1.2 to 2 times. The main breeding components are clay, silica and carbonates. The complex combines the signs of oil-maternal rocks and a collector capable of filtering the fluid satued in them.

According to the authors of the work [7], the process of organic formation in them is not yet complete, which is confirmed by the presence, along with "light" (traditional) oil, hydrocarbons directly in the composed rock-forming mass - keogens, which are form the frame of the formation.

Alekseev A.P., Vassoevich N.B. [3, 8] believe that some of the available hydrocarbons have not lost their genetic connection with the original organic matter and are in the "sealed" (closed) pores formed as a result of the transition of part of solid organics into the liquid. This transition explains the cause of abnormally high pore pressure. The porosity of the rocks is 12 to 13%, permeability of about 1 mD, the rocks are classified as fragile with solid sorities and developed man-made fracking.

Thus, it can be considered that these deposits concentrate large resources of oil, but this oil is "connected" without special "stimulation" it is not forgotten, which determines the need to develop and use different technologies and technical means to ensure the flow of the reservoir fluid to the well and then to the mouth.

THEORY

The most promising for this method of increasing the filtration properties of the collector by hydraulic and thermal impact on the reservoir. [9].

Analysis of the conditions of their conduct allows us to say that:

- hydraulic fracturing of reservoirs and its variety (multi-cycle, larger, etc.) is effective during a certain (3-6 months) production time, then is effectively reduced and there is a need for its subsequent use or using other methods to intensify the inflow of the reservoir fluid [10].

- thermal impact causes an increase in temperature in the well zone. Thus, the temperature on this site increases by 2 to 4 times compared to the natural (up to 200 - 300 degrees Celsius and above) [11]. Therefore, the design of the well (a

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casing column, cement stone) must meet these temperature changes, have a high heat resistance.

As part of the solution to these problems, the authors consider the need:

1. Development of alternative hydraulic fracturing technology, a way to increase the filtration properties of the reservoir;
2. Recipe of technological liquids (primarily drilling solutions that have minimal impact on the pore structure of the reservoir;
3. Composition of composite materials (grouting mixture) and solution based on it, forming a temperature-resistant cement, in the early terms of hardening.

It is known that the process of oil recovery of reservoirs is determined by the filtration characteristics of the reservoir collector. This is the basis of the technology of hydraulic fracturing, in which in addition to natural porosity are created artificial, i.e. increases the volume of the drainage system. This effect can be achieved and even enhanced by the creation of several side tables in the reservoir, i.e. to build multi-slaughter wells with horizontal borehole (multilateral well). At the same time, it is possible to increase filtration activity by conducting vertical methods of perforation, as the depth of perforation channels, depending on the method of perforation, is 240 to 400mm [12], i.e. the creation of the creation of the creation of the channel in the higher or lower layers can be prevented. In this case, the question is about the length of the side drains, location and profile, and this is determined by the geological conditions of the reservoir and for each region they should be subject to the results of the "pilot" project.

As part of this decision, theoretical and experimental research proposes:

1. Unlike the existing experience of the construction of multilateral well, carried out under the I-II level of complexity under the classification of TAML, the main horizontal section of the wellbore and the lateral branches extending from it should be located within the reservoir in the sequence from top to bottom from the beginning of the horizontal section of the main trunk to its end.

At the same time, each subsequent branch is slaughtered in such a way that the interval above the point of "tie-in" would have azimuth, close to the azimuth of the main borehole. This allows you to save one azimuth of drilling well as a whole and ensure that the final slaughter tolerance is allowed into the total depth. At the same time, the technology of cutting the "main" horizontal section from drilled boreholes includes: the formation of a local uplift with an anti-aircraft angle of 2 - 5 degrees (e.g., from 89 - 90 to 90 - 95 degrees) and subsequent deviation swaying away from the azimuth already drilled part of the horizontal borehole with an intensity of 2.0...3.0/10m. After the horizontal borehole drilling is completed, the instrument is lifted at the beginning of the local uplift interval, followed by the development of the "gutter" (preferably in loosely cemented rocks) by creating a load on the chisel 0.5 - 2.0 tons, up to the formation of a "ledge" under the armament of the chisel, sufficient to perform the cutting of the new barrel. Due to the local rise of the branch profile before the interval of cutting the new table, the process of forming a "ledge" in the gutter is facilitated, as the area of contact of the armament of the chisel with the rock increases. To ensure the descent of the shank into the main horizontal borehole of the trunk, each cut is carried out with a drop of the anti-aircraft angle by 2 - 5 degrees and a slight reversal on the azimuth by 1 to 3 degrees in the opposite direction from the borehole.

The descent of the shank into the main horizontal borehole must be finally confirmed by the instrument measurements (the main horizontal borehole usually has a greater depth on the trunk than when hit in an offshoot). In order to implement the multilateral well construction project, it is supposed to be a method of justifying its main parameters (the length of the main horizontal borehole, the number of beatings, the distance between the trunks). It is shown that when planning the design of the borehole multilateral well, it can be considered that the horizontal borehole of the main trunk is "straightforward" due to its slight deviation from the straight.

There is a need and importance to take into account the length of the "non-measure" zone of the culling telemetry system - the distance from the chisel to sensors of inclinometer.

In order to ensure the control of the barrel wiring process in the multilateral well, the maximum allowable "non-measure zone" should not exceed 0.25 to 0.5 of the distance between the points of cutting of the nearest boreholes. The area of offshoots in the multilateral well should be located outside the interference zone with the main horizontal borehole. In the process of building a well (the main borehole, horizontal boreholes) considerable attention should be paid to ensuring the preservation of the natural filtration properties of the collector - permeability, porosity.

Analysis of the experience of building wells with horizontal endings with low-permeable and high thermobaric conditions collectors and their autopsy shows the effectiveness of the use of hydrocarbon-based solutions (OBM) wide use which was received during the drilling of wells at the Sakhalin Shelf field (closed circulation and cleaning system, the presence of a sludge processing plant, the need to build limited space wells with large and long waste from verticals, etc. There is an interesting experience of wiring wells using hydrocarbon-based solution (OBM) and in Western Siberia, in the fields of New Year, Sterkhova, Yurkharovskaya, etc. [15,16].

According to the composition and concentration of substances, OBM is divided into two groups - emulsion of the first genus and the second, so-called reverse or inverted emulsion. If the first is a dissolved hydrocarbon liquid, the second are represented by dissolved water in hydrocarbon liquid.

Thus, depending on what is the dispersion phase and that the dispersion environment is determined by groups of emulsions. As intended, two large groups can be identified - drilling solutions and special liquids (for capital and underground repair of wells, perforation, conservation, etc.). Close alternative OBM are only polyethylene glycolic based solutions, the only advantage of which is environmental cleanliness in the environment.

At the same time, OBM are inherent and negative phenomena that prevent their widespread use - low stability of the physical and mechanical properties of solutions, significant material and time costs for their preparation and disposal, negative impact on the surrounding area, laborious work with them, a strong dependence of mineral oils on external factors of influence (temperature, pressure, chemical aggression of plastic fluids, etc.). These problems on the use of OBM are solved by the use of synthetic and semi-synthetic oils, multiple use (on several wells), increased degree of "fire" of oil during disposal.

To solve the problems, the composition of the solution is proposed using as: emulsion environment of multigrade low-temperature hydraulic oil such as VMG 60 and VMG 45; emulsator reagents KES-1M and KES-1C; regulators of the reological properties of organophilic clays (organobentonite, beto-34), surface-active substance (neonol), biopolymers - polyanionic cellulose, carboxymethyl starch; to regulate the density of drilling solution - barite, calcium carbonate; in the penogasitel - silicon silicon organic liquids of the type Penta 467 or Penta 468.

The composition and some properties of the proposed inverted emulsion solution are shown in Table **1**.

According to the data from the table, it should be noted that the estimated composition of the solution can be subjected to weighting, due to the increased input of the weighting additive. At the same time, the

Table 1:

№ n/n	Название ингредиентов	Content, %	Solution Settings	Value Parameter
1	Oil: Mineral/Synthetic	69 / 59	Density, kg/m3	1120 / 1120
2	Water solution sodium form	9.0 / 6.0	Filter yield indicator cm3/30 min	≈ 1 / less than 1
3	Hydrophoxicized bentonite	3.0 / 4.0	Plastic viscosity, MPa * s	35-40 / 35-45
4	Barit	12 / 10	Dynamic shear stress, dPa	18-20 / 15-20
5	Reological modifier	0.4 / 0.6	Statistical shear stress, dPa	5-10 / 10-25
6	KES-1M / KES-1C	4.0 / 3.5	Electrostability, V	350 / 380
7	Unsalted Lime	1.0 / 0.4	pH	> 7 / > 7
8	Break	0.6 / 0.5		
9	Surface-active substance	1.0 / 1.0		

Note: in the numerator, an inverted-emulsion solution based on minimal oil; in the significant - inverted-emulsion solution based on synthetic oil.

rest of the solution indicators are not much different from those given.

However, for the condition of abnormally high formation pressure it is more effective to use solutions on a biopolymer basis - inhibited biopolymer systems with low solid-phase content.

To solve the problems of the use of solutions in the conditions of abnormally high formation pressure in productive horizons offered some recommendations on the formulations of biopolymersalt drilling solutions, as well as described the main results of their experimental-industrial introduction in the field (Table **2**).

Table 2: Information on Recommended Formulations of Salt Drilling Fluid Biopolymer

Geological and Technological Conditions of Productive Horizons	Recommended Flushing Fluid			Results of Experimental Industrial Introduction
	Name	Composition	Options	
Plastic pressures above the hydrostatic pressure of a water column. Plastic temperatures up to 150 degrees Celsius. The collector is represented by terriogenic rocks with porous and porous-cracked	salt-resistant drilling solution (Patent №2277574)	- polymer; - electrolyte; - weighter; - technical water	- density 1050-1450 kg/m3; - filter yield rate 2-4 cm3/30min; - dynamic shear stress 80-140 dPa; - plastic viscosity, 30 -60 MPa * s	- productivity ratio ($\frac{Q_ф}{Q_п}$) – 1,26; - skin factor minus 1,64
	Clay-free drilling solution (Patent №2277571)	- biopolymer; - electrolyte; - weighter; - foam (dissolved in diesel); - technical water	- плотность 1050-1400 kg/m3; - filter yield rate 1-5 cm3/30min; - dynamic shear stress 45-150 dPa; - plastic viscosity 25-75 MPa * s	- productivity ratio ($\frac{Q_ф}{Q_п}$) – 1,22; - skin factor minus 1,4
	Polymersalt drilling solution	- polymer; - electrolyte; - weighter; - technical water	- density 1050-1750 kg/m3; - filter yield rate 8-9 cm3/30min; - statistical shear stress, 20-40 / 30-50 dPa; - dynamic shear stress 15-40 dPa	- productivity ratio ($\frac{Q_ф}{Q_п}$) – 1,17; - skin factor minus 1,3
	Weighted drilling solution-clay	- clay - biopolymer - electrolyte; - утяжелитель; - SAA; - sodium hydroxide; - foam (dissolved in diesel); - stabilizer; - technical water	- density 1070-2100 kg/m3; - filter yield rate 0.5-3.5 cm3/30min; - dynamic shear stress 70-180 dPa; - statistical shear stress, 15-20 / 60-90 dPa	- productivity ratio ($\frac{Q_ф}{Q_п}$) – 1,26; - skin factor minus 1,64
Plastic pressures above the hydrostatic pressure of a water column. Plastic temperatures up to 240°C. It is designed to drill high-collodooid clays, argylites.	High-temperature weighted drilling solution (Patent №223575)	-clay; - polymer; - regulator of reological properties; - the water efficiency regulator; - foam; - lubricant; - technical water	- density till 2400 kg/m3; - conditional viscosity 30-60s; - filter yield rate 3-5 cm3/30min; - statistical shear stress, 20-50 / 45-75 dPa	Used in drilling wells En-Yahinsa SG-7, En-Yahina 610, Yarudeiskaya 38
	High-temperature weighted drilling solution	- clay; - polymer; - inhibitor; - regulator of reological properties; - the water efficiency regulator; - foam; - lubricant; - technical water	- density till 2400 kg/m3; - conditional viscosity 30-60s; - filter yield rate 3-5 cm3/30min; - statistical shear stress 20-50 / 45-75 dPa	Used in the drilling of wells of the Yurkharovsky and Tazov fields

In the implementation of the technology of thermoimpact on the reservoir maximum heat and physical loads account for the rock and fasten wells - temperature expansion, accompanied by the formation of thermo-mechanical stresses, destruction of cement stone, which is due to the processes of interphasic transformation (re-crystalization) of high-core hydrosilicates into low-core hydrosilicates [22-24].

The solution to this problem is possible by the formation of low-core calcium hydrosilicates in the emerging stone in the early stages of hardening by the introduction of astringent (portlandcement) silica additives [25, 26] or the use of slag. compositions of the compositions of the other raw material base - alumina, lime-creamy, white-cream-smeared, etc.

RESULTS

The results of experimental studies have shown that the most thermostoke stone formed from the composition of alumina cement in combination with portlandcement and microsphere additives, fine-dispersed ash, as well as high-clay cement combined with portlandcement, slag and barite additives. For example, the drawings **1** and **2** show samples of cement stone after thermal impact, which clearly confirm the above.

Figure 1: A sample of cement stone formed from the composition of alumina cement in combination with portlandcement and microsphere additives and fine-dispersed ash.

Figure 2: A sample of cement stone based on highly alumina cement combined with portlandcement, slag and barite additives.

DISCUSSION

With the slag component of the studied compositional material within 20 to 80 percent of the change in strength after 90 days of finding samples at ambient temperature of about 160 degrees Celsius, there is no sign of a change in strength.

Small changes in the direction of reducing strength are established for samples with slag content of 20 and 50 %, which is quite explained by the content of portlandcement, namely the destructive phenomena of its hydration products. With less content, on the contrary, the effect of stability, and even, in some respect, increase the limit of strength.

The greatest values of stability and ultimate strength are observed when the mixtures harden already in the first day. Reducing the slag component in the mixture leads to lengthening of grasping time and lowering the strength of the formed stone.

It was revealed that these indicators initially increase, but then, after reaching the maximum (certain) value, decrease.

The optimal amount of blast slag in cement, which is 80%.

CONCLUSIONS

Thus, experimentally confirmed that the compositions of cement stone in combination with domain slag meet the basic requirements (on the physical-mechanical properties of tampon solutions) fixing wells in areas of elevated temperatures.

Over time, the cement stone does not lose its strength, which is important, as the formed stone is considered not only as a means for fixing the casing column, but also as a material for thermal insulation, which is especially important when applying thermal oil production (e.g. steam-gas methods to ensure inflow).

GRATITUDE

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