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Issue Article

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OPENING OF PRODUCTIVE HORIZONS WITH HYDROCARBON–BASED DRILLING MUD FOR DUAL COMPLETION WELL

***Abstract**: the article discusses the opening of productive horizons in the process of drilling a well with a solution of a hydrocarbon base of the "Versadril" type for dual completion (DC). In difficult geological conditions. The analysis of the state of oil and gas reservoirs opening at exploration and production areas, systematic studies of the influence of the drilling fluid on the hydrocarbon-based "Versadril" on the reservoir properties of productive formations, as well as the preservation of the natural permeability of the productive formation are given. Such work can be in demand and useful when drilling exploration and production wells in fields with difficult mining and geological conditions and abnormally high reservoir pressure, in order to open productive formations while preserving natural reservoir properties and increasing oil and gas recovery of formations.*

***Key words**: hydrocarbon-based solution, electrical stability, diesel, water, static shear stress, solid phase, zenith angle, offset from vertical.*

***Language**: English*

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Introduction

For the opening of productive horizons with the preservation of natural permeability, as well as for drilling in particularly unstable clay saline deposits and the successful conduct of work, it is necessary to use oil-based solutions. In such solutions, the dispersion medium is represented by diesel fuel, and the dispersed phase is finely ground oxidized bitumen.

At wells №№ 147 and 156 of the Northern Goturdepe field, all productive horizons were opened on hydrocarbon drilling fluid. At well № 147 from a depth of 3800 meters to a design depth of 4400 meters, and at well №156 from 4100 meters to 4300 meters from the ALKAR-3M type system, the transition to a hydrocarbon base solution was ensured and the successful completion of the construction of wells to the design depths was achieved [1, 2, 4].

The construction and opening of the productive part of the above wells was carried out on a solution of a hydrocarbon base. At well № 147, when drilling a hole of Ø295.3 mm, a substitution was made for a solution of a hydrocarbon base of the "Versadril" type, from a depth of 3800m. Further, the hole Ø 295.3 mm from a depth of 3800 meters to a depth of 4206 meters along the hole, was drilled obliquely at a zenith angle of 45 degrees and an azimuth of 264 degrees on a solution of a hydrocarbon base of the "Versadril" type.

Versadril drilling fluid is a hydrocarbon–based system that uses diesel as a basis to prevent the swelling of clays. The system "Versadril is one of the most ideal systems for drilling active clays, where the stability of the hole is the main issue, in addition, this system operates at high temperatures up to 180-190 degrees and has more improved rheological properties of the solution and inhibition. The system "Versadril" has a very low water output. The water output can be lowered, if necessary, by adding the Versatrol reagent (a water loss reducing agent) and VG-69 (clay to create a crust). This system will prevent hydration of clays and, subject to appropriate density regimes, instability of the hole and even prevent the process of cavern formation and oil seal formation, due to its high inhibitory abilities, and also has good lubricating characteristics [3, 5, 6, 10].

To drill this interval, the equipment of the company "Schlumberger" was used to set the angle and exit in the direction, which requires special control of the rheological parameters of the drilling fluid. The choice of a hydrocarbon system was based on the composition of this system, which is a direct emulsion, where the aqueous phase is a dispersed medium, which excludes the chemical reaction of the solution with rocks in the well. Calcium carbonate (SafeCarb) was added to this solution in order to prevent filtrate penetration and minor absorption. The addition of calcium carbonate makes it possible to stop the penetration of filtrate into microcracks and prevent instability of the borehole. The type, parameters and components of the used hydrocarbon drilling fluid for opening productive horizons for the II technical and operational column at well № 147 Northern Goturdepe are given in the table.

At borehole №147 Northern Goturdepe, drilling of the hole Ø215.9 mm from a depth of 4206 meters to a depth of 4555 meters along the hole was performed obliquely directed at a zenith angle of 42 degrees and an azimuth of 264 degrees, with a displacement of 298 meters on a solution of a hydrocarbon base of the "Versadril" type. The system "Versadril" has a high emulsion stability with a diesel/water ratio at 70/30 with electrical stability, being maintained at 800-1500 Volts to create an emulsion and maintain the necessary parameters of the solution of this interval. Considering that this interval is with productive collectors, the water output readings were kept within 3ml/30 minutes. This water output minimized the likelihood of damage to the collector and sticking of the drilling tool [7, 8, 9].

Table 1. Parameters and components of the used hydrocarbon drilling fluid for the opening of productive horizons for the II technical and operational column for well № 147 Northern Goturdepe

Drilling mud parameters	II technical column (3800m-4206 m along the hole)	operational column (4206m-4555 m along the hole)
Barrel diameter, mm	295,3	215,9
Density, g/cm^3	1,40	1,46
Conditional viscosity (sec/kv)	45-60	45-60
Plastic viscosity	<35	<35
Dynamic shear stress ($lb/100\ ft^2$)	15-25	15-25
Water output ml/30 min	3-4	3-4
Solid phase (%)	<5,0	<5,0
Electrical stability	800-1500	800-1500
Salt content, % by weight	26	26
Quicklime, kg/m^3	18-25	18-25
Additional quicklime, kg/m^3	8-12	8-12
Diesel/water ratio (%)	70/30 (75/25)	70/30 (75/25)
Static shear stress	10-20	10-20
Type of solution	"Versadril"	"Versadril"
Interval Components	Quicklime	Quicklime
	VG-69	VG-69
	Versamul	Versamul
	Versacoat HF	Versacoat HF
	Versatrol	Versatrol
	$CaCl_2$	$CaCl_2$
	Diesel	Diesel
	Water	Water
	Barit	Barit

So, in case of technological necessity of using drilling fluids with a solid phase, the mechanical rate of penetration and penetration into the bit is sharply reduced due to the deterioration of the working conditions of the drill bit. During the drilling process, it is necessary to eliminate or significantly reduce the influence of the solid phase on the drilling fluid. In order not to damage productive reservoirs, the solid phase content indicators for well №147 Northern Goturdepe were reduced to a minimum of less than 5%.

At the Northern Goturdepe field, well № 156, unlike well №147, was drilled vertically to a design depth of 4300 meters with a drilling fluid density of 1.40g/cm^3. When opening productive horizons, all parameters (electrical stability, water output, emulsion creation, solid phase) were maintained at a stable required level.

In order to regenerate barite and remove the solid phase, hydrocyclones, a sitohydrocyclone and double centrifuges were used. Centrifuges were constantly used to avoid the solid phase in solution. Before cementing the casing columns Ø244.5 and 139.7 mm, the readings of the dynamic shear stress in the solution were reduced.

Thus, in order to preserve the natural permeability during the initial opening of the productive reservoir, it is necessary to minimize the repression on the reservoir (before drilling at "equilibrium"). When implementing such technology, the probability of occurrence of oil and gas occurrences and the danger of well gushing increases. In this regard, in order to control the productive reservoir and reduce the risk of open gushing, it is advisable to develop technical means for detecting the oil and gas occurrence of a productive reservoir at the initial stage, that is, fixing the moment of formation fluid appearance in the annular space in the zone of the productive reservoir. The opening of productive formations is mainly carried out with a chisel of the same diameter as drilling of the overlying interval. The production column descends to the bottom of the well, and the cement mortar behind the column rises to a great height up to the wellhead. At the same time, a high hydrodynamic pressure is created on the productive formation during cementing, which ensures the penetration of cement mortar into the pores and cracks of the productive formation and often leads to hydraulic fracturing of the formation with subsequent withdrawal of significant volumes of cement mortar into it, as indicated by cases of under-raising of cement mortar to the calculated level. That is why a very important task when cementing an operational column is to reduce the hydrodynamic pressure of the cement mortar on the productive formation and, if possible, completely eliminate the contact of the cement mortar with the productive formation.

During the cementing process, the “Safety rules in oil and gas producing enterprises” were strictly observed at the wells under study. High hydrodynamic pressure was not created on the productive layer during cementing, and no absorption of cement mortar into productive layers was observed. In all cementing processes, the level of cement mortar rise is obtained to the calculated level [11, 12].

The methods of opening the reservoir depending on the reservoir pressure, the degree of saturation of the reservoir with oil, the degree of drainage and other factors may be different, but they must all meet the following basic requirements:

1. When opening a reservoir with high pressure, the possibility of open gushing of the well should be prevented.

2. The natural filtration properties of the rocks of the bottomhole zone must be preserved at a high level. If the permeability of rocks is low, measures should be taken to improve the filtration properties of the bottom-hole zone of the well.

3. Appropriate reservoir opening intervals must be provided to guarantee long-term waterless operation of wells and maximum relief of oil inflow to the bottom.

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