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Modifying the Effects Around the Well can have an Impact on the Drilling Process

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Abstract Environmental changes around a well can significantly affect the drilling process. This paper examines the effects of flow rate, bottomhole pressure, sheet permeability, viscosity, pressure gradient and well radius on the drilling process. It is shown that the energy-dynamic instability of the sheet's near-shiva space, a highly active region in the formation, leads to changes in reservoir rock and fluid properties during the drilling process. These changes include physicochemical transformations such as deposition of asphaltenes, paraffins, and resins, as well as swelling of clay particles, which can disrupt reservoir physical properties and affect hydrocarbon flow. In addition, completion and production techniques and the chemistry of drilling and pressure fluids are particularly critical for low-permeability reservoirs. In this paper, the concept of skin effect is also introduced to assess the impact of process fluids on the bottomhole region, and a new assessment model is proposed. The results of the study are important for improving drilling technology and optimising reservoir development.

Index Terms flow rate, bottomhole pressure, slab permeability, viscosity, pressure gradient, well radius

I. Introduction

Numerous previous observations indicate that the sheet near-shiva space is currently a special highly active region in the formation. The bi-ionic zone is a region of unstable energy dynamics. The energy-mechanical balance between this formation and the surrounding space is disrupted during drilling, extraction and completion of the producing formation, as well as during fluidisation. In this case, the nature and characteristics of reservoir rocks and reservoir fluids undergo physical, mechanical and hydrodynamic changes in the vicinity of the reservoir. Considering the scenarios described in this section, physico-chemical transformations occur, such as the deposition of asphaltenes, paraffins and resins.

Maintenance of the clay slurry during operation and during drilling can lead to swelling of the clay particles. Destruction of reservoir physical properties can impair the flow of hydrocarbons.

Note that in general, deterioration of permeability in the region adjacent to the well can be explained by a variety of processes and parameters affecting permeability and porosity in the vicinity of the surrounding space. In this case, an aligned layer is formed around the well wall.

It is important to note that completion and production techniques as well as the chemistry of drilling and pressure fluids are particularly important for low-permeability reservoirs. In

order to assess the impact of drilling and pressure fluids on the bottomhole region of a formation, the concept of "skin effect" is introduced in the teaching.

Components in the wellbore are susceptible to mechanical impacts from the wellbore or shot hole. This paper analyses the effect of process fluids on the bottomhole region during drilling and well pressure [1-9].

The results of the impact of different drilling fluids or formation permeability are not considered when evaluating the skin factor parameters. Based on the analysis, a new model for evaluating the skin effect is proposed.

In this paper, a theoretical and practical solution to the problem is presented. Domestic and foreign drilling work shows that hydraulic pressure interruptions occur during down drilling, casing, wellbore flushing and additional operations.

II. The Main Part

In order to ensure that drilling goes smoothly, evaluation calculations are very useful, allowing us to obtain high-quality scientific and practical results on the amount of drilling fluid absorbed during hydraulic fracturing. However, it is of practical importance to determine the range of fluid dynamic pressures, especially considering the effects of loads and rock pressures. In this range, the volume of spray powder solution in the wellbore will deviate from the predetermined value.

According to the research of scientists [1-4], the main reason for absorbing a large amount of unloading in the

formation is the fact that when drilling plastics, all the rock is squeezed into the well, thus establishing a state of stress in the area of the wellbore, which is determined by the stress in the overlying rock and is determined exclusively by the load-bearing capacity of the clay plate. It is proved in practice that above the unloading space the overlying rock forms a vault, and the redistribution of the increased pressure no longer acts in the distant zone.

Many foreign authors have pointed out that if the rupture of the plate occurs when the hydrodynamic pressure in the well is low, then in this case zones of increased permeability are formed. Assuming that it is equal to the unloading zone, the drainage of the pit will be significant. In this case, the pressure difference between the Sivakhiya reservoir and the formation will not be significant.

If rock fracture occurs at high shear dynamic pressure, the radius of shear permeability will decrease and the pressure will increase. As the shear dynamic pressure increases further, the main effect of the second factor leads to a decrease in the effective radius in the formation.

Consequently, during drilling, the drilling mud is absorbed least strongly at pressures close to the average pressure between the formation and rock pressures. Considering the above, a new problem arises: the examination of the rheological properties of the drilling fluid. We note that when absorption of the well occurs during drilling, depending on its intensity, the following measures are mainly carried out:

- transition to flushing with special drilling fluids
- insulation
- flushing hardening

These measures can be carried out individually or mixed and combined. In practice, the method of combat absorption is usually determined by the rheological properties of the insulating mixture and the absorption of pure water. In addition, the properties of the flushing rheological fluid are taken into account. Literature analyses have shown that when drilling fluid absorption tests are performed, the effect is defined as:

$$P_e - P_n = \xi h, \quad (1)$$

where:

- ξ - the density of the flushing fluid
- h - the viscosity of the rinse solution.
- P_n - the static pressure of the flushing column.
- P_e - the reservoir pressure.

These formulas and measurements help to optimise the use of drilling fluids and ensure effective operation under high shear pressure conditions. The analyses show that when the casing pressure is increased by a factor of 1.5, the pressure absorbing the formation increases significantly, although the depth of penetration of the flushing fluid into the formation decreases slightly. It should be emphasised that this relationship increases further with depth. It is clear that as the ultimate shear stress of the clay slurry increases, its effectiveness against mud complications diminishes. The literature indicates that the best results are obtained when a highly viscous and elastic solution

that does not increase the ultimate shear stress is used. The hydraulic resistance of such solutions in the annulus changes very little with increasing shear rate, whereas the resistance H increases significantly when filtered in porous media.

The analyses also showed that the rheological properties of the flushing solution as it passes through the absorbing layer can be reflected by the dependence of the shear stress on the rate of deformation.

Several laboratory studies have shown that polymer solutions can significantly reduce the permeability of rock as they move through porous media due to adsorption and mechanical retention of polymers in the rock. Such polymers have a significant effect on the mobility in porous media.

According to the laws of hydrodynamics, drilling fluids obey the generalised law:

$$\delta = \frac{k}{\mu} \left(\frac{dp}{d\delta} - G \right), \quad (2)$$

where:

- 1) δ -filtration rate.
- 2) k -Permeability of the wellbore region.
- 3) μ -Dynamic (structural) viscosity of solutions.
- 4) $\frac{dp}{d\delta}$ -pressure gradient.
- 5) G -Initial pressure gradient.
- 6) Multiply the left and right sides by the partial equation ($F = 2\pi r^2$)

$$\delta F = \frac{k}{\mu} 2\pi r^2 \left(\frac{dp}{dr} - G \right), \quad (3)$$

where:

- F -Area of cutting layer.
- r -walking radius.

From a course on subsurface fluid dynamics we know that the average velocity in the waterfall for each cross-sectional area provides us with the volumetric flow rate, i.e.

$$Q = \frac{k}{\mu} 2\pi r^2 \left(\frac{dp}{d\delta} - G \right). \quad (4)$$

Let us solve this (dp) and (dδ)

$$\left(\frac{Q\mu}{2\pi k} \cdot \frac{1}{r^2} + G \right) dr = dp. \quad (5)$$

In order to solve this problem, we introduce the boundary concept condition.

$$r = R_c; P = P_c;$$

$$r = R_k; P = P_k;$$

$$r = R_s; P = P_s;$$

where:

- $R_c; R_k; R_s$ -Radius of the well, contour and radius of the absorption zone;
- $P_c; P_k; P_s$ -Pressure at the bottom of the well, contour and absorption zone.

In this filtering equation, we introduce the notion of protocol halls or packets of a particular order.

$$\frac{Q\mu}{2\pi k} \left(\frac{1}{k_s} \frac{dr}{r^2} + \frac{1}{k} \frac{dr}{r^2} \right) + Gdr = dP. \quad (6)$$

Integrating this formula into the given chonic integers we have:

$$\frac{Q\mu}{2\pi k} \left[\left(\frac{k}{k_s} - 1 \right) \left(\frac{1}{R_c} - \frac{1}{R_s} \right) + \left(\frac{1}{R_c} - \frac{1}{R_k} \right) \right] + G(R_k - R_c) = P_c - P_k. \quad (7)$$

In this equation, we introduce the

$$S = \left(\frac{k}{k_s} - 1 \right) \left(1 - \frac{R_c}{R_s} \right), \quad (8)$$

where: Factor, dimensionless quantity .

Eventually, we obtained an expression that considers the volumetric flow rate of the drilled well.

$$Q = \frac{2\pi k R_c}{\mu} \frac{[(P_c - P_k) - G(R_k - R_c)]}{\left[S + \left(1 - \frac{R_c}{R_k} \right) \right]}. \quad (9)$$

This equation is the main equation for determining the crushing volume of the drilling fluid. It can be seen that the volume of absorbed fluid decreases as the fineness of the drilling fluid increases. Whereas, under dark conditions, when $(P_c - P_k) = G(R_k - R_c)$, it is the volume flow rate of absorbed fluid

III. Conclusions

- 1) Analyses have shown that viscoplastic elastic fluids exhibit superior drilling fluid characteristics as they pass through the loss zone.
- 2) Calculations show that pumping such solutions into rough spaces produces significant resistance. In this case, the fluid exhibits high viscosity as it moves through the narrow portion of the absorption channel.
- 3) the use of such solutions reduces the extent of absorption due to the high resistance of the fluid during its movement and the reduced pressure in the absorbing layer.
- 4) the stability analyses carried out showed that the addition of weakly concentrated solutions of some polymers (e.g. polyethylene oxide, guar gum, polyacrylamide) to the clay solution is necessary in order to increase the viscoelasticity.
- 5) Addition of polymers to clay solutions reduces hydrodynamic resistance under large Reynolds number flow conditions (Thomas effect). At the same time, the volume of these fluids increases significantly as they pass through the porous structure due to the high velocity Edwidge flow in small channels.

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