THE EFFECT OF THE SKIN-ZONE ON NON-NEWTONIAN OIL FIELDS.

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Annotation

This article shows the properties of non-Newtonian fluids, examines the causes of the skin zone, and considers the effect of the skin factor depending on the value it receives. Most of the recently put into operation oil fields are non-Newtonian. The presence of substances such as asphaltene, tar, and paraffin in the fluids of such deposits makes it difficult to filter them and increases the costs of their operation and transportation. The formation of a skin zone can lead to a decrease in production in such oil fields. Thus, at positive skin values, a decrease in permeability and well production is observed.

Keywords: non-Newtonian fluids, skin factor, productivity, formation permeability, formation, pressure drop

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ВЛИЯНИЕ СКИН-ЗОНЫ НА НЕНЬЮТОНОВСКИЕ МЕСТОРОЖДЕНИЯ НЕФТИ.

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Аннотация

В данной статье показаны свойства неньютоновских жидкостей, рассмотрены причины возникновения скин-зоны, рассмотрено влияние скин-фактора в зависимости от получаемого им значения. Большинство недавно введенных в эксплуатацию нефтяных месторождений неньютоновские. Наличие в жидкостях таких отложений таких веществ, как асфальтен, смола, парафин, затрудняет их фильтрацию, увеличивает стоимость эксплуатации и транспортировки. Образование скин-зоны может привести к снижению добычи на таких месторождениях. Таким образом, при положительных скин-ценах происходит снижение проницаемости и дебита скважины.

Ключевые слова: неньютоновские жидкости, скин-фактор, продуктивность, проницаемость пласта, пласт, перепад давления

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Calculation of production of non-Newtonian oil wells

In non-Newtonian oil fields, we can use the following reporting methodology to find and predict the productivity of wells.

We know that the production of wells in operation in anomalous fluid oil fields is calculated using the following formula:

$$Q = \frac{2\pi kh}{\mu}\frac{[(P_k - P_q) - \mathrm{i}_0\left(R_k - R_q\right)]}{\left[ln\frac{R_k}{R_q} + S\right]}$$

Here the thickness of h-layer ,k-layer conductivity ,P_k - contour pressure , P_q -wellbore pressure , R_k - the radius of the zone around the well ,R_q - the radius of the well ,S-skin factor , μ-dynamic viscosity , $i_0 = \frac{\tau_0}{\sqrt{k}}$– initial pressure gradient , τ_0-initial touch voltage

It is clear from the equation that $R_k >> R_q$. Therefore, it can be ignored in the report:

$$Q = \frac{2\pi kh}{\mu} \frac{[(P_k - P_q) - \mathrm{i}_0 R_k]}{\left[ln \frac{R_k}{R_q} + S\right]}$$

Now let's run the reports based on the given values:

h=10m, k=0.1*10 -12 m ^{2} , P_k =120*10 5 N/m ^{2} , P_q =80*10 5 N/m ^{2} , R_k =1000 m , i_0 =220 N/m ^{2} ,μ=15*10 -3 N*s/m ^{2}

Based on the given prices, let's calculate the volume production:

1) When S=1:

$$Q = \frac{2\pi kh\left[(P_k - P_q) - i_0 R_k\right]}{\mu\left[ln \frac{R_k}{R_q} + S\right]} = \frac{2 \cdot 3{,}14 \cdot 0{,}1 \cdot 10^{-12} \cdot 10[(120 - 80) \cdot 10^5 - 220 \cdot 1000]}{15 \cdot 10^{-3}\left[ln \frac{1000}{0{,}12} + 1\right]}$$

= 0.00083 m 3 /s = 71.712 m 3 /day

2) When S=5:

$$Q = \frac{2\pi kh\left[(P_k - P_q) - i_0 R_k\right]}{\mu\left[ln \frac{R_k}{R_q} + S\right]} = \frac{2 \cdot 3{,}14 \cdot 0{,}1 \cdot 10^{-12} \cdot 10[(120 - 80) \cdot 10^5 - 220 \cdot 1000]}{15 \cdot 10^{-3}\left[ln \frac{1000}{0{,}12} + 5\right]}$$

= 0.00056 m^3 /s = 48.38 m 3 /day

3) Let's assume that S=20:

$$Q = \frac{2\pi kh\left[(P_k - P_q) - i_0 R_k\right]}{\mu\left[ln \frac{R_k}{R_q} + S\right]} = \frac{2 \cdot 3{,}14 \cdot 0{,}1 \cdot 10^{-12} \cdot 10[(120 - 80) \cdot 10^5 - 220 \cdot 1000]}{15 \cdot 10^{-3}\left[ln \frac{1000}{0{,}12} + 20\right]}$$

= 0.00031 m^3 /s = 26.78 m 3 /day

Studies show that in most cases, one of the methods used to increase well production is washing the bottom zone with acid. In general, it has been shown in the literature that the amount of acidic solution per 1 meter thickness of the layer is (1.0 ÷ 1.2) m 3 . In this case, the amount of acid:

V = sigh

Then we can use the following expression to find the volume of the acidic solution:

$$V_k = V \frac{X_p(5{,}09X_P + 999)}{X_k(5{,}09X_k + 999)}$$

Here X is the concentration of the p -acid in the solution

X_k -acid (%)

If there is a change in the acid's concentration over time and as the storage conditions change, then the volume of this acid is calculated in the following form:

$$V_k' = V \cdot 5{,}09 \cdot \frac{X_P(5{,}09X_P + 999)}{\rho_k(\rho_k - 999)}$$

Here, ρ k is the density of the solution at a temperature of -15 0 C.

$$\rho_k = \rho_{kt} + (2{,}67 \cdot 10^{-3}\rho_{kt} - 2{,}52)(t - 15)$$

ρ kt is the density of the acid at a given temperature.

Barium-chlorine is used to neutralize this acid. Its amount is determined by the following expression:

$$G_{bx} = 21{,}3V\left(a\frac{X_P}{X_k} - 0{,}02\right)$$

Here $a-$ indicates the volume of sulfuric acid in the total acid. In mining conditions, this amount is calculated as follows:

$$a = 0{,}490$$

Then we can find the volume of barium-chlorine with the following formula:

$$V_{bx} = \frac{G_{bx}}{\rho_{bx}}$$

Here $\rho_{xb}$is the density of barium-chlorine, its value is approximately ρ_{xb}= 4000 kg/m 3

is accepted. The volume of the inhibitor, in turn, is determined as follows:

$V_i = b_i\frac{V}{c_i}$ Here, b i -inhibitor addition rate. If reagent B-2 was used as an inhibitor, then b i =0.2%. c i is the total volume of inhibitor (c i =100%)

Based on this, we calculate the conditional volume of the solution using the following formula:

$$V_k = 13{,}2 \cdot \frac{13{,}5(5{,}09 \cdot 13{,}5 + 999)}{27{,}5(5{,}09 \cdot 27{,}5 + 999)} = 5{,}91\text{m}^3$$

Now let's find the density of the given acid at 15 ^{0}C:

$\rho_{15^\circ}C = 1134 + (2{,}67 \cdot 10^{-3} \cdot 1134 - 2{,}52)(25 - 15)$ = 1139.1 kg/m 3

According to the given temperature, the volume of acid is calculated as follows:

$$V_k' = 12{,}65 \cdot 5{,}09 \cdot \frac{13{,}5(5{,}09\cdot 13{,}5+999)}{1139{,}1(1139{,}1-999)} = 5.8\ \mathrm{m}^3$$

Now let's find the amount of barium chloride:

$$G_{bx} = 21{,}3 \cdot 13{,}2 \cdot \left(0{,}4\frac{13{,}5}{27{,}5} - 0{,}02\right) = 49{,}5\mathrm{kg}$$

The volume of barium chloride is:

$$V_{bx} = \frac{49{,}5}{4000} \approx 0{,}0123 \approx 1{,}23 \cdot 10^{-2}\mathrm{m}\ 3$$

Thus, we get the required volume of technical acid:

$$V_T = \frac{3\cdot 12{,}65}{80} = 4{,}74 \cdot 10^{-1}\mathrm{m}\ 3$$

Let's calculate the volume of the inhibitor with the help of the formulas mentioned above:

$$V_i = 0{,}2 \cdot \frac{12{,}65}{100} = 2{,}52 \cdot 10^{-2}\mathrm{m}^3$$

Volume of the intensifier:

$$V_{in} = 0{,}3 \cdot \frac{12{,}65}{100} = 3{,}8 \cdot 10^{-2}\mathrm{m}^3$$

Finally, let's calculate the volume of water required:

$$V\ s = 12.65-5.82-(0.0123+0.474+0.026+0.0379)=6.28\ \mathrm{m}^3$$

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