PEERIAN JOURNALS

The Peerian Journal

Open Access | Peer Reviewed

Volume 18, May, 2023. **ISSN (E): 2788-0303**

Website: www.peerianjournal.com **Email:** editor@peerianjournal.com

Special Methods Of Using Oil Fields With High Viscosity

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Annotation

The coefficient of coverage can also decrease with formation seepage, because when the pressure gradient is less than the pressure gradient of the limit structure failure in the oil, the oil is less immobile in the low-permeability layers and mainly moves in the high-permeability layers. If the pressure gradients in the formation are smaller than the pressure gradient of the dynamic displacement of this oil, zones can be formed where the movement of oil with an almost intact structure is observed.

The main part: These zones can be conventionally called "stagnant" zones. In the stagnant zones of the formation, oil leaks only in some highly permeable layers or zones. In the remaining parts of the formation, the oil is almost not moving. If measures are not taken to reduce the anomalous oil viscosity or increase formation pressure gradients, this will lead to a decrease in the final oil yield of the formation.

The occurrence and distribution of anomalous oil viscosity zones depends on the distribution of formation pressure gradients across the accumulation area, which depends on the system of placement of drilling and extraction wells, as well as their mode of operation. It again depends on the composition of anomalous viscous oil and the permeability of the pore medium. The influence of the chemical composition of rocks on the occurrence of anomalous viscosity is currently not fully studied.

It is known that the composition and properties of oil can change significantly depending on the area of the pile and the thickness of the layer. Many researchers reported that the density of oil increases from the top of the formation to the bottom. However, the distribution of oil viscosity throughout the pile has been little studied. Usually, the viscosity of degassed oil is determined. It was observed that this indicator of oil changes in a large interval along the layer. For example, the viscosity of degassed oil in the Taimurzin field (Russia,) was found to vary from 28 to 200 mPa s across the field.

Usually, the average value of the physical properties of the oil and the physical properties of the formation is taken in the design of oil fields. It is modeled according to the shape of the oil. Such an approach cannot be applied to anomalous oil piles for predicting key field performance

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indicators. In order to determine the important technological indicators of oil fields, it is necessary to take into account the change in the rheological properties of oil and the heterogeneity of the layer when performing hydrodynamic calculations. Thus, the main feature in the design and analysis of oil piles with anomalous viscosity is the need to study in detail the changes in oil and gas composition, physical and important rheological properties along the size of the pile. The choice of the scheme of hydrodynamic calculations should be made taking into account the characteristics of the distribution of oil and gas properties along the pile. The anomalous viscosity properties of oils are greatly influenced by the physical properties and heterogeneity of the formation. For example, the dynamic shear pressure gradient and the marginal structural failure pressure gradient in petroleum are highly dependent on the permeability of the rocks. Sharp deterioration of rheological properties is manifested in oil seepage in porous media characterized by a small permeability coefficient. Thus, it is necessary to ensure that the placement system of the receiving and driving wells, the distances between them, and their operating modes are greater than the pressure gradients of formation pressure during heap operation, and the pressure gradients of the limit failure of oil structures. If it is impossible to achieve this goal due to a serious deterioration of economic indicators of operation, then it is necessary to design measures to improve the rheological properties of oil.

At the stage of drawing up the initial projects of the oil field, the designer will not have sufficient detailed information about the characteristics of oil composition, distribution over the heap area, and permeability coefficient, which affect the structural and mechanical properties of oil. Therefore, as new information about formation and reservoir oil becomes available, changes should be made to measures to reduce anomalous oil viscosity.In addition, the properties of the oil obtained from the use wells may change significantly during the operation of the heap for various reasons. Therefore, it is necessary to regularly monitor the composition of oil and gas, as well as changes in their rheological properties.

Based on the problem of flat-radial leakage of anomalous oil, the change of oil viscosity and leakage rate depending on the pressure gradient was obtained.

The results of experimental studies of anomalous oil seepage in a porous medium can be developed in two ways. In the first step, of all variable rheological properties of oil, only its viscosity is taken into account, and permeability is considered a constant quantity. In the second method, the anomalous oil mobility coefficient at different pressure gradients is determined from the experimental data. This approach is correct from a methodological point of view, because with the increase of the pressure gradient, on the one hand, the permeability of the layer increases in the porous medium. As a result of the development of experimental data in each case, it is possible to obtain an empirical expression connecting the anomalous oil mobility with the formation pressure gradient.

Expressions for calculating anomalous oil viscosity and mobility have the following form:

1) for effective oil viscosity

$$\mu_s = \mu_m + \frac{\mu_0 - \mu_m}{1 + \exp C(y - y_n)}; \qquad (1)$$

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2) for the mobility of oil in formation

$$\frac{\kappa}{\mu} = \frac{K_{и}\left[1 + expC(y - y_n)\right]}{\mu\left[1 + expC(y - y_n)\right] - \Delta\mu}, \qquad (2)$$

here: K_n - rock permeability in large pressure gradients; μ_m, μ_0 - minimum and maximum values of oil viscosity; c va Y- constants; $\Delta\mu = \mu_0 - \mu_m; y = gradP.$

It should be noted that the direct use of functions (1) and (2) in solving the set tasks causes mathematical difficulties. Therefore, the anomalous oil flow scheme in a circular layer is used to solve the tasks.

Replacement of straight curves of change of anomalous oil viscosity with broken lines a, b, c, sufficient for the accuracy of calculations in practice. Three zones can be distinguished in a circular layer on the basis of this scheme of dependencies.

The outer radius around which the use wells are placed r_m in all the first zones, the formation pressure gradient is greater than the pressure gradient of the limit failure of structures in oil. In this zone, oil has the lowest constant viscosity μ_m or greatest mobility $(\kappa/\mu)_m$ with, will be in a completely broken structural movement. The size of the radius of the first zone is determined by the rheological properties of the oil and the mode of operation of the wells. In the second zone, the viscosity and mobility of oil varies according to the linear law, depending on the formation pressure gradient. The outer radius of the second zone also depends on the parameters affecting the first zone. The main role in this zone is played by the dynamic pressure gradient of displacement.

Main result: Oil viscosity in the first zone μ_m equal, in the third - μ_0, secondly, depending on the gradient, it changes according to the following law:

$$\mu = \mu_0 - \frac{\mu_0 - \mu_m}{H_m - H}\left(\frac{dP}{d_ч} - H\right); \qquad (3)$$

where: P is the variable pressure and the coordinate of the point where the pressure is determined, respectively.

Equation 3 is directly proportional and inversely proportional to the product of the permeability and the structural failure threshold pressure gradient in the oil. Under equal conditions, the greater the viscosity of oil, the farther the zone of anomalous properties of oil is located from the wellbore. The radius of the first zone is larger for low-permeability layers than for high-permeability layers.

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ISSN (E): 2788-0303
Email: editor@peerianjournal.com

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