



Dependence of Oil and Gas Production Rate on the Formation Structure

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Annotation. In most cases, oil production occurs when it is replaced in the pore space of a productive formation with water or gas, both under natural operating conditions and with artificial methods of maintaining reservoir pressure by flooding or gas injection.

Main part. The development of gas fields and the operation of gas storage facilities are also often accompanied by the displacement of gas by water.

The interaction of formation fluids with each other and with a porous inhomogeneous structure causes capillary phenomena, incomplete and uneven displacement, formation of zones of joint flow of fluids in a productive formation, i.e. multiphase filtration. Incomplete displacement, of course, reduces the oil and gas recovery factor of the formation. Liquids and gases that saturate oil and gas condensate reservoirs are mixtures of hydrocarbon and non-hydrocarbon components, some of which are able to dissolve in hydrocarbon mixtures. Phases moving at different speeds carry out intensive mass transfer. The transition of individual components from one phase to another entails a change in the compositions and physical properties of the filtered phases. Such processes occur, for example, during the movement of carbonated oil and its displacement by water or gas, during the development of deposits of a complex component composition, during the displacement of oil by active impurity rims (polymeric, alkaline and micellar solvents used to increase oil recovery). The basis for calculating such processes is the theory of multiphase multicomponent filtration, which has been intensively developing in recent years.

Filtration refers to the movement of liquids, gases and their mixtures in porous and fractured media. A fractured environment consists of solid rocks interconnected by pores and microcracks.

Filtration takes place at extremely low liquid velocities along the cross-section of extremely small porous channels.

A porous medium that transmits liquid and gas through itself is called permeability. This feature is characterized by the conductivity coefficient "k". The difference between the permeability coefficient and the filtration coefficient is that it depends on the properties of the porous medium.

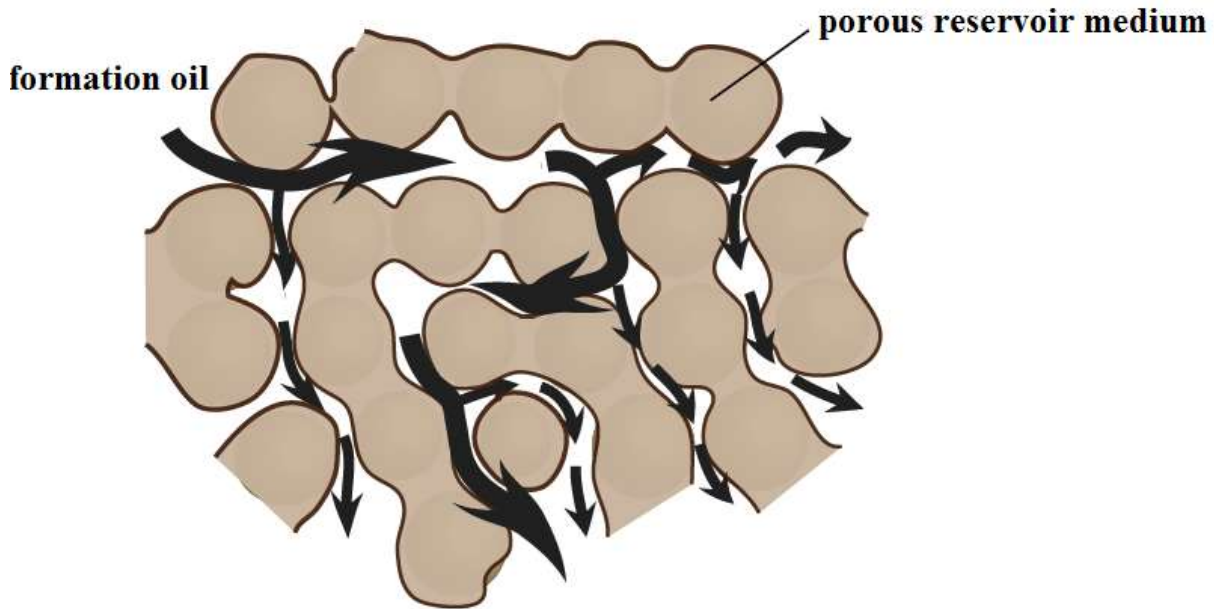


Figure 1. Parallel oil fluid movement in pores

The saturation a_i of the pore space with the i -th phase is the fraction of the pore volume ΔV_i occupied by this phase in the elementary volume:

$$a_i = \Delta V_i / \Delta V_n$$

$$i=1, 2, 3, \dots, n.$$

a_i	1	2	3	4	5	6
	0,51	0,52	0,59	0,61	0,625	0,635

Hydrocarbon systems can be homo- and heterogeneous. In a homogeneous system, all its parts have the same physical and chemical properties. The components of a homogeneous system (called components) are "smeared" throughout space and interact at the molecular level.

For a heterogeneous system, physical and chemical properties are different at different points. Heterogeneous systems consist of phases. A phase is a part of a system that is homogeneous and separated from other phases by distinct boundaries. The mixture of water, oil and gas in a reservoir is a typical example of a heterogeneous environment.

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