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Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

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TRD

The liberated free-gas phase, generated due to reservoir pressure decline, can either be a handicap or a benefit during oil production. The unfortunate scenario is that disconnected immobile gas bubbles can block individual pore throats, lowering, thus, the effective permeability of the reservoir. Unfavorable pore geometry, along with capillary forces/wettability balance are the main contributors to that possibility. On the other hand, a favorable case is that the liberated gas bubbles coalesce easily, forming a mobile gas phase, which can provide energy to the reservoir by a competent gas-oil gravity drainage mechanism. For such an effective upwards gas migration, though, crucial parameters are permeability and dip of the reservoir, layering/stratigraphy, as well as the relative permeabilities of the fluid phases. The experimental study of this work aims to determine the mobility of the formed gas bubbles and their effect on the effective (relative) permeability of the oil. The experiments involve gas liberation in low permeability outcrop and reservoir samples, induced by pressure decrease. The pressure varies from above to below the saturation pressure, while X-ray computer tomography is applied to detect the in-situ gas liberation and determine the gas saturation. Effective oil permeability versus pressure and saturation is monitored. The onset of gas-phase production (the value of residual saturation) is monitored as well. Along with the experimental work, the modeling part of the study is developed. For calculating the amount of the produced gas, a previously developed thermodynamic model (DTU) is adjusted and applied. The model involves oil and gas equilibrium under the action of capillary forces. If the released gas stays in the pores in the form of bubbles, a correlation between the amount of liberated gas and the reduction of oil permeability is provided. For the time being, the correlation between the amount of liberated gas and the reduction of oil permeability is being modeled and verified using date from the literature. The final experimental setup has been determined, and the first results are obtained for model oils and outcrop or reservoir cores.