Stress-dependent Flow Properties Within Shale Plays And Their Impacts On Estimated Ultimate Recovery (eur)

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Abstract

Objectives/Scope: Unconventional reservoirs have become a significant source of oil and gas production because of advancements in drilling and hydraulic fracturing techniques. They generally exhibit stress-dependent flow properties, including permeability and porosity. This study presents a characterization of the stress-dependent flow properties of a Middle East shale play and their impacts on EUR through a combination of laboratory experiments and numerical simulations.

Methods, Procedures, Process: Shale play reservoir properties, like porosity and permeability are key parameters impacting reservoir performance. These parameters vary with production and as the reservoir is depleted as a result of stress dependency. To systematically characterize the stress dependency, a pressure pulse decay approach was used to measure permeability and porosity in laboratory for forty-six core-plug samples from an organic-rich calcareous mudstone. The samples are dried for 72 hours at 105 °C under a vacuum. All measurements are conducted at the same pore pressure of 2500 PSI and a constant temperature of 50 °C. Rock samples were tested with confining pressures of 3000, 3500, 4000 and 4500 PSI, respectively. Numerical simulations were conducted in order to evaluate the impact of the changing stress on well production.

Results, Observations, Conclusions: The results showed a significant stress dependency of rock permeability because of the reduction in pore size under high net pressure and hence the reduction in permeability. The rate of permeability decline and compressibility factor varied based on rock composition, especially the amount of organic matter. The stress sensitivity parameter ranges from 1.54E-04 to 2.23E-03 psi-1 with an average of 7.28E-04 psi-1. Rock porosity exhibits a less degree of stress dependency than permeability. The measured stress sensitivity parameter for porosity ranges from 2.60E-05 to 9.34E-04 psi-1 with an average of 1.89E-04 psi-1. Numerical simulation based on the laboratory measurements results was used to assess the impact of variation in flow properties on reservoir performance and to predict EUR by modeling flow through a representative rock volume as a function of time. The model utilized the measured rock compaction factors as a primary input parameters to accurately predict the reservoir performance. The simulations showed a significant influence of stress-dependent permeability and porosity reduction on the overall reservoir performance. The results indicate that the stress sensitivity of the reservoir flow properties plays a crucial role in its performance and accurate EUR estimation.
**Novel/Additive Information:** This study provides new insights into the stress-dependent flow properties and underlines the importance of their characterization. The findings can aid in improving the accuracy of production forecasting and reservoir management strategies for unconventional reservoirs. The combination of laboratory experiments and numerical simulations provides a comprehensive and robust characterization method, which can be utilized to optimize hydrocarbon recovery and improve the efficiency of reservoir management.