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Neural network applications to reservoirs: Physics-based models and data models

New techniques for estimating properties of saturated reservoirs, using readily-available rate decline data

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Highlights

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A new method of solving material balance equation of saturated reservoir is found.

- The method is used to draft a procedure for computing scarce data from known data.
- The procedure is applied to meet the data need of property estimation techniques.

Abstract

A recent work presented two techniques for estimating permeability and well drainage radius, for solution-gas drive reservoirs. However, data requirement has placed a limitation on the application of the techniques. Applying the techniques requires readily-available production data – cumulative production and production rate, versus time. In addition to these, it also requires the scarcely-measured average reservoir pressure, $\bar{P}$ P^{-} and average oil saturation, $\bar{S}_o$ So^{-}, versus time.

This work presents a practical method for deriving the scarcely-measured data from the readily-available data. This method, based on a new solution methodology to the MBE for solution-gas drive reservoirs, is presented as a sub-routine, added to the procedures of the properties estimation techniques. The methodology is analytically founded on the equality of the LHS (fluid withdrawal terms) and RHS (fluid expansion terms) of the conventional MBE, and the pressure value that upholds the equality.

The sub-routine has been applied to two reservoir models and was found to yield excellent estimates of $\bar{P}$ P^{-} and $\bar{S}_o$ So^{-} data, exhibiting good agreement with $\bar{P}$ P^{-} and $\bar{S}_o$ So^{-} data resulting from simulating the reservoirs. Furthermore, the sub-routine-generated $\bar{P}$ P^{-} and $\bar{S}_o$ So^{-} data that have been used in implementing the properties estimation techniques, and the results have compared well both with the results of the techniques′ implementation using simulator′s $\bar{P}$ P^{-} and $\bar{S}_o$ So^{-} data, and with the true values of these properties.

Keywords

- permeability;
- drainage radius;
- estimation techniques;
- decline curve analysis;
- solution-gas drive;
- material balance equation;
- MBE solution methodology