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DEVELOPING A NEW FORMULA FOR PREDICTING OIL RECOVERY FACTOR IN WATER FLOODED-HETEROGENEOUS RESERVOIRS

By

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Abstract

In this work, two sets of empirical correlations were developed for predicting the recovery factor (RF) in water-flooded layered oil reservoirs. The first set of these correlations encompasses four key parameters believed to have significant impact on water flooding performance, namely, reservoir heterogeneity (permeability variation coefficient), injected water viscosity, permeability anisotropy (ratio of vertical permeability to horizontal permeability), and water injection rate. This first set consists of two expanded forms, one for predicting the RF at water breakthrough time (BT) and the other for predicting the RF at the end of project (EOP). Out of the aforementioned four key parameters, the second set of the developed correlations only considers the parameters that have been found most effective in the process of water flooding. Thus, the second set consists of two reduced forms, one for predicting the RF at BT (RF_{BT}) and the other for predicting the RF at EOP (RF_{EOP}).

In the development process of the new correlations, the ECLIPSE simulator was used to generate a large number of data points representing, among other profiles, the RF and water cut performances for various combination scenarios of the above key parameters. These simulation-generated data were then processed by the General Linear Model analysis technique to develop the target empirical correlations.

When tested against 144 simulation-generated data points used in their development, the expanded forms of the new correlations have been found to give reliable estimates of RF_{BT} and RF_{EOP} with AAPCD of 6.9 and 1.02, respectively. The reduced forms were found to yield a slightly higher AAPCD for the same data set. When tested against 48 simulation-generated data points not included in the development of the proposed correlations, the expanded forms of the new correlations have been found to give good estimates of RF_{BT} and RF_{EOP} with AAPCD of 6.5 and 14, respectively. The new correlations have been found to give more accurate estimates of RF_{EOP} than for RF_{BT} . The highest RF_{EOP} of 50.6% was achieved for a combination scenario defined by: $q_i = 10,000$ bpd, $\mu_w = 1.0$ cp, $k_z/k_x = 1.0$, and $V = 0.1$. When tested against two published empirical correlations using a single field data point, the proposed correlations were found to give relatively high AAPCD but still comparable to the API method.

Keywords: Recovery factor. Layered reservoirs. Water flooding. Permeability anisotropy. Prediction.