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Permeability Prediction Based on Hydraulic Flow Unit Identification and Artificial Neural Networks

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Abstract : The concept of hydraulic flow units (HFU) has been used for decades in the petroleum industry to improve the prediction of permeability. This concept is strongly related to the flow zone indicator (FZI) which is a function of the reservoir rock quality index (RQI). Both indices are based on reservoir porosity and permeability of core samples. It is assumed that core samples with similar FZI values belong to the same HFU. Thus, after dividing the porosity-permeability data based on the HFU, transformations can be done in order to estimate the permeability from the porosity. The conventional practice is to use the power law transformation using conventional HFU where percentage of error is considerably high. In this paper, neural network technique is employed as a soft computing transformation method to predict permeability instead of power law method to avoid higher percentage of error. This technique is based on HFU identification where Amaefule et al. (1993) method is utilized. In this regard, Kozeny and Carman (K–C) model, and modified K–C model by Hasan and Hossain (2011) are employed. A comparison is made between the two transformation techniques for the two porosity-permeability models. Results show that the modified K-C model helps in getting better results with lower percentage of error in predicting permeability. The results also show that the use of artificial intelligence techniques give more accurate prediction than power law method. This study was conducted on a heterogeneous complex carbonate reservoir in Oman. Data were collected from seven wells to obtain the permeability correlations for the whole field. The findings of this study will help in getting better estimation of permeability of a complex reservoir.

Keywords : permeability, hydraulic flow units, artificial intelligence, correlation
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