Klinkenberg Corrected Gas Permeability Correlation for Shuaiba formation. "An Experimental Investigation for use in Conventional Core Analysis in Shuaiba Formation"

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Abstract

Porosity and permeability are two important petrophysical parameters in formation evaluation. This is due to the fact that porosity distribution has a direct impact on hydrocarbon volumes in place while permeability distribution gives an indication about how producible the hydrocarbon accumulation is. Therefore a reliable description of porosity and permeability distributions is a key factor for understanding reservoir performance. Both parameters can be measured from well logs. Logging tools can in principle measure hydrogen content, magnetic resonance, acoustic velocity, neutron density etc, but none of these parameters is a direct measurement for porosity and permeability and relies on models or conversion keys, with underlying assumptions, for determining porosity and permeability distribution. This needs to be calibrated with real and direct measurements and this is area where core analysis comes in. Reservoir simulation is a way to model the behaviour of the reservoir over time. Different parameters are used to build the dynamic model such as porosity, absolute permeability, oil and water saturations ect. In this model, both water and hydrocarbons are present in the hydrocarbon zone. The permeability will therefore be the product of K*Kr, where K is the absolute permeability, together with viscosities of involved fluids, that will determine mobility and transmissibility between grid blocks in the dynamic model. Standard industry practice for permeability measurement in core material is to perform single point gas permeability measurement and use assumptions or correlations for correcting gas permeability. However, using correlations developed for specific fields/formations might be misleading as these correlations might not be applicable for the field under study. In this study, a comprehensive experimental investigation aiming at establishing one or several correlations to correct single point gas permeability measurement (standard conventional core analysis) for Klinkenberg effect will be used in conventional core analysis for Shuaiba formation. 175 core samples from

Shuaiba formation were selected for the experimental investigation. Multi-point gas permeability was measured for each core sample from which KL was evaluated. A correlation between KL and Kg was established:

$$K_L = 0.5787\ K_g^{1.0976}$$

The robustness of the derived correlation has been challenged by performing validity testing. This was done by using data from 95 core samples undergone direct multi point technique for KL from another study on the Shuaiba formation, i.e. used passively to test sensitivity of error using the derived correlation. A negligible error of about 2% has been found as a result of using the correlation.As a final stage of this study, Principal Component Analysis has been used to explore variance in measured data. Permeability was found to be the major controller of data variance and there are two groups of data representing Upper and Lower Shuaiba.