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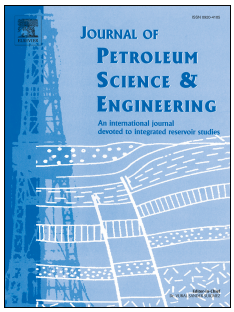

Modeling of the cementation factor and hydraulic permeability using Mercury Injection Capillary Pressure (MICP) measurements

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Modeling of the Cementation Factor and Hydraulic Permeability Using Mercury Injection Capillary Pressure (MICP) Measurements

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Abstract

Electrical models of the porous medium are widely used for the estimation of the volume fraction of fluids filling in the pore space. One of the input parameters into this type of models is the geometrical factor associated with the complexity of the pore network system also known as "cementation factor" used in Archie's saturation model. While this parameter can be measured in the laboratory, the aim of this work is to infer it from the pore size distribution (PSD), which in itself does not bear any information about the geometry of the 3D pore network. The proposed probabilistic model assumes a predefined geometry of the elementary cell, and uses PSD obtained from the Mercury Injection Capillary Pressure (MICP) measurements and porosity to predict the cementation factor. The model achieved a good agreement with an average value of the cementation factor measured on the numerous core samples obtained from the two fields investigated in this study. Geometrical considerations were also investigated through introduction of tortuosity and shape of the capillaries in the model to allow for the potential lithological variations of the reservoir rocks. Similar approach was used to estimate hydraulic permeability using the probabilistic model, and the results were tested against air permeability values measured in the laboratory.

Keywords: Cementation factor, Pore size distribution, Mercury Injection Capillary Pressure (MICP), Probabilistic model

1. Introduction

Estimation of the water saturation is one of the essential parts of the static and dynamic description of the reservoir. Accurate saturations are critical in volumetric calculations as well as understanding the sweep efficiency during flooding. Among the several existing techniques of saturation estimations in the petroleum industry, electrical methods are considered to be the most pragmatic and readily available, especially for an open hole environment. As in every method, the electrical model bears an uncertainty that is addressed either through abundance of core measurements or integration with other techniques. Archie's model and its modifications are by far among the most often used models expressed through equation (1) [1]. Parameters "m" and "n" commonly accepted as cementation factor and saturation exponent, respectively, are deemed to be characterizing the geometrical perturbations of the path of the electrical current through the conductive phase of the