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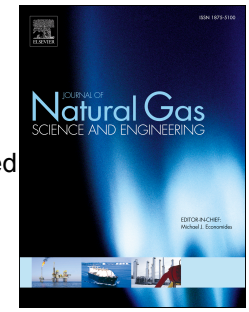

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Discussion on Similarity of Recovery Curves in Scaling of Imbibition Process in Fractured Porous Media

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Abstract

Spontaneous imbibition is the main production mechanism for water invaded naturally fractured reservoirs. The efficiency of this mechanism depends on different parameters such as fluid, rock and geometry properties of the matrix-fracture system. Upscaling of imbibition recovery curves from laboratory scale tests to field scale matrix blocks is important for properly characterizing and simulation of fluid flow in naturally fractured reservoirs. Distinct scaling equations have been presented in the literature presuming similarity of recovery curves. In the previous works, it was attempted that the recovery curves from different samples are scaled to a single recovery curve by presenting the recovery factors versus dimensionless times. The dimensionless times were obtained by multiplying the recovery times in a constant value. The various existing scaling groups mainly differ in the manner this constant value is defined. This work, proposes a framework to investigate the possibility of having a single scaled recovery curve by multiplying the recovery curve time in a specific constant value. Therefore, the similarity of recovery curves obtained by varying different matrix block properties is studied. Hence, numerous imbibition recovery curves are simulated by employing a commercial numerical reservoir simulator and their similarity is analyzed and calculated using an innovative similarity analysis method. Results of this research show that the proposed methods in the previous studies for scaling of imbibition data could fail where certain matrix block parameters including rock permeability, oil viscosity and oil-water capillary pressure have considerable differences. Therefore, one can say that actually a non-uniform shifting is required for scaling of recovery curves if the certain mentioned properties are different among the samples. It can be concluded that a new scaling method is required that incorporates time-dependent parameters to scale recovery curves to a single recovery curve.

Keywords: Curve similarity; Spontaneous imbibition; Upscaling; Naturally fractured reservoirs