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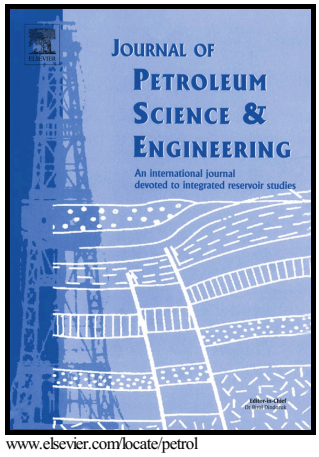

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Approximate semi-analytical modeling of transient behavior of horizontal well intercepted by multiple pressure-dependent conductivity fractures in pressure-sensitive reservoir

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Abstract:

Pressure sensitivity is a fundamental issue in the investigation of transient performance analysis in unconventional reservoirs. In this study, the focus is put on the transient behavior analysis for multi-fractured system with the effect of pressure sensitivity in fracture and reservoir. A generalized model is primarily formulated, where the details of fracture properties are taken into account. The corresponding semi-analytical solution is proposed by coupling fracture-reservoir flow model on the basis of linear superposition principle in the terms of Pedrosa's transform formulation (Pedrosa, 1986). Furthermore, an accurate and reliable algorithm is developed to solve the resulting nonlinear mathematical problem. The validation of semi-analytical model is demonstrated based on the fact that the results from this study agree well with those reported in the previous literatures, numerical simulation, and field performance.

On the basis of the model, the transient flow behavior is detected and analyzed in detail. Results in this investigation show that the system exhibits six typical flow regimes: pseudo-bilinear flow, pseudo-linear flow, pseudo-radial flow, compound-linear flow, compound-radial flow and fracture closure effect. The characterization of transient behavior depends on the intense of pressure sensitivity in the fracture and reservoir, and fracture property parameters including fracture conductivity, number, spacing and asymmetry factor. Likewise, the transient behavior has four unique features: (1) the pressure sensitivity causes a gradual increasing in both pressure drop and derivative over time due to the partial closure in fracture, until to the maximum; (2) the deviation of derivative from the non-pressure-sensitive case can be used to investigate the period when the partial fracture closure occurs, and the occurrence of maximal

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