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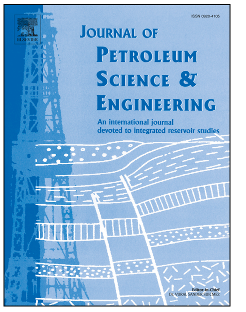

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Analytical Modeling of Linear Flow in Single-Phase Tight Oil and Tight Gas Reservoirs

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Abstract

Unconventional reservoirs, including tight oil, tight gas and shale gas are economically attractive, but operationally challenging, particularly for cases when complex flow behavior occurs within the reservoir. Accounting for the physics of flow in such formations is central to providing improved short- and long-term oil and gas production forecasts. At the early phase of development of these reservoirs, and in the presence of limited data, analytical models are more suited for mechanistic studies leading to improved understanding of the reservoir. Analytical models often utilize solutions to flow equations for liquids with constant viscosity, and small and constant compressibility. In tight formations, however, these assumptions simply do not apply as fluid and rock properties change with pressure drawdown. Historically, efforts have concentrated on linearizing the governing partial-differential equations to account for these effects by employing appropriately defined pseudopressure and pseudotime functions. A rigorous approach for determination of pseudotime includes the use of average pressure in the distance of investigation during transient flow.

In this work, an analytical expression for average reservoir pressure in the (dynamic) drainage area is derived for constant pressure and constant rate production scenarios. By deriving an explicit relation for average pressure in the drainage area as a function of the initial reservoir