SEMI-ANALYTICAL PRESSURE TRANSIENT MODEL FOR COMPLEX WELL – RESERVOIR SYSTEMS

by

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ABSTRACT

This research presents a semi-analytical model to obtain the pressure-transient response for vertical, horizontal, or multilateral wells in heterogeneous reservoirs. This model is based on the Green's function solution of the three-dimensional pressure diffusivity equation for single-phase flow in a bounded and homogeneous reservoir, following a methodology similar to the boundary element method. Reservoir heterogeneity is addressed by discretizing the reservoir into homogeneous subsections and imposing both flux and pressure continuity at the interface between contiguous subsections. Results from this semi-analytical model are compared and validated against results obtained from both the finite differences and the finite elements methods. It is demonstrated, through validation examples, that the semi-analytical model provides accurate results for heterogeneous reservoirs. This semi-analytical model also requires less discretization than either the finite difference or finite element methods in order to obtain the same level of accuracy at early times. The model has also proven helpful in computing the pressure response for tight reservoirs with localized heterogeneity in the near-wellbore region. Applications in production data analysis, identification of flow regimes, and pressure transient analysis for a hydraulic fractured horizontal well in a tight reservoir contacting a region with natural fractures are presented. The pressure response for hydraulically fractured horizontal wells contacting a natural fracture network indicates that the hydraulic fracture(s) control(s) the drainage of the region within natural

fractures, whereas the drainage of the tight reservoir is controlled by the naturally fractured region and reservoir permeability.

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