Texas Tech University - Department of Mathematics and Statistics
Seminar in Applied Mathematics

Fluid Flow through Porous Media in the Periphery of Darcy's Law

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ABSTRACT. Conventional treatment of oil flow in porous media assumes that oil is in the typical range of flow velocity and pressure, and it behaves as a Newtonian fluid. This assumption, however, may not be always accurate, especially for heavy oil. It is also not accurate in modeling injection behavior for fluids such as fracturing fluids, or polymer fluids for secondary recovery of oil. Sufficient literature has been published about Pre-Darcy flow in non-petroleum disciplines. Investigators dissent about the significance of deviation of Darcy's Law at very low fluid velocities. Most of their investigations are based on coarse unconsolidated porous media with aqueous fluid. However little has been published regarding the same for consolidated oil and gas reservoirs. If a significant departure from Darcy's Law is observed, then this could have multiple implications on: reservoir limit tests, under prediction of reserves, unrecognized prospecting opportunities etc. In our research we examine the solutions presented in the literature showing their limitations. We will examine the mathematical reasons for the problems and demonstrate rigorously that these (published) analysis techniques are impractical not only for real world problems but also for simulated data. Our in depth analysis explains away the problems analysts have had with the existing methodology. We also present a new reliable methodology for determining reservoir properties. The new methodology was tested on six real field data and two simulated datasets. The examples showed that the previously presented methodologies under-predict the permeability by at least 40%.