# Rheological Behavior of Single-Phase Non-Newtonian Polymer Solution in Complex Pore Geometry: A Simulation Approach

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## Abstract

Polymers are known for their ability to increase fluid viscosity and are among the most important components of various oilfield chemicals. One of the most important criteria for evaluating chemical enhanced oil recovery (EOR) and other related processes that use polymers is its complex rheological behavior in porous media which in turn accounts for other physical effects of adsorption and resistance factors during polymer-formation rock interactions. This behavior depends on the nature of the pore structure of the porous media and polymer system itself, as well as the interaction between the components in the polymer and the porous media. Furthermore, viscous dispersion is assumed to be localized only in the pore throats. Therefore, accurate computation of polymer rheological behavior in porous media is considered as an important aspect for accurate well pressure representation, pressure distribution far away from the wellbore and accurate predictions of injection rates since the economics are quite sensitive to rates of injection. As the viscosity of non-Newtonian polymer solution depends on shear rate, shear rate calculations must be accurate. However, complete knowledge of behavior of polymer solution in porous media has not yet been fully gained. For example, there are high, medium and low molecular weights polymers; knowing which one is best for a specific application including their operational efficiencies is still an issues.

In this study, a computational fluid dynamics (CFD) simulations implemented in COMSOL Multiphysics® interface (single-phase Laminar Flow) is used to simulate a 1D single-phase, non-elastic, high molecular weight xanthan gum flow in geometries approximating pore throats (Figure 1).

Simulation results show the degree of solution viscosity degradation at different inlet pressures and shear rates at varying pore constriction diameters. Results also revealed that numerical techniques can aid in design and interpretation of laboratory tests, field projects and predict the performances of polymer solution applications in actual field operational conditions.