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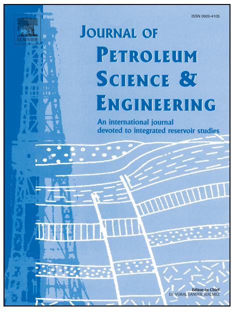

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Computation of polymer in-situ rheology using direct numerical simulation

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Abstract

In-situ rheology of synthetic polymers like hydrolyzed polyacrylamide, HPAM, cannot be directly calculated from bulk rheology. The in-situ viscosity of polymers will be influenced by shear history and local pore structure contraction / expansion. Transition from flux in porous media to bulk shear rate requires empirical correlations. The conventional approach for in-situ rheology is to define apparent viscosity vs. Darcy velocity and connecting Darcy velocity to bulk shear rate by using a correction factor, which generally depends on both polymer and rock properties.

Estimating polymer in-situ rheology is important for estimation of displacement pressure gradients and injectivity in the reservoir. In the following study, different models used to quantify the shear-to-flux correction factor are compared by using direct numerical simulation in 3D real rock images. We found that the models developed based on capillary bundle approach are not able to predict accurately in-situ rheology and microstructures of a rock sample can influence in-situ rheology. A novel approach is suggested to provide a more accurate prediction of in-situ rheology by adjusting appropriately bulk power index of the Carreau model before applying the correction factor. The pore scale simulations have revealed that the key parameters of porous media influencing in-situ rheology are pore aspect ratio and inaccessible pore volume.

Keywords: Pore scale modeling, apparent viscosity, polymer rheology μCT rock image, Direct Numerical Simulation.