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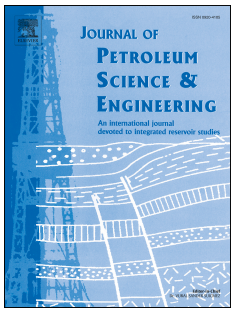

The influence of thixotropy in start-up flow of yield stress fluids in a pipe

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Abstract

In oil production in ultra-deep water fields, difficulties can appear in the transport of oils with high paraffin content. If the production stops and the produced fluid cools down inside the pipeline, paraffin crystals may appear and form an interlocking gel-like structure, usually exhibiting a thixotropic yield-stress behavior. The restart of the production line should be designed with reasonable precision, taking into account the complex behavior of the gel formed. The start-up flow represents the transient response due to a differential pressure applied to a single fluid initially at rest, and is highly dependent on the fluid rheological behavior and other properties. In the present work, we present experimental and numerical results of the start-up flow of yield stress fluids in a horizontal pipe. The experiments are performed using a flow loop and two different fluids, one thixotropic and another non-thixotropic. Rheological data and velocity profiles are obtained and related to the pressure drop, yield stress and thixotropy. Secondly, numerical results are obtained using the finite volume method to solve the mass and momentum conservation equations. A constitutive model based on the Oldroyd-B equation for viscoelastic fluids, is used to describe the thixotropic fluid behavior. The numerical results captured the main physical features of the flow, and showed a fair agreement to the experimental results.

Keywords: Viscoplastic fluids, yield stress, thixotropy, start-up flow