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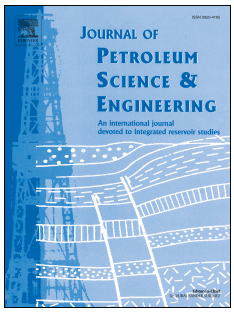

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Sedimentation of solids in drilling fluids used in oil well drilling operations

Nara Brandão Costa Santos [a,*], Flávia Marques Fagundes [a], Fábio de Oliveira Arouca [a], João Jorge Ribeiro Damasceno [a]

[a] Federal University of Uberlândia, School of Chemical Engineering, Av. João Naves de Ávila, 2121, Bloco 1k, Santa Mônica, Uberlândia/MG, ZIP Code 38.408-100, Brazil

[*]Corresponding author.

E-mail addresses: narabcs@hotmail.com (N.B.C. Santos), flaviamfagundes@gmail.com (F.M. Fagundes), arouca@ufu.br (F. de Oliveira Arouca), damasceno@ufu.br (J.J.R. Damasceno).

Abstract

Petroleum stands out as an important energy source. In oil well drilling operations, drilling fluids are used with the main purpose of cleaning and maintaining the hydrostatic pressure in the wellbore. Due to the importance of understanding solid-fluid interaction and the lack of quantitative studies on solids content in regions with high solids concentrations, this study evaluated the stability of drilling fluids. Rheological tests and gravitational and batch sedimentation tests with fluids differentiated by the addition of calcium carbonate assessed the separation dynamics as a function of time and position and determined the constitutive equations for pressure on solids, which are fundamental to solve models of flow through porous media. Gamma-ray attenuation, a non-destructive technique, quantified the local volumetric solids concentration in sedimentary regions. The results showed a shear-thinning behavior and thixotropic effects in the fluids and the influence of calcium carbonate on the sedimentation profile. The non-thickened suspension had lower values of apparent viscosity, higher sedimentation rates, and more compressible sediments than the thickened system. Thus, the formulation of drilling fluids affected the separation process in suspensions; for that reason, it must be adjusted to the operational conditions. This study contributed to increase rheological and stability knowledge on non-Newtonian suspensions.

Keywords: drilling fluids; rheology; suspension sedimentation; gamma-ray attenuation technique.

Highlights:

- Gamma-ray attenuation is a non-destructive technique that quantifies the volumetric solids concentration.
- Drilling fluids show shear-thinning and thixotropic behavior.
- When added to a suspension, calcium carbonate increases its stability.
- Proposal of constitutive equations for pressure on solids.
- Plotting of constant concentration curves for solids.