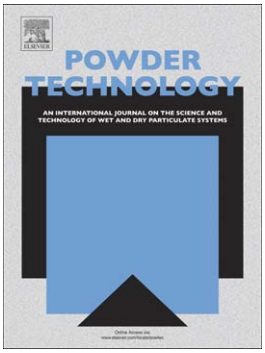


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Rida Elgaddafi, Ramadan Ahmed, Fred Growcock

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# Settling Behavior of Particles in Fiber-Containing Herschel Buckley Fluid

Rida Elgaddafi[a], and Ramadan Ahmed[a,1], and Fred Growcock
[a]University of Oklahoma, Sarkeys Energy Center, 100 E. Boyd St, , Norman, OK 73019, USA

**Abstract**

Fiber-containing, or fibrous, fluids are used in the Petroleum Industry to improve well-bore cleaning. Field studies indicate that fiber-containing sweep fluids can clean horizontal and highly inclined wells of drill cuttings very effectively. Fibrous fluids are also utilized in fracturing operations to place proppant particles within induced fractures. Efficiency of solids transport by these fluids depends on their ability to hinder settling of the dispersed particles.

This article presents results of experimental and theoretical investigations conducted on settling behavior of spherical particles in Herschel-Bulkley fluids containing chemically inert monofilament fibers 10 mm in length and 0.1 mm diameter at concentrations ranging up to 0.08% by weight. A model has been developed to predict particle settling velocity under transient and steady state settling conditions. Experiments were carried out with spherical glass particles 2 to 8 mm in diameter in a 100-mm fully transparent cylinder of sufficient length (2 m) to establish terminal settling conditions. Wall effects were minimized by maintaining a ratio of particle diameter to cylinder internal diameter ($d_p/d_{cyl}$) no greater than 0.08. To vary the rheological properties of the fluid, xanthan gum suspensions with three different polymer concentrations were used as base fluids. A moving digital video camera was used to track settling particles. The camera records were used to determine instantaneous settling velocity of each particle as a function of time.

In fibrous suspensions, resistance to settling is provided by both the base fluid (viscous drag) and the fibers (fiber drag). Fiber drag arises from mechanical and hydrodynamic interferences. Measurements of the terminal velocity of particles in the base fluids were used to compute viscous drag, while the terminal velocity data in the fibrous fluids was utilized to determine total drag (i.e. fiber drag plus viscous drag). Analysis of the data resulted in the development of an empirical correlation for the

[1] Corresponding Author: Tel: (405) 325-0745; Fax: (405) 325-7477; Email: r.ahmed@ou.edu