NORMAL STRESSES IN NON-BROWNIAN SUSPENSIONS: EFFECTS ON PARTICLES MIGRATION (MEASUREMENTS AND SIMULATIONS)

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While the viscosity of concentrated non-Brownian suspensions has been the subject of numerous studies, few attempts have been made to measure the normal stresses that develop when the concentration is high enough.. Their knowledge is however of importance especially because, according to the Suspension Balance Model proposed by Nott and Brady [1] and refined by Morris and Boulay [2], they are supposed to play an important role in the shear induced particle migration. In this model, the total stress in the suspension is split up into two parts: the fluid stress, Σ^f, and the particle phase stress, Σ^p. The migration is the result of the action of the particle normal stresses that have to be experimentally determined.

Here we present some experiments that have been performed in order to measure both the total normal stresses and the particle phase normal stresses. The total normal stresses are measured using two different geometries: the first one consists in two rotating parallel plates where the radial profile of the second normal stress is recorded and the second one is an annular Poiseuille flow cell. The fluid pressure is recorded in the parallel plates geometry. The suspensions are made of monodisperse spherical polystitrene particles (140mm in diameter) suspended in a mixture of water and Ucon oil. The particle volume fraction varies from 30 to 50%.

Once determined experimentally, the particle phase normal stresses are introduced in the Suspension Balance Model. The equations are solved using the Finite Volume Method. Comparisons with previous published studies, discussions, and validations are presented.

[1] Nott, P. R. & Brady, J. F. "Pressure-driven flow of suspensions: simulation and theory," J. Fluid Mech. **275**, 157–199 (1994)

[2] Morris, J. F. & Boulay, F. "Curvilinear flows of noncolloidal suspensions: the role of normal stresses," J. Rheol **43**, 1213–1237 (1999)