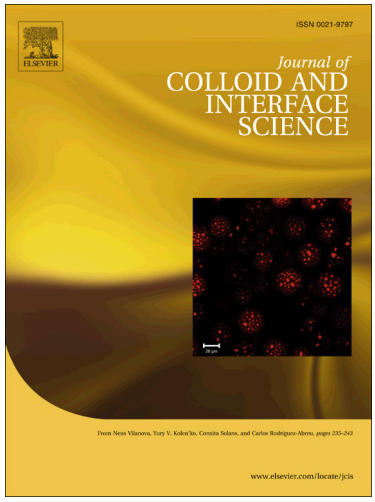

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PII: S0021-9797(16)30420-9
DOI: http://dx.doi.org/10.1016/j.jcis.2016.06.055
Reference: YJCIS 21365

To appear in: *Journal of Colloid and Interface Science*

Received Date: 8 April 2016
Revised Date: 23 June 2016
Accepted Date: 23 June 2016

Please cite this article as: B. Gheshlaghi, H. Nazaripoor, A. Kumar, M. Sadrzadeh, Effect of Intrinsic Angular Momentum in the Capillary Filling Dynamics of Viscous Fluids, *Journal of Colloid and Interface Science* (2016), doi: http://dx.doi.org/10.1016/j.jcis.2016.06.055

Effect of Intrinsic Angular Momentum in the Capillary Filling Dynamics of Viscous Fluids

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Abstract

In this study, an analytical model is provided to describe the filling dynamics of a capillary filled with a viscous fluid containing spinning particles. The aim is to demonstrate the effect of angular momentum on the capillary filling dynamics of molecular fluids which has not been explored before. The presence of spinning particles generates additional coefficients of viscosity, namely, spin viscosity and vortex viscosity, which couples rotational and translational movements. Three different time stages have been noticed during the capillary filling phenomenon: inertia force dominated, visco-inertial, and viscous-dominated regions. The last two regions are found to be mainly affected by the spinning particles. An increase in the spin and vortex viscosities is found to increase the viscous force and thus reduce the front position of the moving liquid. The results of this study are validated using the literature no-angular-momentum (NAM) base-case results and an excellent agreement is observed.

Keywords: Capillary filling dynamics, molecular fluids, rotational, vortex viscosity, spin viscosity

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