

Particle Migration in Free-surface Flows: Die-swell and Slot Coating

I. R. Siqueira¹ and M. S. Carvalho²

¹ *Department of Chemical and Biomolecular Engineering, Rice University, Houston, TX, USA*

² *Department of Mechanical Engineering, Pontificia Universidade Catolica do Rio de Janeiro (PUC-Rio) Rio de Janeiro, RJ, Brazil*

ISCST-20180918PM-B-PC6

Presented at the 19th International Coating Science and Technology Symposium,
September 16-19, 2018, Long Beach, CA, USA[†].

Abstract

Many industrial applications deal with free-surface flows of complex liquids composed by solid particles suspended in a viscous continuous phase. In these cases, shear-induced particle migration leads to a non-uniform particle distribution in the flow, which, in turn, might affect the flow pattern and particle structure in the final product. We study the effects of particle migration on the flow behavior and particle distribution in two free-surface flows of relevant importance in engineering applications: die-swell and slot coating flows. In the first case, we found that, at high enough concentration, particle migration drastically changes the stress field in the flow and leads to a die contraction under the free surface. In the second case, we observed that the final particle distribution at the coated film is a strong function of the operating conditions of the process, such that particle migration has important effects on the operating window in slot coating of particle suspensions. In both cases, the results show that particle migration dramatically changes the flow dynamics when the suspension is compared to a Newtonian liquid with the same average bulk properties, highlighting the importance of considering this phenomenon in accurate flow modelling.

[†] Unpublished. ISCST shall not be responsible for statements or opinions contained in papers or printed in its publications.