# Slot Coating Flows of Elongated Particle Suspensions

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Slot coating is one of the preferred methods to obtain a thin and uniform liquid layer over a moving substrate. In many industrial applications, such as in the manufacturing processes of magnetic tapes, specialty papers, imaging films and flexible electronics, the coated film must have a particular microstructure in order to function as intended. The coating liquid is usually not a Newtonian fluid and in some particular applications, it is a suspension of elongated particles. The rheology of these systems may be quite complex and depends on the particle concentration and orientation with respect to the flow. Moreover, particles can migrate driven by different mechanisms leading to a non-uniform particle distribution in the flow. The fundamental understanding of this problem and its impact on the coating process are not well understood.

The main goal of this work is to analyze slot coating flows of elongated particle suspensions, investigating particle distribution and particle alignment in the flow, especially at the film formation region. The suspension consists in rigid, non-colloidal elliptical particles dispersed in a Newtonian solvent liquid, so that its viscosity is given as a function of the local concentration and particle axis aspect ratio only. Particle migration is described by the well-known Diffusive Flux Model, and the average particle orientation is given by a conformation tensor. Furthermore, since the particles are non-spherical, their average orientation in the flow can be considered as a source of an additional stress depending on the conformation tensor. The conformation evolution and the constitutive equation for the additional conformation stress are adapted from classical models used to describe the behavior of rod-like polymer molecules that are almost or completely rigid. The complete mathematical model for elongated particle suspensions proposed here consists in mass and momentum conservation, particle transport and conformation evolution equations, and it is applied to free surface slot coating flows. The resulting set of nonlinear differential equations is solved using Galerkin's Finite Element Method together with Newton's Method. The results show particle distribution and particle orientation at the film region in function of typical operating parameters of the process, such as substrate speed and film thickness.