Two-limits of confined dip coating flow

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Dip coating is a one of the most widely used film fabrication methods. In this post-metering coating method, the force balance among viscous force, gravity and capillary force near the curved meniscus determine the film thickness. To predict the thickness, various models are proposed for dip coating flow analysis, but the most of them assumed that the container wall is far away from the moving substrate, i.e, "infinite" pool assumption. This ensures that the curvature of the liquid/gas interface vanish as far away from the moving substrate. When the distance of between a wall of container and a substrate is not far enough, especially for the small container, such condition is not guaranteed. In this case, the wetting effect of wall of container and the confinement effect cannot be neglected because the shape of the liquid/gas interface can be changed significantly. The change of the interface results in changing capillary force, which arise due to its curvature and surface tension. In this research, influence of the wetting effect and the confinement effect on the film thickness is analyzed by the finite element computation. Confined dip coating system was investigated by the solution of the two-dimensional Navier-Stokes equation for free-boundary flows. From the results, the two distinct flow regimes are identified: meniscus-control and channel-control regimes.