Scraping Non-Newtonian Power-Law Paint

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Abstract

A similarity solution to Taylor's paint scraper problem for the flow of a non-Newtonian power-law fluid is presented. A shooting method numerical solution agrees with the results found for Newtonian fluids and is able to capture both shear-thinning and shear-thickening fluids. Simulations created in COMSOL Multiphysics® software are also presented to corroborate the shooting method and display the character of the results. The resulting equations are solved analytically in several limits. The effect of temperature dependent rheology is examined by using COMSOL software to couple the solution from the temperature field into the nonlinear viscosity.