Simulated Rheometry of a Nonlinear Viscoelastic Fluid

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Abstract

Introduction
The modeling and simulation results of the rheometry of a highly viscous nonlinear viscoelastic fluid will be presented in this contribution.

In certain cases, the accuracy of measurements with a rotational rheometer can be influenced by inefficient thermal management, by the heat generated in the sample, or by rod-climbing due to the Weissenberg effect.

Use of COMSOL Multiphysics®
We investigate the effect of these phenomena with simulations in COMSOL Multiphysics®. Our model is based on the axial symmetric (2D) formulation of the two-phase flow with the level-set method, including swirl velocity. The rheological constitutive equation is implemented in general PDE mode, coupled to the flow problem. Here we use an upper-convected nonlinear Maxwell model with shear-thinning viscosity, which is based on a lumped parameter model derived from standard rheometry measurements. The model is completed by coupling a heat conduction problem for the simulated measuring device.

Our primary goal is to get and give insight into the process of a simulated rheometric measurement with concentric cylinder geometry, by computing and analyzing the most important physical quantities.