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# Large Amplitude Oscillatory Shear Flows for a Model of a Thixotropic Yield Stress Fluid

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**Abstract**

It has recently been shown that the PEC (partially extending strand convection) model of Larson is able to describe thixotropic yield stress behavior in the limit where the relaxation time is large. In this paper, we discuss the behavior of the model under an imposed periodic shear force $\tau(t) = A + B\sin(\omega t - \Phi)$. We identify regimes of fast, slow and yielded dynamics and discuss the overall behavior of the system in dependence of the parameters $A, B, \omega$ and $\Phi$. The method of averaging turns out to be a crucial mathematical tool for the analysis.

The scale of the period of the oscillation relative to the times over which yielding and unyielding occur has a crucial influence on the qualitative dynamics.

*Key words:* Large amplitude oscillatory shear flow, PEC model, yield stress, singular perturbation, averaging method.

## 1 Introduction

Many fluids such as pastes, suspensions and colloids show a yield stress phenomenon. That is, they will start flowing only if the applied stress exceeds a critical value. "Traditional" theory of yield stress fluids is typically formulated in terms of generalized Newtonian models such as the Bingham or Herschel-Bulkley model.

However, experiments on many yield stress fluids show phenomena which are well outside the realm of Bingham-like models. For instance, stress overshoots

[1] This paper is dedicated to Ken Walters on the occasion of his 80th birthday.