Preliminary Efforts in Simulation of molding of a polypropylene melt reinforced with long glass fibers using transient shear rheology

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The purpose of this work is to associate the rheological behavior of long glass fiber reinforced polypropylene with the transient evolution of fiber orientation in simple shear in an effort to ultimately model fiber orientation in complex flow. A sliding plate rheometer was designed to measure stress growth in the startup and cessation of steady shear flow. Results were confirmed by independent measurements on another sliding plate rheometer. A fiber orientation model that accounts for the flexibility of long fibers, as opposed to rigid rod models commonly used for short fibers, was investigated and results are compared with experimentally measured values of orientation. The accuracy of this model, when used with the stress tensor predictions of Lipscomb and Dinh-Armstrong, is evaluated by comparing against experimental stress growth data. Samples were prepared with random initial orientation and were sheared at different rates. Results show that fiber flexibility has the effect of retarding transient fiber orientation evolution. Additionally, it is shown that the stress growth measurements provide results that are not fully explained by the chosen models. Preliminary efforts at simulating molding operations of these materials based on the knowledge generated in simple flows are presented.