ABSTRACT

The redefinitions of the energy policy of the US have multiple fronts. One objective of the DOE is to enforce the development of new lightweight materials with identical or better properties than existing materials. The goal is to reduce the weight of vehicles by 23% (in comparison to 2002) by 2010. One of the promising alternatives under consideration is injection molding parts made of polymers reinforced with large aspect ratio particles (i.e. long fibers or nanoparticles). However, these types of parts have not been successfully manufactured because of the unknown molecular behavior of the materials during processing. In this research we are trying to extend the Doi’s theory for rod-like systems to simulate the rheological behavior of these composites. A numerical code is being written to simulate the flow of fiber suspensions in injection molding flow geometries. The preliminary results of the simulation for shear flow shows that the model can reproduce the experimental data under stress growth conditions. The code has been validated in shear and elongational flow which are used to determine matrix parameters.

BACKGROUND

High Strength Weight Reduction Materials
Office of FreedomCAR and Vehicle Technologies

To identify and develop materials and processes which can contribute to weight reduction without sacrificing strength and functionality:
- Increase the fuel efficiency
- Reduce emissions of class 1-8 trucks

GOAL

To combine numerical simulation and experimental programs to confirm the prediction of microstructure in both glass and nano-particle reinforced thermostplastics

OBJECTIVES

- To simulate the mold filling process for thermoplastic melts reinforced with short fibers, long fibers and nano-particles of high aspect ratio using constitutive relations (i.e. stress tensors coupled with a generation expression) which allow coupling between the flow and particle orientation.
- A key aspect of this work will be an experimental evaluation of the predicted fiber or particle orientation distribution throughout an injection molded part.

INNOVATION

Use of constitutive relations, which contain the micro-structural aspects of the reinforced melts and viscoelastic effects.