Note on Contraction flow for Characterization of Extensional Rheological Properties

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ABSTRACT

Processing of viscoelastic materials involves a significant amount of extensional flow, which has an impact on both the processing technology and the final properties of the product. Since many of such materials are non-Newtonian elastic liquids, any change in geometry during the process generates a flow with an extensional component.

Despite the documented influence of extensional viscosity in processing, it is seldom measured due to experimental difficulties. There is commercial equipment available for dilute solutions and for polymer melts. Neither of these methods are suitable for viscoelastic materials such as foods, which have a shear viscosity significantly higher than dilute solutions, but are not solid enough for a melt rheometer.

A new test method has been developed suitable for viscoelastic foods and similar fluids using extensional flow in a designed contraction flow geometry. In the method the transient stress is measured under constant extension rate through a specially designed contraction nozzle. The method has been used for measurements of the extensional rheology of e.g. dough and dairy products.

The results from contraction flow are shown to be comparable to filament stretching results for model systems. The method is also shown to distinguish between different dairy products which behave similarly in shear. Contraction flow can be used as a laboratory method as well as in a process line.