A NON-ISOTHERMAL STUDY OF RHEOMETRY WITH INTENSIVE BATCH MIXER DATA

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Abstract

Intensive batch mixers (e.g., Brabender, Haake) have proved to be useful devices to investigate the rheological behavior of polymeric materials in that 1) the conditions (flow environment) of the measurements are very similar with that of actual processing, 2) estimation of viscosity changes by reaction during processing (e.g., reactive compatibilization, chain modification) are relatively easy to evaluate in comparison with other rheometers and 3) viscosity of material which is hard to measure with conventional rheometers is relatively easy to obtain.

Recent studies of the rheometry with the intensive batch mixers propose mathematical models which attempt to extract the viscosity and shear rate from the measured rpm and torque. Basically, those models assume that the flow dynamics of the intensive batch mixer is equivalent with that of the two adjacent cylinders. The discrepancy of the geometries between model and actual rotors can be compensated successfully by introducing a (or a few) parameter which is derived by mathematical manipulations and verified by comparison with experimental results. But there exist potential limitations for using the models that 1) rheological information from other rheometry (e.g. consistency) is needed in order to extract the viscosity data, and 2) the flow is assumed to be isothermal independent of operational conditions.

This study investigates non-isothermal behavior inside the mixer by two dimensional simulations with a commercial FEM package, which give many virtual experimental results with various geometrical, material and operational conditions. From the results of the simulations, the optimized model parameter can be determined without any other rheological information, and the predictions of the rheometry with the optimized parameter show good agreement with the experiments.