

Draw resonance instability in spinning process with viscoelastic Giesekus model

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Melt spinning is one of the representative extensional deformation polymer process. Thin and highly-oriented polymeric filaments with enhanced mechanical properties, are produced by using this process. The polymer melt is extruded from the spinneret and axisymmetrically stretched at the take-up position faster than extrusion velocity and then solidified inside the spinline region.

Periodic fluctuation of state variables, called draw resonance, occurring when draw ratio is increased beyond its critical value. In this study, linear stability analysis was performed for determining onset points and drawing stability windows. Giesekus fluid model, which is capable of portraying the mobility of molecule, and extensional-thickening and extensional-thinning behaviors was adopted. And theory of kinematic wave was applied for explaining physics of draw resonance in terms of traveling wave perspective. In addition, the effect of extensional properties on the stability was systematically investigated.