Crystallization Kinetics and Stability in Film Blowing Processes

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The complicated dynamics and transient stability of the nonisothermal film blowing process have been examined using a newly expanded model with the crystallization kinetics equation. Unlike the published simulation results on film blowing, this new model doesn't assume the boundary condition of the bubble radius at the freezeline height having the zero bubble slope with respect to the axial spatial coordinate. Instead, the governing equations of the system produce this important result as part of the solution of the set of the partial differential equations. The results by the new model in this study clearly show better agreement with experimental data in both steady state and transient response of the system. Simulations of film blowing by orthogonal collocation and finite elements(OCFE) now cover the entire axial distance from the die exit to the nip rolls in revealing the dynamic behavior of the film in terms of various state variables such as stress, temperature, velocity, thickness, bubble radius, etc. For instance, stress profiles do not portray the unreasonable overshoots near the freezeline height and transient solutions yield temporal curves of the bubble radius during draw resonance correctly exhibiting the skewness.