EXPERIMENTAL AND THEORETICAL ANALYSES OF FILM CASTING PROCESS

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ABSTRACT

A film casting process of polymer melts was discussed in this report and, in particular, the experimental measurement for rheological properties in film casting was carried out using with polypropylene and low density polyethylene. As a result, no remarkable difference in the viscoelastic properties was observed between two polymers except for the elongational ones. Low density polyethylene showed a remarkable increase in the elongational viscosity at high strain. Serious differences in the elongational properties were observed in the behavior of the necking phenomenon in the experimental film casting process. The necking width at the film edge of polypropylene was increased under the condition of higher draw ratio. However, in the case of low density polyethylene it was nearly constant and independent of the draw ratio. From these experiments, we concluded that the necking phenomenon in film casting depends on the elongational properties. Furthermore, to clarify the behavior in film casting, the flow simulation was carried out using three rheological models (the Newtonian, the Bird-Carreau and the Giesekus models) and their applicability was evaluated respectively. The simulation results on the necking phenomenon and film thickness distribution calculated with the Giesekus model was quantitatively agreed

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with the experimental ones for two polymers used in this study. For low density polyethylene with the remarkable increase of elongational viscosity at high strain, in particular, we clarified that the Giesekus model is suitable for the simulation of the film casting process, but other ones (the Newtonian and the Bird-Carreau models) are not applicable owing to the inaccurate expression in elongational viscosity.