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INFLUENCE OF MATERIAL PROPERTIES OF EACH LAYER ON THE DEFORMATION BEHAVIOR OF MULTILAYER FILM IN A TRANSVERSE STRETCHING PROCESS

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In recent years, the needs for film market have increasingly diversified and it is desired to develop higher-value-added films. The multilayering of films is one of effective methods to increase the added value of film products. However, a multilayer film composed of several resins with different characteristics exhibits extremely complicated deformation behavior in a stretching process. The uniformity of film thickness closely related to film deformation behavior seriously affects the important quality of film product. Therefore, it is important to understand the deformation behavior of film in detail. Though reports on the deformation behavior of film in a casting process can be somewhat found, those in a stretching process can be hardly founded. This work has examined the influence of material properties of each layer on the deformation behavior of multilayer film in a transverse stretching process with a tenter by a finite element method (FEM). Numerical analysis by an FEM has been performed in order to examine the influence of material properties of the central layer of three-layer film on the deformation behavior of multilayer film in a transverse stretching process under several stretching conditions, where the previously proposed stress-strain expressions were used as a constitutive equation. The predicted film thickness distributions in the transverse (width) direction by an FEM were in good agreement with experimental ones by a pilot plant. These results support that a proposed model by an FEM may predict the deformation behavior of multilayer film in a transverse stretching process. According to numerical analysis, it has been found that the control of the material properties of each layer makes possible the control of thickness distribution in the transverse direction.