Constitutive Modeling of the Mechanics of Polyethylene Films in Stretch Wrapping Processes

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Abstract. This study contributes to the optimization of lightweight packaging concepts regarding their stability. A very widespread packaging concept is the distribution of goods on a pallet whereas a Polyethylene (PE) stretch film stabilizes the lightweight structure during the shipment. Usually, a stretch wrapping machine applies this stretch film to the pallet. Stiffness and internal stresses of the applied stretch film decisively determine the cohesion of the packaging system but they are difficult to adjust, as the strain history during the wrapping process has a decisive influence on the mechanical behavior of the stretched film on the pallet. Accordingly, the designer has to reflect the strain history dependent mechanical behavior of stretch film to make optimum use of the packaging material. For this purpose, this study experimentally calibrates a constitutive model of the stretch film. The calibrated model enables us to compute the result of the wrapping process depending on the process parameters during stretch wrapping. We use this result as a base for further numerical and experimental investigations on pallet stability.

Keywords: pallet stability, mechanical characterization under process conditions, tertiary packaging, packaging, stretch film, wrapping process, constitutive model