Influence of amorphous thermoplastic polymers behaviors on the filling of micro cavities during hot embossing process

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Abstract

An important challenge in the simulation of the Hot Embossing process is the modeling of the unfilled shaped mould. The fact that the unfilled area exists is due in many cases to an inappropriate behavior law applied to embossed polymers. This study investigated the influence of the elastic-viscoplastic behaviour on the filling efficiency of two amorphous polymers during the micro–Hot Embossing process. For two amorphous polymers (PMMA and PC), mechanical tests were performed at 20∘C and 30∘C above their Tg. The viscoplastic parameters are characterized based on stress–strain curves from the compression relaxation tests under different strains and strain rates. The 2D numerical models were applied in FEM simulation with different temperatures to analyse the filling efficiency of micro cavities. The effects of temperature, imposed displacement and pressure, associated with the friction coefficient on the filling ratio were investigated with two polymers. The replication of a micro cavity was effectuated on the polymer plate by using a metallic micro-structured mould. The hot embossing process was performed under various loading conditions. The micro features were successfully replicated on the polymer. The comparison between the experimental and numerical results confirmed the efficiency of the numerical approach. **Keywords:** micro–Hot Embossing, Two-Layer Viscoplastic model, numerical modelling, micro cavity, experimental validation.

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