P-4-256

VARIOTHERMAL EXTRUSION EMBOSSING FOR MANUFACTURING OF MICRO-STRUCTURED FILMS

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In order to produce large quantities of micro-structured films in a fast and economic way, the variothermal extrusion embossing process excels as a one-step-process. The variothermal modification of the common extrusion embossing process, using an internal liquid cooling system in addition to an external heating system, allows to meet the challenges regarding the complex temperature profile that is required along the circumference of the embossing roll. Hence, applying variothermal heating concepts for the extrusion embossing process enables the production of micro-structured films.
At the Institute of Plastics Processing (IKV), laser-based and inductive heating concepts are developed and tested. For the current experiments, the cylindrically shaped surface structure of the leaves of the lotus is chosen as a functional prototype surface structure and replicated applying the variothermal extrusion embossing process. Holes with diameters ranging from 5 µm up to 20 µm and aspect ratios around 1 are studied in order to replicate the bionic abilities of the lotus - water does not stick to the surface resulting in its self-cleaning ability. A second generation of embossing rolls enables the analysis of even larger aspect ratios (up to 2.5 presumably improving the self-cleaning effect) in order to study the challenges that occur during the haul-off of the micro-structured film as well as during the filling process of the micro-scaled holes. Furthermore, the laser-based and inductive heating concepts are compared with respect to their suitability to further improve the accuracy of the replication process. The influence of processing conditions as well as of the processed material itself are considered.