

A calibrated integrative Simulation Model for Blown Film Extrusion

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Increasing the capacity of a blown film line is the major task to gain a more efficient production plant. Still the film cooling system is the device which sets the upper limit for the whole plant. Developments in the recent past have shown that thanks to computational blown film-calculation models it is theoretically possible to optimize or even redesign cooling systems. This work deals with the development of such an integrative computational model to predict the bubble shape in the tube formation zone, taking into account the interaction of the cooling air flow and the molten polymer. It is based on an iteration process which contains the linkage between the bubble deformation and its interaction with the air flow. Thus the contour calculation algorithm based on the rheological model of Phan-Thien and Tanner has been linked with a CFD-Program in an iteration circle. To gain a tool which is suitable for industrial usage, this contour calculation model is not founded on rheological experiments as it has been done in the past. To avoid this, a calibration of the contour calculation procedure is invented to fit the necessary polymer data by means of experimentally determined set of bubble contours. This set contains data of varying blow up ratios, film thicknesses and process condition set up by the machine operator. By using this form of calibration the amount of determined data is reduced to a few photographically detected bubble shapes to make the rheological model well suited for the prediction of film blowing process. Furthermore a simple approach taking into account the rheological elongation viscosity depending on the stretching directions is introduced. In comparison to experimentally determined bubble shapes it could be outlined, that using this kind of calibration varying process condition can be predicted.