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Combination Model of Dispersed and Compacted Solids Melting

Helmut Potente (a), Jens Pape (b), *Karsten Anger (a)

(a) *KTP/Institut für Kunststofftechnik, University of Paderborn, Germany*
(b) *Pape GmbH, Porta Westfalica, Germany*

To describe the process simulation of single screw extruders the solid melting behaviour is one of the main tasks. In general compacted and dispersed solids melting can be distinguished. A thin melting layer between the barrel wall and the solid bed is observed for conventional screw designs and most polymers, whereas the melt is transported into the melt pool. The dispersed solids melting behaviour is based on the melting of small particles, which move within the hot melt matrix along the screw channel. In this concept the solid bed breaks up and the single particles are melted separately.

Experimental investigations in single screw extruders have shown that the dispersed solids melting concepts, like wave- or pin-screws, lead to a wide distribution of sizes of the polymer particles. It can be observed that next to very small particles there are also very large solid agglomerates. The effort to describe this distribution is doomed to failure because of the complexity of the melting procedures and the lack of knowledge about the relevant material parameters. Despite of these practical experiments the models to describe the dispers and the compacted solids melting behaviour are useful to predict the real melting procedures. The dispersed solids melting model is able to display the solids melting procedures with a small fraction of solid very well, whereas the compacted solids melting model represents the procedures with a small melt fraction much better.

Both states exist side by side in the changeover area, which can be described with a mathematical superposition approach. To use the combination model for the common interval the two models are conformed to the current solid fraction, because with a separate reflection the models show different melting lengths over the screw length.