EXPERIMENTAL STUDY OF MATERIAL DEGRADTION OF HIGH-MOLECULAR WEIGTH POLYPROYPLENE IN THE MELTING ZONE OF A CO-ROTATING TWIN SCREW EXTRUDER

Hans-Jürgen Luger, Michael Wenninger and Jürgen Miethlinger

Institute of Polymer Extrusion and Compounding, Johannes Kepler University Linz, Linz, Austria

During compounding up to 80 % of the mechanical power input is used for plasticizing of the polymer resin, which could cause non-retrievable material degradation. Hence, realizing efficient and low energy plasticizing is a crucial approach to achieve high-compound properties and high output rates.

The aim of the present work was to study the influence of the screw configuration in the melting zone of a co-rotating twin screw extruder (Leistritz ZSE27MAXX 24 L/D) on the melting capacity with respect to melt quality and temperature homogeneity. Material degradation was determined by means of rotational rheology and verified by Size-exclusion chromatography (SEC).

Processing in a twin-screw extruder involves a considerable amount of elongational flow, which is known to be favorable for dispersion of agglomerates. Significant melting in a twin-screw extruder only occurs in fully filled zones and is characterized by the DSM (Dispersed Solids Melting) mechanism. Consequently breaking up solid particle agglomerates by elongational flows created with special screw geometries is a very efficient way to accelerate plasticizing. Therefore, eccentric triple-flighted kneading blocks as well as high pitch conveying elements were compared to standard double-flighted kneading blocks.

The results of these investigations showed that triple-flighted kneading elements led to a higher temperature level, but a more homogeneous temperature profile in the screw channel than double-flighted. On the other hand the degradation of the triple-flighted elements is higher. Especially the number of triple-flighted kneading elements is highly decisive for the degradation. The high pitch conveying elements were promising with respect to energy consumption and melt temperature.