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INVESTIGATION OF THE PLASTIFICATION BEHAVIOUR OF POLYMERS IN HIGH SPEED CO-ROTATING TWIN SCREW EXTRUDERS

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The objective of this work is to study the initial plastification process of polymers in co-rotating high speed twin screw extruders by experimental and numerical investigations in order to have a basis for the development of new melting models, which are applicable to describe the onset of plastification. The plastification is still one of the most important tasks of the twin screw extruder, because up to 80% of the energy input in a twin screw extruder takes place in the plastification zone. The fundamental knowledge on the initial plastification process is extremely limited up to now. Common melting models are only valid if a first meltpool exists. The optimization of the plastification process offers a very high potential for an increase of the economic efficiency (energy savings and throughput increase) as well as an improvement of the product quality. The responsible mechanisms for the plastification of polymer granules are friction, heat transfer, plastic and viscous deformation, which occurs coupled inside the processing unit. The distinctive evaluation of these different mechanisms, depending on the screw position, is one of the main goals of this work. To be able to describe the melting process in the extruder completely, it is necessary to consider different material and different process parameters like screw configuration, screw speed, throughput and barrel temperature. Furthermore, the melting zone as well as the conveying zone needs to be considered because the heating of the polymer granules in the conveying zone cannot be neglected. To analyze the preheating of the polymer granules passing through the conveying section, numerical investigation (discrete element modelling) has been coupled with experimental investigation. Both, the numerical and the experimental results are further used to understand more detailed what happens during the plastification process.