The role of feeding conditions in twin-screw extrusion of PP/MWNT composites

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In todays market different types of commercial multiwalled carbon nanotubes (MWNT) are available, which differ in their characteristics such as e.g. length, diameter, purity, agglomerate density and strength, and functionalization. On the basis of these structural properties an individual optimization of extrusion melt mixing may be required. This means that the processing conditions such as screw configuration, mixing speed, temperature profile, throughput, and the way of filler feeding have to be adapted for respective type of MWNT.
In our investigation electrically conductive compounds containing Baytubes® C150P and Nanocyl™ NC7000 were prepared. In a first set, composites were produced using a DSM Xplore 15 twin screw microcompounder. The different structural properties of both carbon nanotubes materials induced different electrical percolation thresholds in the polypropylene (PP) composites which were found for Nanocyl™ NC7000 between 0.5 and 1 wt% and for Baytubes® C150P between 1 and 2 wt%. In a second set, the optimization of the feeding conditions was performed for both nanotube types using a twin-screw extruder ZE25 (Berstorff) with the aim to achieve the highest electrical conductivity. The MWNT were fed either in the main feeder or using a side feeder. All runs have been realised under the same conditions (speed, throughput, temperature). The electrical conductivity measured on pressed plates and injection moulded samples as well mechanical properties were found to depend on the feeding location of MWNT.
According to the results on different compositions, Baytubes® C150P material is recommended to be added at the main feeder together with the polymer granules, whereas Nanocyl™ NC7000 material is recommended to be added using the side feeder. The macro dispersion of MWNT agglomerates as observed using light microscopy on thin cuts was significant changed when comparing both feeding methods.

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