LONG CHAIN BRANCHING AS INNOVATIVE TOOL FOR THE UP-CYCLING OF POLYPROPYLENE POST-CONSUMER WASTE

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Polypropylene (PP) with a share of 19.2% on European plastic demand is the second most important commodity polymer. Nearly half of the produced PP ends up after a short period of use as post-consumer waste [1]. Recycling rates of PP are increasing since years, but converting PP-waste into a valuable resource is still a challenge and needs scientific research from a different perspective.

Long chain branching (LCB) is known as a suitable method to introduce strain-hardening behavior to virgin polypropylene (PP) and increases thereby the melt strength [2]. In our study, LCB is shown as an innovative up-cycling tool for value adding to PP from household post-consumer waste. Within our feasibility study, we started to investigate the influence of polymeric impurities like polyethylene with high density (PE-HD) first. Model mixtures from PP containing 10% PE-HD were prepared, chemically modified and compared with PP without impurities. The same study was repeated with real post-consumer material from household plastic waste. The melt properties were improved in any case, independent of the PE-HD in the blend. However, the mechanical properties showed mixed results, especially in the case of the post-consumer feedstock, the material suffered from the formation of highly branched gel particles and an unfavourable viscosity ratio of the PE-HD impurities.

Consequently, we concentrated on single polymer PP post-consumer waste and continued our investigation on the influence of different PP types and therefore different molar masses on the LCB formation itself. PP-types with higher molar masses, like for water pipe systems, show lower yield of LCB compared to an injection moulding PP-type with low molar mass.

Due to the promising results from the pre-experiments, we also performed up-scaling experiments on a lab-scale single screw extruder.

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[1] PlasticsEurope - Plastics-The facts 2016

[2] Gotsis, A. D., B. L. F. Zeevenhoven, et al. (2004). "Effect of long branches on the rheology of polypropylene." Journal of Rheology 48(4): 895-914