Influence of cooling conditions on the structural morphology of high-density polyethylene

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High-density polyethylene (HDPE) is a semi-crystalline polymer, with its crystallinity significantly affecting mechanical and chemical resistance properties [1]. The crystal morphology consists of lamellae that form spherulites, while the amorphous chains are situated between the individual lamellaes [2]. By varying the crystallization temperature (T_C) the size of the resulting crystalline lamellae can be altered [3].

This study investigates various cooling conditions for the crystallization of HDPE, including different crystallization temperatures and cooling rates. A polymer solution with an organic solvent is utilized to enhance consistency. Figure 1 illustrates the experimental setup used for the process.

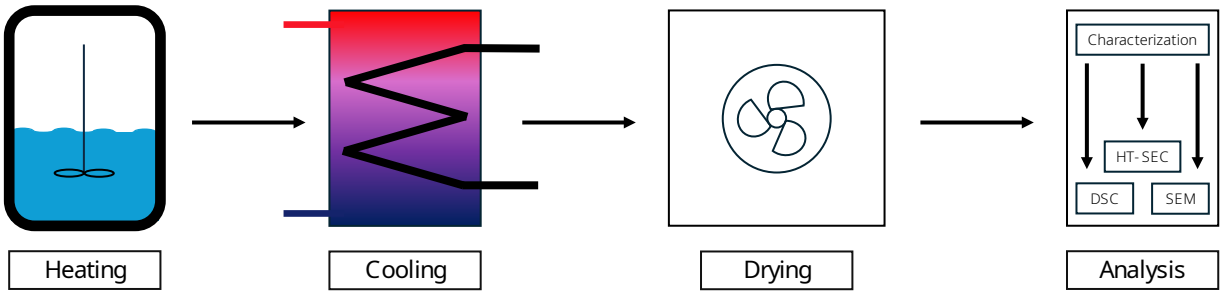

Figure 1: Experimental setup for the thermal treatment and characterization of the polymer solution.

The polymer solution is heated up to temperatures around the polymer´s melting point and then cooled at different conditions using a heat exchanger. The solvent is evaporated in a heating cabinet at low temperatures to maintain the structural integrity of the material. The dried polymer is characterized using Focused Ion Beam – Scanning Electron Microscopy (FIB-SEM). The resulting images are correlated with crystallinity data obtained from Differential Scanning Calorimetry (DSC) and the molecular weight distribution measurements using High Temperature – Size Exclusion Chromatography (HT-SEC).

Keywords: High-density polyethylene, SEM (scanning electron microscopy), crystallinity

Acknowledgments
The authors acknowledge financial support through the COMET Centre CHASE, funded within the COMET – Competence Centers for Excellent Technologies program by the BMIMI, the BMWET and the Federal Provinces of Upper Austria and Vienna. The COMET program is managed by the Austrian Research Promotion Agency (FFG).

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