Multi-stage polymerization of ethylene in a single-reactor setup

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Introduction

About 50 % of the world plastic demands are polyolefins, mostly Polyethylene (PE) and Polypropylene (PP). It is used in a wide field of applications, for low cost products in packaging as well as high end applications like water pipes and constructive parts in the automotive industry. Over the last years the properties of polyolefins and their control have been improved, which allows the substitution of other plastics and even other materials. Further advantages are the low cost of production, the easy accessibility of the feedstock and an easy way of recycling.

Experimental

The approach in this work is to investigate the influence of the polymerization conditions of different Ziegler-Natta catalysts on the kinetic behavior of PE polymerization at industrial near conditions.
PE is produced in a single batch reactor setup by multi stage polymerizations. In a first step a high molecular weight polymer is produced in slurry polymerization with low co-monomer content. For the second step the solvent is flushed and the reaction is continued in gasphase with higher co-monomer and hydrogen content. By this procedure industrially relevant multi-reactor polymerizations can be mimicked in a single bench scale batch reactor.
Further the materials are evaluated in terms of molecular composition by GPC and morphology studies. For this purpose a new tool was developed to get a fast, cheap and easy visualization and evaluation of the pore size distribution of the obtained materials.

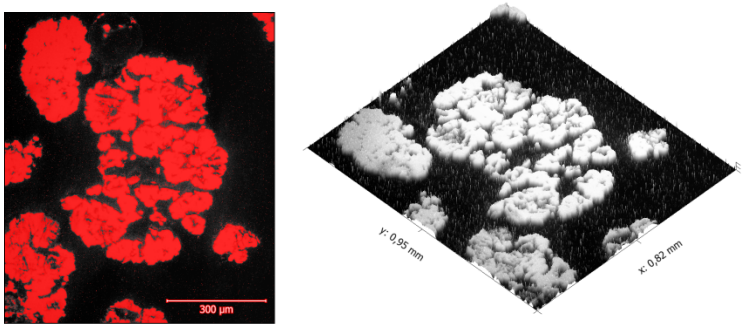

Figure 1: Typical pore size distribution of a PE-powder.

Results

Different types and amounts of co-monomer have been used to investigate the influence on the kinetics of a state-of-the-art industrial Ziegler-Natta catalyst system at different temperatures. Furthermore the obtained powders are characterized by means of GPC for investigation of the co-monomer incorporation and the influence of different conditions are evaluated by morphology studies.