PRODUCT DEVELOPMENT IN HIGH PRESSURE POLYMERIZATION TECHNOLOGY

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The development of polymeric products in high-pressure polymerization technology appears to be a demanding task. Besides that experiments applying high pressure are laborious, its application on (small) laboratory scale is technically demanding and as a consequence the scale-up becomes problematic. Historically this was handled by several steps of development starting from laboratory scale going to mini-plants, pilot plants, and small production scale up to application in world-scale plants. However, shortened development cycles and cost pressure as the dominating factors raised the need to new concepts that allow being more time efficient and for lager steps in scale-up.

Computer simulations were identified as a tool of high potential to reach this goal. The basic idea behind this is, that, in case a simulation model being based on a physico chemical reasonable approach depicts the chemical reaction based on elementary reaction steps, the description of the chemistry becomes independent for the scale of its application. On the other hand it is necessary then, that engineering parts of the model describe the effects of reactor technology in a similar independent and scalable manner. To test this concept polymerizations are a highly attractive object of interest as the micro-structural polymer properties are sensitively determined by the applied reaction conditions.

We inspect high-pressure polymerization experiments on very different scale and investigate the micro-structural polymeric properties by sophisticated analytical techniques. In parallel we apply micro-kinetic models on such experiments to see whether these are capable of describing these polymeric properties. The success over a wide range of reactor scales encourage to test this concept on product development and process engineering. Examples of these activities are the product description of α-olefin waxes being used as cold flow improvers. Here the description of several product grades resulting of a mini-plant is inspected where the complexity rises from *co-* to *tar*-polymerizations. The reactor diversity is tested using ethene homo-polymerizations as example inspecting reactors of various scales and of various types. In-depth understanding of the microscopic molecular structure and how this is affected by analytical methods is the focus in this field.

Understanding how a polymeric product is formed by reactor operation conditions is another challenge. It is a test whether modeling the polymeric microstructure is a one-way road or whether it can used to study desired or undesired effects in order to optimize process conditions.

The good success in these fields encourages proceeding along these lines. It appears to be in reach that product development is feasible on laboratory scale with the potential of direct transfer up into production facilities.