Investigation of multistage propene polymerizations using a single reactor setup

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Introduction

Polyolefins dominate the global plastics market. Their versatility in properties as well as the economic aspect is responsible for their success. Properties like a high melting point, chemical inertness, stiffness and low density make polypropylene suitable for many different applications. For the production of tailored polymers with specific properties multistage polymerization processes, combining slurry homo- and gasphase copolymerization steps are imperative [1].

In course of this work, a multipurpose 5 L reactor was used to investigate multi-stage processes. The reactor system had to be adapted in order to combine both, gas phase and bulk polymerizations in one experiment.

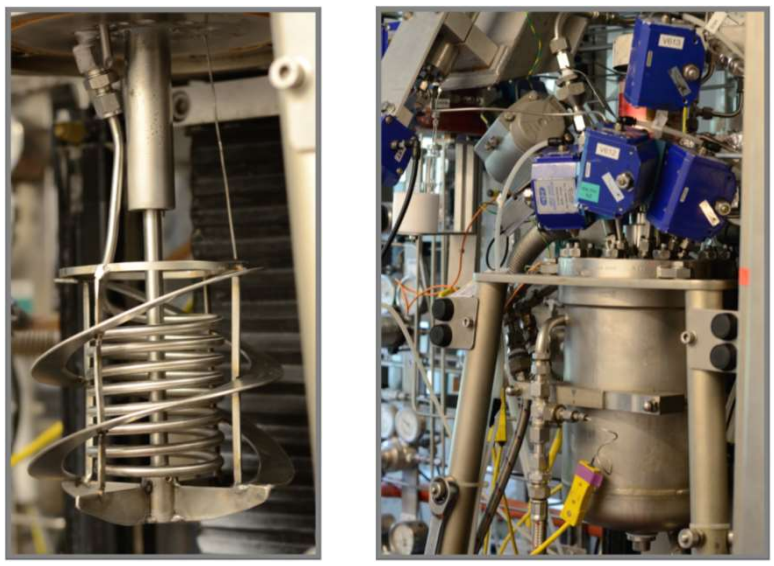

Figure 1: 5 L reactor system with helix stirrer and internal resistance-heating coil

Experimental

For the installation of the internal heating coil, a new helix stirrer was constructed (Figure 1). In order to observe the stirring behavior, it was tested in a transparent replica of the 5 L reactor at various stirring rates (Figure 2).

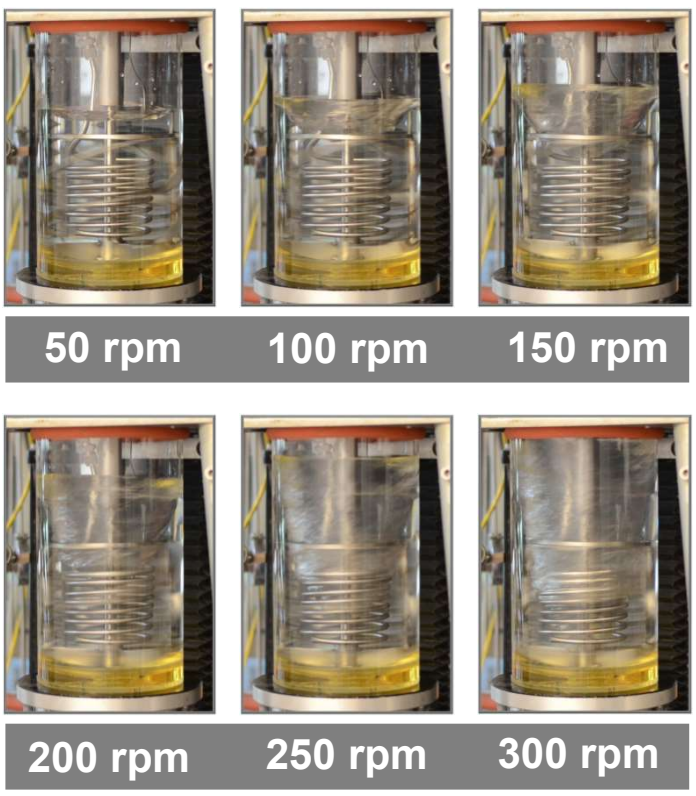

Figure 2: Transparent 5 L reactor replica, showing vortex formation for different stirring rates.

In particular for multistage polymerizations it is essential to be able to observe activity and kinetics in detail. In principle the setup with an internal resistance-heating coil works similar to the principle of a calorimetric bomb. The heating power is constant until the catalyst is added. If heat is generated by the exothermic polymerization reaction, the power of the heating coil decreases immediately to keep the reactor temperature at a constant level (example in Figure 3). The compensated heating power, recorded during the reaction, gives information about the polymerization activity.

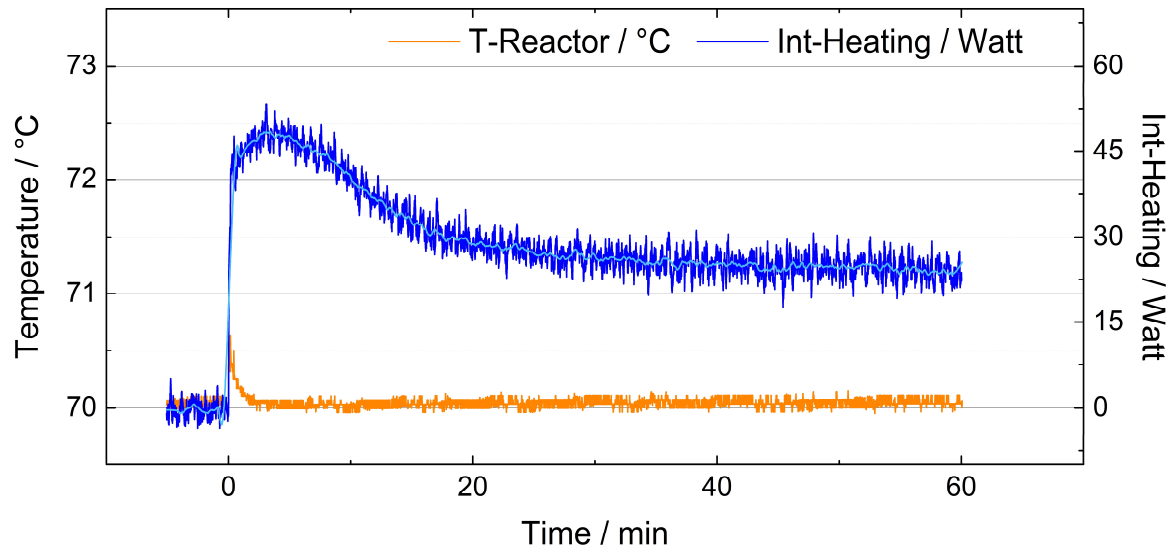

Figure 3: Reactor temperature and compensated heat during homopolymerization.

References

[1] M. Gahleitner, C. Paulik, *Polypropylene*, *Ullmann's Encyclopedia of Industrial Chemistry,* Wiley-VCH Verlag GmbH, Weinheim, 2014.

Results

An internal heating coil is a suitable instrument to observe reaction progress during polymerization in liquid phase. It can be used for both, propene or ethylene polymerization. In addition precise temperature control is possible. Experiments showed that stirring rates above 250 rpm lead to incomplete wetting of the heating coil.

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