Polymerization Fouling Test Rig

Technische Universität Braunschweig | Institute for Chemical und Thermal Process Engineering
ictv@tu-braunschweig.de | Phone +49 (0) 531 391-2791

Motivation

Fouling: Unwanted deposition on heat transfer surfaces

➡ Increased heat transfer resistance, higher pressure drop, contamination

Special challenge for the polymer process industry if fouling occurs:

- Very low thermal conductivity of the deposit
- Heat dissipation is particularly important for process control

Fouling behavior depends on material system and the type of reaction

No general knowledge about fouling and mitigation in the chemical industry during synthesis

Sample plates

- Stainless steel (cold, rolled, 1.4301) with different surface modifications: electropolished, diamond-like-carbon coatings (SICON, SICAN)
- Dimension: w x l x h = 20 x 80 x 2 mm

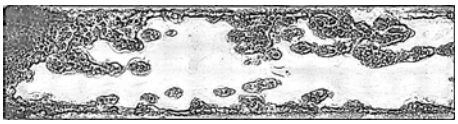

Fig. 1: Sample plate with an exemplary fouling layer

Experimental setup

- Reactor system combined with a flow channel
- 5 L double-walled reaction vessel as storage vessel for mixing and preheating the reactants
- Fouling experiments are performed in the flow channel on replaceable sample plates
- Flow channel can be heated or cooled

Process parameter	Unit	Range
Reaction Temperature	°C	67
Wall temperature	°C	10 – 80
Flow velocity	m/s	0.1 - 1
Reynolds number	-	5 - 300

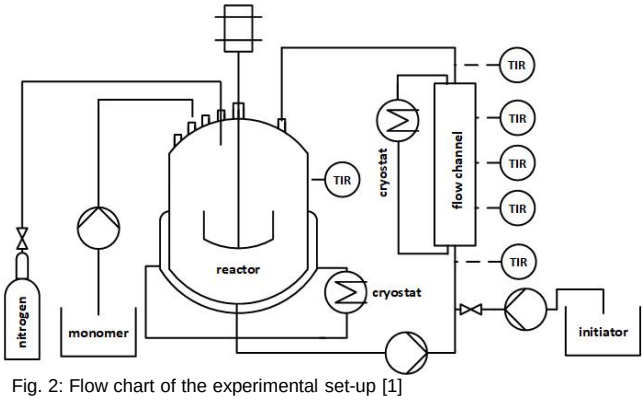

Fig. 2: Flow chart of the experimental set-up [1]

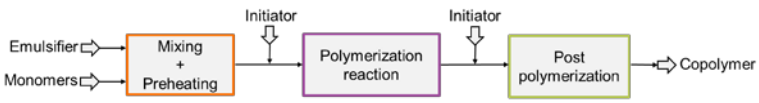

Fig. 3: Block flow diagram of the synthesis process

Model fouling system

- Emulsion polymerization of a Vinyl acetate/ vinyl ester copolymer
- Monomers: vinyl acetate and vinyl ester
- Initiator: Ascorbic acid and tert-butyl hydroperoxide
- Emulsifier: Polyvinyl alcohol

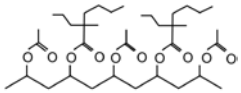

Fig. 4: Vinyl acetate/ vinyl ester copolymer

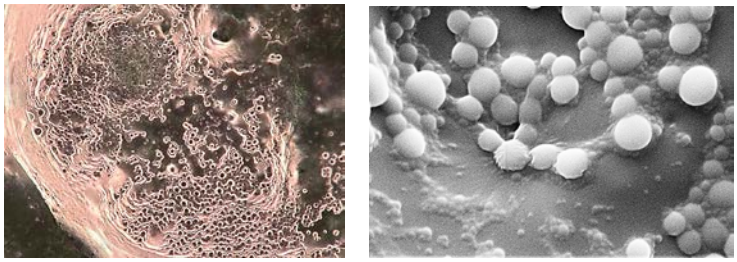

Fig. 5: Micrographic image (left) and SEM image (right) of the deposited material

Literature

- [1] A. Hohlen, W. Augustin, S. Scholl: Quantification of Polymer Fouling on Heat Transfer Surfaces During Synthesis, Macromol. React. Eng, 2019, 14.

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