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Sven Bettermann, Baldur Schroeter, Hans-Ulrich Moritz, Werner Pauer, Marcel Fassbender, Gerrit A. Luinstra

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CONTINUOUS EMULSION COPOLYMERIZATION PROCESSES AT MILD CONDITIONS IN A 3D-PRINTED TUBULAR BENDED REACTOR

Sven Bettermann, Baldur Schroeter, Hans-Ulrich Moritz, Werner Pauer

Marcel Fassbender, Gerrit A. Luinstra

Institute for Technical and Macromolecular Chemistry, University of Hamburg, Bundesstraße 45, 20146 Hamburg, Germany

HIGHLIGHTS

- Suitable and inexpensive tubular bended reactor was 3D-printed.
- Geometry led to short and narrow residence time distribution with low dead volumes.
- First redox-initiated continuous emulsion copolymerizations in a 3D-printed reactor.
- Stable continuous operation leading with grade transition to uniform and adjustable products.
- Visualization of polymerization processes by thermal imaging.

ABSTRACT

A polylactic acid tubular bended reactor, printed by fused deposition modeling with a short and narrow residence time distribution, air-cooled, and with dead volumes below 5 vol% was integrated into a modular reaction system enabling product changes in the running system. Continuous, redox-initiated emulsion copolymerizations of styrene - butyl acrylate and of vinyl acetate - neodecanoic acid vinyl ester were successfully performed with 20 and 40 wt% monomer in the feed. Copolymerizations had an ambient starting temperature with a mean residence time of 5 and 15 min, conversions were between 81 and 99%. The resulting emulsions were stable with Zeta potential values up to -132.0 mV and no product adhesion to the reactor wall was found. A stable steady state of the reaction plant was also obvious from thermal imaging, showing an invariant temperature profile along the 3D-printed reactor. The