INVESTIGATION OF BUBBLE FREE, UV INITIATED FRONTAL POLYMERIZATION IN AQUEOUS CONDITIONS

Paul Michael Potzmann[1], *Francisco Javier Lopez Villanueva*[2], *Robert Liska*[1]

[1]Institute of Applied Synthetic Chemistry, Vienna University of Technology, Vienna, Austria
[2]BASF - The Chemical Company, Ludwigshafen, Germany

For large scale industrial processing the use of water as green solvent, as well as the application of energy efficient process techniques is of high interest for a variety of polymer syntheses. Frontal polymerization of acrylic acid in aqueous formulations fits perfectly both requirements.

Frontal polymerization is a macromolecular synthesis method of converting monomer into polymer by means of a localized reaction zone. Once the reaction is started by a local, onetime energy input by heat or light, the heat of the reaction induces polymerization in the surrounding monomer formulation which leads to a self propagating, stepwise polymerization through the whole reaction vessel.

From the industrial point of view the most interesting method of energy input is the application of UV-light to start a thermal frontal polymerization process. Therefore our goal was to investigate this initiation process considering the challenging conditions given by the presence of water during synthesis, such as high heat capacity, low viscosity, and possible solvent boiling. Especially the formation of bubbles can lead to a number of drawbacks like uncontrollable heat loss, porous polymer samples and expansion of the formulation. For the initiation by UV light any bubble formation, due to solvent boiling or initiator decomposition, in the exposed area, additionally leads to diffuse scattering of the light beam resulting in non reproducible measurements.

Within this work a new thermal initiator has been synthesized, allowing us to report the first completely bubble free steady state thermal front reaction in water. The new system allowed us to achieve a well observable front reaction and provided the basis for the accurate and reproducible, systematic analysis of UV initiation in water based frontal polymerizations, considering the ratios of all reactive components.