

Emulsion Polymers Consulting and Education, LLC

Did you know?

Special note: For this last issue of our "*Did You Know?*" series, we have partnered with Bruggeman Chemicals to discuss a number of topics related to the use of redox initiators in emulsion polymerization. Both organizations hope you find this series informative and useful.

Did you know.....there is valuable information available about the use of redox systems for effective reduction of residual monomers/VOCs used in emulsion polymerization? EPCEd is partnering with Brüggemann for this fifth in a series of *Did You Know* issues to highlight best practices for redox application in emulsion polymers, including reaction kinetic data and guidelines for best practices.

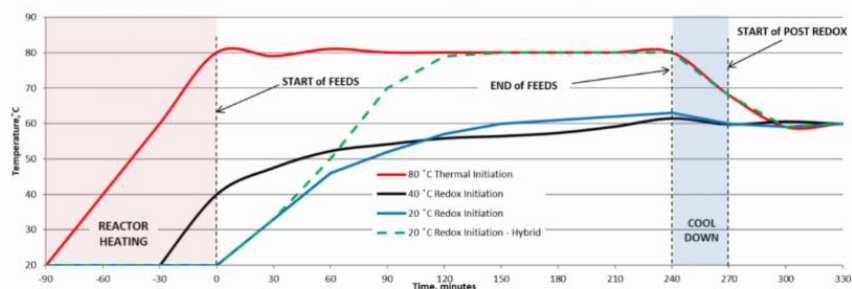
Previous issues in this series highlighted:

- 1) Fundamentals of redox systems typically used for emulsion polymer chase
- 2) How redox dosage and rate of addition affect residual monomer removal
- 3) Initial screening tests for redox and best practices for redox optimization
- 4) Influence of redox balance on biocide retention

Not as commonly used for production of emulsion polymers, redox use during the main polymerization can provide for significant reductions of energy consumption and cycle times. Notably, the reactor pre-heat step and the hold period after the monomer feed (semi-batch reaction) can be reduced or eliminated. Combined, these account for significant portions of the overall turn-around time for the reactor.

Unsaturated monomers rely on a free radical to react with the carbon=carbon double bond in the initiation step leading to monomer propagation and polymerization. Typically, this free radical is generated by thermal initiation via cleaving a persulfate at elevated temperature. Radicals can also be generated at low temperature, ~20 °C, via redox combination of a reducer (e.g. Bruggolite® FF6) with an oxidizer (persulfate or peroxide) to provide radical initiation during the main polymerization.

In the chart below, we show lab scale (3-liter) reactor temperature profile comparisons of main (seeded) latex polymerizations initiated thermally with ammonium persulfate (APS) & three variants of redox initiation with Bruggolite® FF6/APS redox combinations, the latter starting at both 20 °C and 40 °C, with polymerization starting at time 0. In all cases, the monomer feed time was 4 hours. Note the time required to heat up the batch to 80 °C in the Thermal Initiation Run before polymerization was started. The heating time for the thermally initiated reaction shows a reaction + cooling time that is significantly longer than the 20 and 40 °C reactions for this reactor setup.



Using redox initiation for the entire polymerization could enable significant cost reductions, including:

- Energy savings.
- Cycle time savings by eliminating all or most of the initial heating step.
- Elimination of the lag/hold time between the main polymerization and the chase, further reducing cycle time.
- Reactor is constantly in cooling mode (perhaps reducing dried polymer on the reactor walls).

As always, we invite your questions and comments by going to info@epced.com .
Additionally, we invite you to go to Brüggemann's Institute of Redox Chemistry (see link at end) – a collection of tutorials on redox chemistry for emulsion polymerization, providing greater detail of redox combinations and process optimization techniques. For more information, contact Brüggemann, BCUS_Sales@brueggemann.com