

## SEMI-BATCH REACTORS FOR EMULSION POLYMERISATION

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### Abstract

A new dynamic model for emulsion polymerisation in a semi-batch reactor is presented. This model incorporates material and energy balances together with recent theories for predicting radical numbers in particles and for estimating diffusion-controlled rate coefficients for radical reactions. The model predicts values for the polymerisation rate, monomer conversion, the degree of polymerisation, monomer concentration in particles, the radical number per particle and kinetic parameters over the whole course of polymerisation. Unlike previous work, full allowance is made for the effect of operation parameters on the approach to the steady state, the decay of the polymerisation rate and the gel effect on polymerisation kinetics. The open-loop stability of the semi-batch emulsion polymerisation reactor is explored also.

Use of the model shows that, when the monomer feed rate is low, the reaction rate may reach a steady state. When the feed rate is relative high, a steady state is unlikely to occur even though the system is still monomer-starved. These results agree with the experimental observations by previous workers.

The degree of polymerisation is always found to increase during the monomer feed stage even though the monomer concentration in the particles and the average radical number per particle are constant. When the monomer concentration is low the radical loss in the particles is predominantly by radical exit from the particles. When the monomer concentration is already high enough for the radical loss to be predominantly by termination, the gel effect on the termination still exists.

If no feedback control system is used to adjust the jacket temperature when the feed rate is high, both reaction rate and temperature oscillate with time. Converging oscillations (or possibly limit cycles) can be predicted.