May 24, 2017

CHEM-E2145 Polymerization Reaction Engineering

1. Factors affecting the choice of initiator in a free radical polymerization?

2. Principle and benefits of a 'living'-free radical polymerization?

3. How to measure and calculate power of mixing in a polymerization reaction calorimeter?

4. Main polystyrene grades and their polymerization processes?

5. Polyethylene is produced continuously in a PE plant in a loop reactor. The customer has specified that the number average molecular weight (M_n) must be 80000 g/mol. The polymerization is performed in n-heptane at 80 °C using a homogeneous metallocene catalyst. Previous results have shown that chain transfer to monomer and catalyst occurs during polymerization with this catalyst system. Chain transfer does not occur to aluminium, which is used as a cocatalyst in the polymerization.

   The number average molecular weight depends on monomer concentration in the reactor as shown in Table 1.

   Table 1. The dependence of number average molecular weight on ethylene concentration.

[Ethylene] mol/dm^3	M_n g/mol
0,61	100 000
0,21	50 000
0,07	20 000

   The number-average degree of polymerization can be expressed with the relative rate constants for propagation and chain transfer:

$$\bar{X}_n = \frac{R_p}{\sum R_t} = \frac{k_p[C^*][M]}{k_{tr,cat}[C^*]+k_{tr,M}[C^*][M]+k_{tr,cocat}[C^*][cocat]^{1/2}} \quad (1)$$

   What should ethylene concentration be in the reactor, if polyethylene is produced according to the customer's specification?