A First Course on Kinetics and Reaction Engineering

Activity 35.1

Problem Purpose

This problem will allow you to practice reactor analysis using a zoned reactor model with a perfectly mixed stagnant zone

Problem Statement

A tube that is 6 m long with an inside diameter of 7 cm is packed with pellets of solid catalyst. Reaction (1) takes place within this reactor at a constant temperature of 450 ºC and a constant pressure of 5 atm. The reactor will be fed 200 ft^3 h^{-1} of a gas containing 15% A, 15% B and 70% I (an inert gas). Reaction (1) is one-half order in A and first order in B. Suppose that the packing in the tube is not uniform, and as a consequence 5% of the bed has a lower density (leading to a rate coefficient of 59.5 mol h^{-1} $atm^{-0.5}$ m^{-3}), while the remainder has a higher density (with a rate coefficient of 72 mol h^{-1} $atm^{-0.5}$ m^{-3}). Using a zoned reactor model with a well-mixed stagnant zone 3 m into the reactor representing the lower density region and modeling the remainder of the reactor as a PFR, calculate the conversion if 15% of the flow in the PFR is diverted to the well-mixed stagnant zone.

$$2\,A + B \rightarrow 2\,Z \qquad (1)$$