

AFCoKaRE Practice Problem 35.1

Purpose: This problem will allow you to practice the quantitative analysis of a zoned reactor model.

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 °C and a constant pressure of 5 atm. The reactor will be fed $200 \text{ ft}^3 \text{ h}^{-1}$ 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 $59.5 \text{ mol h}^{-1} \text{ atm}^{-0.5} \text{ m}^{-3}$), while the remainder has a higher density (with a rate coefficient of $72 \text{ mol h}^{-1} \text{ atm}^{-0.5} \text{ m}^{-3}$). Using a zoned reactor model with two equally-sized, well-mixed stagnant zones located $1/3$ and $2/3$ of the way into the reactor representing the lower density region and modeling the remainder of the reactor as a PFR, calculate the conversion if 7.5% of the flow in the PFR is diverted to each of the well-mixed stagnant zones.

