A First Course on Kinetics and Reaction Engineering
Activity 36.1 Worksheet

In Example 36.1, the irreversible elementary reaction in equation (1) occurred isothermally in a non-ideal reactor. At the reactor temperature the reaction was second order in A, and the rate coefficient was equal to 0.5 L mol^{-1} min^{-1}. The reactor volume was 25 L, and the feed consisted of 4 L min^{-1} of a solution containing A at a concentration of 2.3 mol L^{-1}. The age function for this reactor had been measured and is given in equation (2). Suppose, instead that reaction (1) is first order with a rate coefficient of 0.7 min^{-1}. Use a late-mixing segregated flow model to compute the conversion in the reactor and compare it to the conversion predicted by the ideal CSTR model.

$$A \rightarrow Z \tag{1}$$

$$F(\lambda) = 1 - \exp(-0.16\lambda) \tag{2}$$

1. Read through the problem statement and each time you encounter a quantity, assign it to the appropriate variable symbol.

2. Read through the problem statement and write down any relationships it provides.

3. Write the equation you will use to model the reactor.

4. Decide how you will solve that equation and determine what you need in order to do so.

5. Generate an expression for the conversion in a fluid element as a function of its residence (reaction) time.

6. Generate the age distribution function.

7. Check that the age distribution function is properly normalized.

8. Substitute in the late-mixing segregated flow model equation and solve for the conversion.

9. Compare to the conversion predicted by the ideal CSTR model and comment.