Chemical Reaction Engineering

# Exercises on Design of Isothermal Chemical reactors

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# Design of isothermal Batch reactors

1. The irreversible, first-order reaction has a kinetic constant . If the initial concentration of A is , what is the time required to obtain a conversion in a constant-volume batch reactor? And what if the desired conversion is ?
2. Considering the same reaction of Exercise 1 with a generic order different from , how would be the concentration profiles of A over time? Which would be the required time to obtain a conversion with and ?

# Design of isothermal CSTRs

1. Calculate the conversion of a species A as a function of the residence time for a bimolecular reaction in a constant-density CSTR:

How much time would be required to get a conversion of A = 95%?

1. Consider the reversible reaction whose reaction rate is:

Find the time required to obtain a conversion of species A equal to , knowing that the inlet concentration of A is , while B is not fed. The density can be considered constant.

1. Find the residence time required to ensure a conversion of species A equal to in a isothermal CSTR, where the following irreversible, 2nd order reaction occurs (ideal gas, isobaric reactor):

Assume the initial concentration of A is equal to , and no feeding of B. The inlet molar flow of A is equal to .

# Simulation of a PFR

1. Build up the numerical model of a plug flow reactor, with an internal diameter of and a length of . The following reactions occur within the PFR:

The reactor works at a temperature of , a pressure of and is fed by a molar flow of A () equal to . Both the reaction rates are of order 1:

Evaluate the concentration profiles of A, B, and C throughout the reactor. What would be the PFR length that maximizes the production of B?