Chemical Reaction Engineering I

Self Test 4

by
Sureena Abdullah
Mohd Sabri Mahmud

Faculty of Chemical and Natural Resources Engineering
sureena@ump.edu.my

QUESTION 1

An irreversible, second order, homogeneous, liquid-phase reaction is carried out in a continuous flow stirred tank reactor (CSTR) having a volume of $2m^3$. The reaction studied is a saponification of ethyl acetate at 60^oC:

$$NaOH + CH_3COOC_2H_5 \rightarrow CH_3COONa + C_2H_5OH$$

Equimolar amount of A and B fed to the reactor. A 50% conversion is reported under the conditions of the reactor.

(a) Determine the Damkohler number (Da) for the reaction

(b) A chemical engineer suggests reducing the volume of the reactor to $1m^3$ to increase the conversion keeping all other parameters constant. Determine the value of Da for the new reactor.

(c) Predict the conversion in the reactor using the Da value in (b) and verify if the suggestion in (b) is valid

QUESTION 2

Acetaldehyde A is to be decomposed in a packed bed reactor (ID = 20 cm) operating at 200°C and 5 atm. The feed consisting of acetaldehyde vapor diluted with nitrogen (y_{A0} = 0.1) enters the reaction temperature and pressure at a volumetric flowrate of 0.16m^3/s. The density and the viscosity of the reaction mixture in the entrance are 6.8kg/m^3 and 2.8 x 10-5 N.s/m^2, respectively. The catalyst density is 1800kg/m^3 and the bed voidage is 0.4. Initially the bed is loaded with 20 kg catalyst particles (d_p = 8mm). The reaction stoichiometry is as follows:

$$C_2H_4O \rightarrow CH_4 + CO$$

a) Determine the conversion in the reactor, if the pressure drop in the reactor is not considered

b) Calculate the pressure drop (P/P_0) at the end of the reactor

c) Evaluate the performance of the reactor in term of achieved conversion when the pressure drop is considered

Authors Information

Credit to the authors:
Assoc Prof Dr Maksudur Rahman Khan,
Madam Hamidah Abdullah