

Chemical Reaction Engineering I

Self Test 4

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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°C :



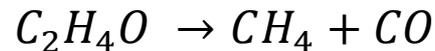
Equimolar amount of A and B fed to the reactor. A 50% conversion is reported under the conditions of the reactor.

- Determine the Damkohler number (Da) for the reaction
- 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.
- 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 0.16m³/s. The density and the viscosity of the reaction mixture in the entrance are 6.8kg/m³ and 2.8 x 10⁻⁵ N.s/m², respectively. The catalyst density is 1800kg/m³ and the bed voidage is 0.4. Initially the bed is loaded with 20 kg catalyst particles ($d_p = 8$ mm). The reaction stoichiometry is as follows:



- Determine the conversion in the reactor, if the pressure drop in the reactor is not considered
- Calculate the pressure drop (P/P_0) at the end of the reactor
- Evaluate the performance of the reactor in term of achieved conversion when the pressure drop is considered



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