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CHG 3127 Blended Learning/Flipped Classroom

CHG 3127 Tutorial Session 4 (2020-02-06)

Question A

A reactor design has a target conversion of 45% for the following heterogeneous, gas phase reaction:

$$2A + B \rightarrow 2C$$

The reaction is first order in A and second order in B with rate constant k_A of 850 $L^3\ mol^{-2}\ s^{-1}\ kg^{-1}$.

The reactor feed consists of 50% inert species, 10% A, 40% B, and the total molar flow rate (F_{T0}) is 20 mol/s. The reactants are fed at a constant temperature (375 K) and an initial pressure of 7.0 atm. The pressure drop through the catalyst bed is significant (α = 0.035 kg^{-1}). How much catalyst is needed to reach the target conversion? **Hint:** you will need to use interpolation to calculate the exact amount of catalyst in the reactor, as described in the documents provided in this course.

Note: Your solution should be accurate in fractional conversion to within 0.002 and in pressure ratio to within 0.0001. Assume a maximum value of 0.045 for the initial change in fractional conversion and then round down your step size estimate to a single decimal (e.g. from 0.79 to 0.7). (You do not need to estimate a maximum step size based on a pressure ratio; carry out the initial estimate using an analysis based on the fractional conversion only.)

Question B

Using the integrated form of the Ergun equation, repeat Question A and then compare and contrast your solution to that of the previous numerical approach.