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Problem P1.3.12 (old manual solution)
Part (c)

\[
\int_0^{20} \eta(p(t)) \, dt = 0.382
\]

between 230 and 270 s, use Simpson's rule for points

Part (b)

\[
\frac{3}{10} \left[ 87.4 + 9.66 + 2(9.72 + 8.14) \right] = \eta(p(t)) \int_0^{20} \frac{3}{10}
\]

Part (a)

\[
\text{Problem P13-12 (old manual solution)}
\]
Part (d)

The fraction spending less than 250 s is 0.422

Part (e)

Mean residence time = \( t_m = \int_0^1 t E(t) dt = 273 \text{ s from polynomial fitting} \)

Part (f)

![Graph showing \( E(t)(t-t_m)^2 \) vs time]

Part (g)

\[ \sigma^2 = \int_0^1 (t - t_m)^2 E(t) dt = 1832 \text{ by polynomial fitting} \]

The standard deviation = 42.81 s

Part (h)

The \( E(t) \) graph demonstrates good symmetry about the mean time \( t_m = 260 \text{ s} \). The model suggested the reactor is a plug flow reactor with \( \tau = 250 \text{ s} \).

Part (I)

For segregation model: \( \bar{X} = \int_0^1 X(t)E(t)dt \)
\[ \frac{1}{r + \frac{1}{K}} = \frac{1}{n} \Leftarrow \frac{r}{p} = \frac{cp}{v} \]

Second order decay

\[ r = 0.05 \text{ s}^{-1}, K = 0.03 \text{ dm}^3/\text{mol.s}^2 \]

\[ I_c = 200/20 = 10 \text{ s} \]

\[ F_c = 20 \text{ Kgs} \]

\[ V_o = 1 \text{ m}^3 \]

\[ C_o = 0.4 \text{ mol/dm}^3 \]

\[ o = 10 \text{ dm}^2/\text{s} \]

The elementary gas phase reaction: \( A + B \underset{C_{STR}}{\rightarrow} C \)

Problem P13.13

\[ \text{gives } x_{bar} = 0.313 \]

\[ x = 10.55/60 = 0.1758 \text{ mol/dm}^3 \]

\[ I + X.C_0 \quad F(t) = X \]

\[ \frac{r + X.C_0^1}{r + C_0} = X \]

\[ \frac{r + X.C_0^1}{r + C_0} = X - 1 \]

\[ \frac{r + X.C_0^1}{r + C_0} = C \]

\[ \frac{r + X.C_0^1}{r + C_0} = C \]

For second order reaction:

\[ (r + X.C_0^1)^{-1} = \frac{c}{1} \]

Part (b)

\[ \text{gives } x_{bar} = 0.45 \%
\]

For first order \( X(1) = 1 - e^{-rt} \) with \( t = 0.0115 \text{s} \)

\[ \text{cond} \]

\[ \text{P13.12} \]