

From Froment & Bischoff, 2nd Ed:

1. A series of experiments were performed using various sizes of crushed catalyst to determine the importance of pore diffusion. The reaction may be assumed to be first order and irreversible. The surface concentration of reactant was $C_s^s = 2 \times 10^{-4} \text{ mol/cm}^3$.

DATA:

Diameter of sphere (cm):	0.25	0.075	0.025	0.0075
r_{obs} (mol/hr cm ³):	0.22	0.70	1.60	2.40

1. Determine the “true” rate constant k_v and the effective diffusivity D_e from the above data.
 2. Predict the effectiveness factor and the expected rate of reaction r_{obs} for a commercial *cylindrical* catalyst pellet of dimensions 0.5 cm x 0.5 cm.
2. The following rates were observed for a first-order irreversible reaction, carried out on a spherical catalyst:

$$\text{for } d_p = 0.6 \text{ cm; } r_{\text{obs}} = 0.09 \text{ mol/g cat. hr}$$

$$\text{For } d_p = 0.3 \text{ cm; } r_{\text{obs}} = 0.162 \text{ mol/g cat. hr}$$

Strong diffusional limitations were observed in both cases. Determine the true rate of reaction. Is diffusional resistance still important with $d_p = 0.1 \text{ cm}$?