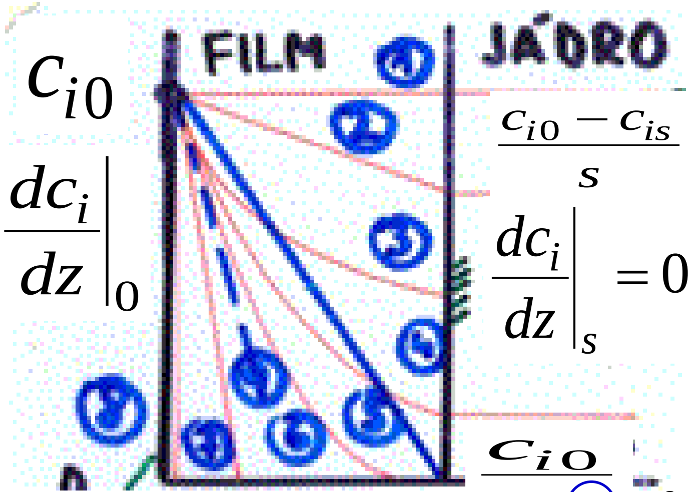
Absorpce s chemickou reakcí



CHR:

1 pomalé v jádře
2 v jádře
} zanedbatelné ve filmu

3 v nehybné vrstvě

④ středně rychlé

⑤ referenční profil bez CHR

⑥ rychlé ve filmu

⑦ okamžité ve filmu

⑧ okamžité na FR

⑨ tečna ke křivce ④

$$E = \frac{-D_i \left.\frac{dc_i}{dz}\right|_{Z=0}}{\frac{D_i}{s} c_{i0}} = \frac{\left.\frac{dc_i}{dz}\right|_{Z=0}}{\frac{c_{i0}-0}{0-s}}$$

7 okamžité ve filmu :

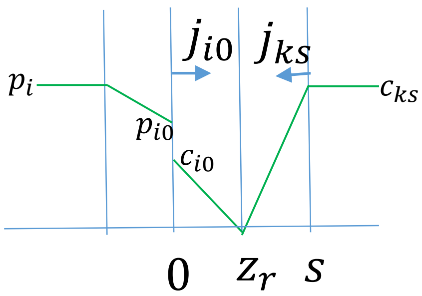
$$E_0 \neq f(H)$$

$$j_{i0} = \frac{D_i c_{i0}}{s}\left(1 + \frac{D_k c_{ks}}{\nu_k D_i c_{i0}}\right)$$

nezávisí na $\frac{V}{As}$

Absorpce s chemickou reakcí

7 okamžité ve filmu:

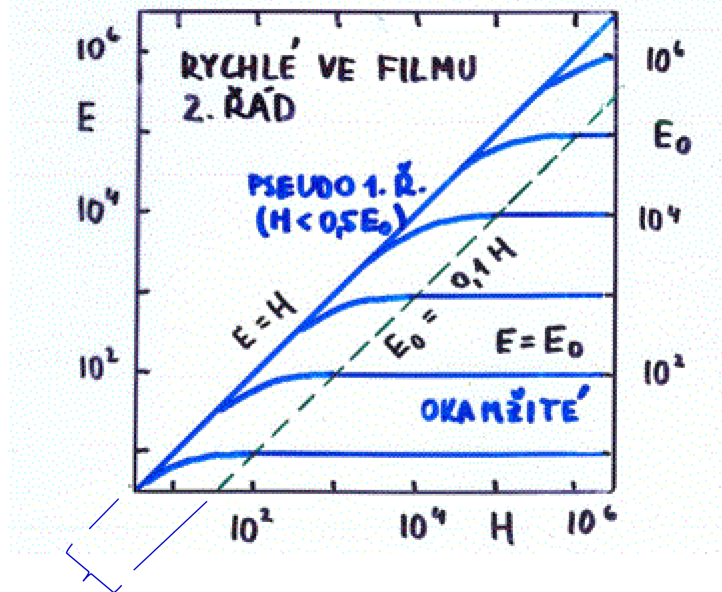


$$\nu_k\, j_{i0} = -j_{ks}$$

$$-\nu_k \frac{D_i(0 - c_{i0})}{z_r - 0} = \frac{D_k(0 - c_{ks})}{z_r - s}$$

$$E_o = \frac{s}{z_r}$$

$$E_o = 1 + \frac{D_k}{\nu_k D_i}\frac{c_{ks}}{c_{i0}}$$

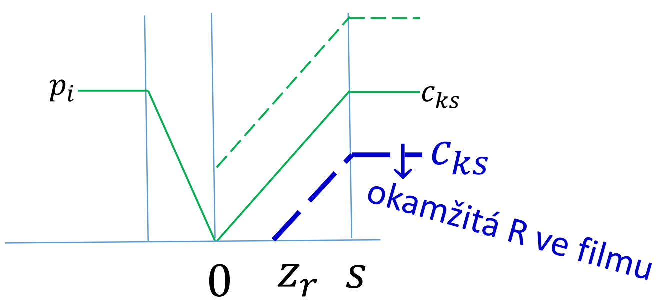


aproximativní řešení kinetiky 2. řádu z odb. literatury

$$E = 1 + (E_o - 1)\left[1 - \exp\left\{-\frac{(1-H^2)^{1/2} - 1}{E_o - 1}\right\}\right]$$

8 okamžité na povrchu:

$$z_r = 0;\ E_0 \to \infty$$



řízení odporem v plynu $j_{i0,max} = k_G \frac{p_i}{RT}$

Ustálená difúze s CHR do částice katalyzátoru

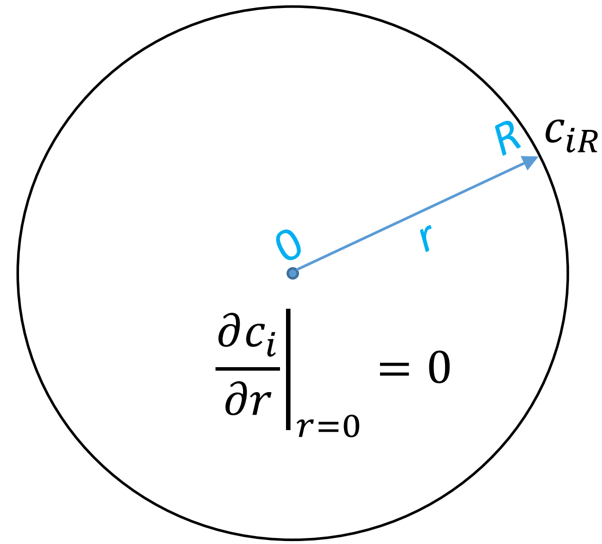
$$D_i\left(\frac{d^2c_i}{dr^2}+\frac{2}{r}\frac{dc_i}{dr}\right)=kc_i$$

$$\left|u=c_i\,r\right|$$

$$\frac{du}{dr}=\frac{dc_i}{dr}r+c_i$$

$$\frac{d^2u}{dr^2}=\frac{d^2c_i}{dr^2}r+\frac{dc_i}{dr}+\frac{dc_i}{dr}$$

$$\frac{1}{r}\frac{d^2u}{dr^2}=\frac{d^2c_i}{dr^2}+\frac{2}{r}\frac{dc_i}{dr}$$



$$\frac{d^2u}{dr^2}-\frac{k}{D_i}u=0 \quad\Rightarrow\quad \beta^2-\frac{k}{D_i}=0$$

$$c_i=\frac{b_1}{r}e^{\beta r}+\frac{b_2}{r}e^{-\beta r}$$

$$\left.\frac{dc_i}{dr}\right|_0=\lim_{r\to 0}\left[\frac{b_1}{r^2}\left(\beta re^{\beta r}-e^{\beta r}\right)+\frac{b_2}{r^2}\left(\beta re^{-\beta r}-e^{-\beta r}\right)\right]$$

$$=\lim_{r\to 0}\frac{\beta^2}{2}\left(b_1e^{\beta r}+b_2e^{-\beta r}\right)=0 \qquad \Rightarrow b_1+b_2=0$$

$$c_{iR}=\frac{b_1}{R}\left(e^{\beta R}-e^{-\beta R}\right) \qquad \Rightarrow b_1=-b_2=\frac{c_{iR}R}{2\sinh(\beta R)}$$

$$c_i=f\left(\phi,\tfrac{r}{R}\right)=c_{iR}\frac{R\sinh(\phi r/R)}{r\sinh\phi}$$

Thiele

$$\beta R=\phi=\sqrt{\frac{kR^2}{D_i}}$$

$$\beta r=\phi\tfrac{r}{R}$$

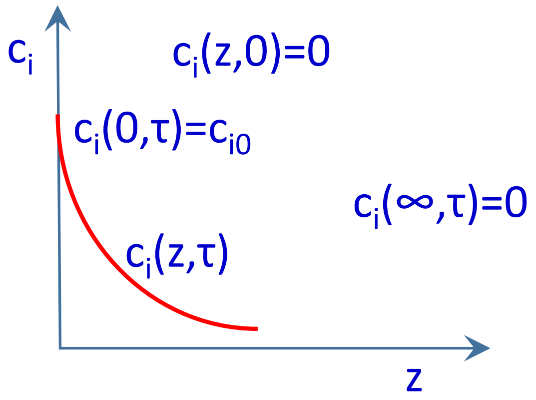
$$\dot{n}_{iR}=4\pi R^2D_i\left.\frac{dc_i}{dr}\right|_R$$

$$\left.\frac{dc_i}{dr}\right|_R=\frac{c_{iR}}{R}\left(\phi\coth\phi-1\right)$$

Neustálená difúze s CHR do polonekonečné vrstvy

$$\frac{\partial c_i}{\partial \tau} - D_i \frac{\partial^2 c_i}{\partial z^2} = -\underbrace{k^+ c_{ks}}_{k} c_i$$

Laplaceova transformace



$$p\hat{c}_i - D_i \frac{d^2 \hat{c}_i}{dz^2} = -k\hat{c}_i$$

$$\propto^2 = \frac{p+k}{D_i} \Rightarrow \alpha = \pm\sqrt{\frac{p+k}{D_i}}$$

$$\hat{c}_i = B_1 exp\left\{z\sqrt{\frac{p+k}{D_i}}\right\} + B_2 exp\left\{-z\sqrt{\frac{p+k}{D_i}}\right\}$$

$$z \to \infty: \ \hat{c}_i = 0 \quad \Rightarrow \quad 0 = B_1 exp\{\infty\} + B_2 exp\{-\infty\} = 0 \quad \Rightarrow \quad B_1 = 0$$

$$z = 0: \ \hat{c}_i = \frac{c_{i0}}{p} \quad \Rightarrow \quad B_2 = \frac{c_{i0}}{p}$$

Neustálená difúze s CHR do polonekonečné vrstvy

$$\hat{c}_i = \frac{c_{i0}}{p} exp\left\{- z\sqrt{\frac{p+k}{D_i}}\right\}$$

$$\frac{c_i}{c_{i0}} = 0.5\left[\exp\left(-z\sqrt{\frac{k}{D_i}}\right)erfc\left(\frac{z}{2\sqrt{D_i\tau}} - \sqrt{k\tau}\right) + \exp\left(z\sqrt{\frac{k}{D_i}}\right)erfc\left(\frac{z}{2\sqrt{D_i\tau}} + \sqrt{k\tau}\right)\right]$$

$$\widehat{j_{i0}} = -D_i \frac{d\hat{c}_i}{dz}\bigg|_{z=0} = D_i \frac{c_{i0}}{p}\sqrt{\frac{p+k}{D_i}} = \frac{c_{i0}}{p}\sqrt{D_i(p+k)}$$

$$\left(\int \mathrm{erf}(x)dx = x\,\mathrm{erf}(x) + \frac{e^{-x^2}}{\sqrt{\pi}} + C\right)$$

$$j_{i0} = c_{i0}\sqrt{D_i k}\left[erf\sqrt{k\tau} + \frac{\exp(-k\tau)}{\sqrt{\pi k\tau}}\right]$$

$$\overline{j_{i0}} = \frac{1}{\tau}\int_0^\tau j_{i0}\, d\tau = c_{i0}\sqrt{D_i k}\left[\left(1+\frac{1}{2k\tau}\right)erf\sqrt{k\tau} + \frac{\exp(-k\tau)}{\sqrt{\pi k\tau}}\right]$$

~1 ~0 $k\tau > 2.8$

$$\bar{k}_L = 2\cdot\sqrt{\frac{D_i}{\pi\tau}} \qquad k\tau = \frac{4}{\pi}\frac{D_i k^+ c_{ks}}{k_L^2} = \frac{4}{\pi}H^2$$