3 SLOŽKY:

SM
$$-\frac{1}{RT}\frac{d\mu_1}{dz} = x_2\frac{v_1-v_2}{Đ_{12}} + x_3\frac{v_1-v_3}{Đ_{13}}$$
$$-\frac{1}{RT}\frac{d\mu_2}{dz} = x_1\frac{v_2-v_1}{Đ_{12}} + x_3\frac{v_2-v_3}{Đ_{23}}$$

BINÁR. KOEF.

$(Đ_{21} = Đ_{12})$

F
$$-J_1 = cD'_{11}\frac{dx_1}{dz} + cD'_{12}\frac{dx_2}{dz}$$
$$-J_2 = cD'_{21}\frac{dx_1}{dz} + cD'_{22}\frac{dx_2}{dz}$$

KOEF. ZÁV. NA SLOŽ.

PŘEP.
$$D'_{11} = D_{13}\left[x_1 D_{23} + (x_2+x_3)D_{12}\right]/Z \qquad D'_{12} = x_1 D_{23}(D_{13}-D_{12})/Z$$
$$D'_{21} = x_2 D_{13}(D_{23}-D_{12})/Z \qquad D'_{22} = D_{23}\left[x_2 D_{13} + (x_1+x_3)D_{12}\right]/Z$$
$$Z = x_1 D_{23} + x_2 D_{13} + x_3 D_{12} \qquad [\alpha_{cr}=1,\ V_V = v_n,\ D_{12}=D_{21}]$$

$$\frac{1}{RT}\frac{d\mu_i}{dz} = \frac{1}{x_i}\frac{dx_i}{dz}$$
$$J_i = (v_i - v_n)cx_i$$
$$v_n = \sum x_i v_i,\quad \sum x_i = 1$$

PSEUDOBINÁR
$$J_1 = -cD_1\frac{dx_1}{dz}$$
$$c\frac{dx_1}{dz} = \frac{x_1 j_2 - x_2 j_1}{D_{12}} + \frac{x_1 j_3 - x_3 j_1}{D_{13}} \qquad [\alpha_{cr}=1]$$

1. $D_{12} = D_{13} = D_{23} = D_1$
$$cD_{12}\frac{dx_1}{dz} = x_1 j_2 + x_1 j_3 - (1-x_1)j_1 = x_1 j - j_1 = -J_1$$

2. $x_1 \to 0$: binár 1 - 2+3

BLANC
$$c\frac{dx_1}{dz} = -\left(\frac{x_2}{D_{12}} + \frac{x_3}{D_{13}}\right)j_1 = -\frac{1}{D_1}J_1 \qquad (j_1 = \cancel{x_1 j} + J_1,\ x_2, x_3 \doteq konst)$$

3. $x_1 \to 0,\ x_2 \to 0$: bináry 1 - 3 $D_1 = D_{13}$, 2 - 3 $D_2 = D_{23}$
$$c\frac{dx_1}{dz} = -\frac{x_3 j_1}{D_{13}} = -\frac{j_1}{D_{13}} = -\frac{1}{D_{13}}J_1 \qquad (j_1 = J_1,\ x_3 \doteq 1)$$

DIFÚZE V ROZTOCÍCH ELEKTROLYTŮ

NERNST - PLANCK $\quad \vec{J}_i^{\,0} = -\underbrace{D_i \nabla c_i}_{\text{ROZP.}} - \underbrace{c_i u_i}_{\text{EL. POHYB.}} \underbrace{\nabla \varphi}_{\text{EL. POT.}}$

EINSTEIN $\quad u_i = \dfrac{z_i D_i F}{RT}$

NÁBOJ (z_i) FARADAYOVA KONST. (F)

$$\vec{J}_i^{\,0} = -D_i \nabla c_i - z_i c_i D_i \frac{F}{RT} \nabla \varphi$$

FORMA STEFAN-MAXWELL $\quad (v_0 = 0,\ c_0 \to c)$

$$\nabla c_i + \frac{F}{RT} z_i c_i \nabla \varphi = -\frac{\vec{J}_i}{Đ_{i0}} \left(- \sum_{j \neq i,0} \frac{c_j \vec{J}_i - c_i \vec{J}_j}{c Đ_{ij}} \right)$$

FARADAY $\quad \vec{i} = F \sum z_j \vec{J}_j^{\,0}$ $\quad$ INT. EL. PROUDU

$$= -F \sum z_j D_j \nabla c_j - \underbrace{\frac{F^2}{RT} \sum z_j^2 c_j D_j}_{\varkappa} \nabla \varphi$$

$\varkappa$ SPEC. VOD/VOST EL-LYTU

OHM $\quad \nabla c_j = 0 \Rightarrow \vec{i} = -\varkappa \nabla \varphi$

NULOVÝ PROUD $\quad \dfrac{F}{RT} \nabla \varphi = -\dfrac{\sum z_j D_j \nabla c_j}{\sum z_j^2 D_j \nabla c_j} \Leftarrow \sum z_j \vec{J}_j^{\,0} = 0$

ELEKTRONEUTRALITA $\quad \sum z_j c_j = 0 \Rightarrow \sum z_j \nabla c_j = 0$

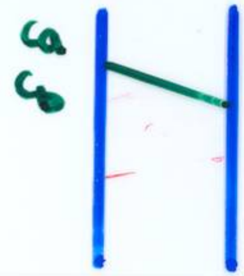
$$z_c c_c = -\sum_{j \neq c} z_j c_j \,, \quad z_c \nabla c_c = -\sum_{j \neq c} z_j \nabla c_j$$

$\boxed{a-b}$

(H^+, Cl^-)

el. pot. zpomaluje H^+
urychluje Cl^-

$z_a = 1,\ z_b = -1,\ c_a = c_b$



N-P: $J_a = -D_a \nabla c_a - c_a D_a G \nabla \varphi$ $\quad G = \frac{F}{RT}$

$J_b = -D_b \nabla c_b + c_b D_b G \nabla \varphi$ $\quad \sim 40\,V^{-1}$

0-PROUD: $J_a - J_b = 0$ $\quad (\sum z_i J_i = 0)$

ELNEUTR.: $c_a - c_b = 0$ $\quad (\sum z_i c_i = 0)$

$\nabla c_a - \nabla c_b = 0$

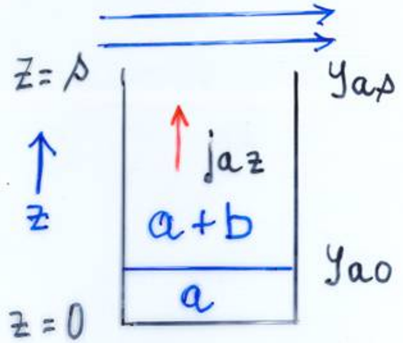
$$0 = -(D_a - D_b)\nabla c_a - c_a (D_a + D_b) G \nabla \varphi$$

$$G \nabla \varphi = -\frac{D_a - D_b}{D_a + D_b} \frac{\nabla c_a}{c_a}$$

$$J_a = -D_a \left(1 - \frac{D_a - D_b}{D_a + D_b}\right) \nabla c_a = -\frac{2 D_a D_b}{D_a + D_b} \nabla c_a = -\underbrace{\frac{2}{\frac{1}{D_a} + \frac{1}{D_b}}}_{D} \nabla c_a$$

$$D = \frac{\frac{1}{|z_a|} + \frac{1}{|z_b|}}{\frac{1}{|z_a| D_a} + \frac{1}{|z_b| D_b}} = \frac{\frac{1}{|z_a|} + \frac{1}{|z_b|}}{\frac{1}{\lambda_a} + \frac{1}{\lambda_b}} \frac{RT}{F^2}$$

USTÁL. DIF. (1 SMĚR, 0 CHR.)

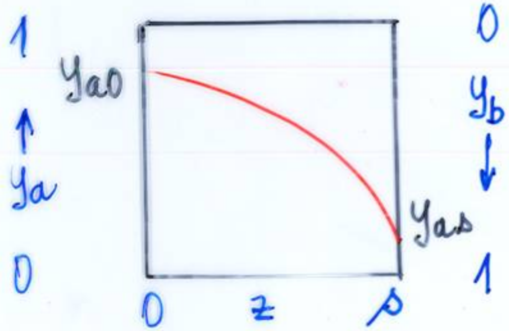


$$\frac{dj_{az}}{dz}=0 \qquad j_{az}=\text{konst.}$$

$$\left.\begin{aligned} j_{az}&=y_a j_z - cD_{ab}\frac{dy_a}{dz} \\ j_{bz}&=0,\quad j_{az}=j_z \end{aligned}\right\} \quad (1-y_a)j_z=-cD_{ab}\frac{dy_a}{dz}$$

$$\frac{j_z}{cD_{ab}}dz=-\frac{dy_a}{1-y_a} \Rightarrow \frac{j_z}{cD_{ab}}z=\ln(1-y_a)+B$$

$$z=0,\ y_a=y_{a0} \Rightarrow 0=\ln(1-y_{a0})+B$$



$$\boxed{\frac{j_z}{cD_{ab}}z=\ln\frac{1-y_a}{1-y_{a0}}} \qquad \frac{1-y_a}{1-y_{a0}}=\exp\left[\frac{j_z z}{cD_{ab}}\right]$$

$$z=\delta,\ y_a=y_{a\delta} \qquad 1-y_a=y_b$$

$$\boxed{\ln\frac{1-y_a}{1-y_{a0}}=\frac{z}{\delta}\ln\frac{1-y_{a\delta}}{1-y_{a0}}}$$

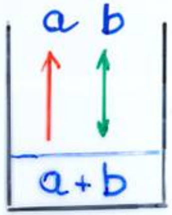
$$\boxed{j_{az}=j_z=\frac{cD_{ab}}{\delta}\ln\frac{1-y_{a\delta}}{1-y_{a0}}=\frac{cD_{ab}}{\delta}\cdot\frac{y_{a0}-y_{a\delta}}{(1-y_a)_{ls}}}$$

$$y_{b\,ls}=(1-y_a)_{ls}=\frac{(1-y_{a\delta})-(1-y_{a0})}{\ln\frac{1-y_{a\delta}}{1-y_{a0}}}=\frac{y_{a0}-y_{a\delta}}{\ln\frac{1-y_{a\delta}}{1-y_{a0}}}$$

$$b:\quad 0=y_b j_z - cD_{ab}\frac{dy_b}{dz}$$

STEFAN

OBEC.



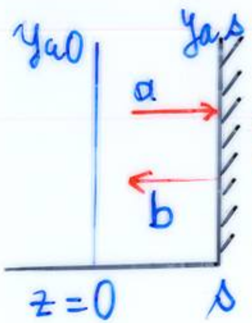
$$j_{az} = y_a j_z - c D_{ab} \frac{dy_a}{dz}$$

$$g_a = \frac{j_{az}}{j_z} = y_a - \frac{c D_{ab}}{j_z} \frac{dy_a}{dz} \Rightarrow \frac{j_z}{c D_{ab}} dz = - \frac{dy_a}{g_a - y_a}$$

$$\ln \frac{g_a - y_a}{g_a - y_{a0}} = \frac{z}{\delta} \ln \frac{g_a - y_a}{g_a - y_{a0}}$$

$$j_{az} = g_a j_z = \frac{c D_{ab} g_a}{\delta} \cdot \frac{y_{a0} - y_{a\delta}}{(g_a - y_a)_{ls}}$$

+ HET. REAKCE



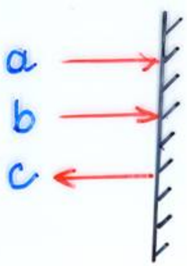
$$n_a a \longrightarrow b \qquad \text{(POLYM.)}$$

$$j_{bz} = - \frac{1}{n_a} j_{az} \qquad (n_a < 0)$$

$$g_a = \frac{j_{az}}{|\vec{j}_{az} + \vec{j}_{bz}|} = \frac{1}{1 - \frac{1}{n_a}} = \frac{n_a}{n_a - 1}$$

$$j_{a\delta} = k_\delta c^m y_{a\delta}^m \qquad y_{a\delta} = \frac{1}{c} \left(\frac{j_{az}}{k_\delta} \right)^{\frac{1}{m}}$$

OKAMŽ. $y_{a\delta} = 0$



$$n_a a + n_b b = n_c c$$

$$j_i = \frac{n_i}{n_a} j_a \Rightarrow g_i = \frac{j_i}{|\vec{j}_a + \vec{j}_b + \vec{j}_c|} = \frac{n_i}{n_a + n_b + n_c}$$

$n_{reakt.} < 0$

$n_{produk.} > 0$

$$j_a = k_\delta c^{m+n} y_{a\delta}^m y_{b\delta}^n$$

PSEUDOBIN. $x_b \rightarrow 1$

OKAMŽ. $y_{a\delta} = 0$

ZVL. PŘ.

$y_a j_z = 0$ $\begin{cases} y_a \to 0 & (j_z = j_{az},\ j_{bz} = 0) \\ j_z = 0 & (j_{az} = -j_{bz}) \end{cases}$

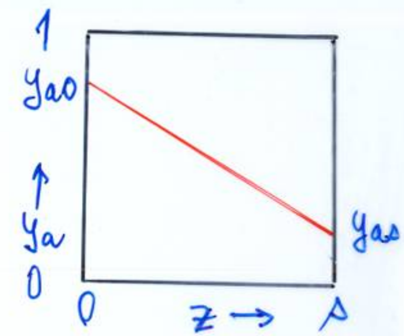
$$j_{az} = -c D_{ab} \frac{dy_a}{dz}$$

$$\left.\begin{aligned} \frac{j_{az}}{c D_{ab}} z &= -y_a + B \\ 0 &= -y_{a0} + B \end{aligned}\right\}$$

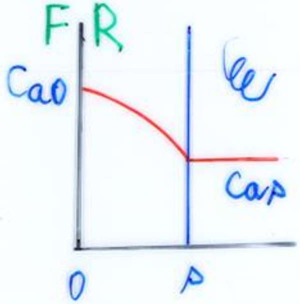
$$\boxed{\frac{j_{az}}{c D_{ab}} z = y_{a0} - y_a}$$

$z = \delta, \quad y_a = y_{a\delta}$

$$\boxed{j_{az} = \frac{c D_{ab}}{\delta} (y_{a0} - y_{a\delta})} \qquad \boxed{y_{a0} - y_a = \frac{z}{\delta} (y_{a0} - y_{a\delta})}$$



FILM



$$j_a = k_c (c_{a0} - c_{a\delta}) = \underbrace{c k_c}_{k_y} (y_{a0} - y_{a\delta})$$

$$k_c = \underbrace{\frac{D_{ab}}{\delta}}_{k_{c\delta}} \frac{1}{y_{b\delta}}$$

$$\frac{\dot{n}_a}{V} = j_a a = k_c a (c_{a0} - c_{a\delta})$$

VÍCESL.

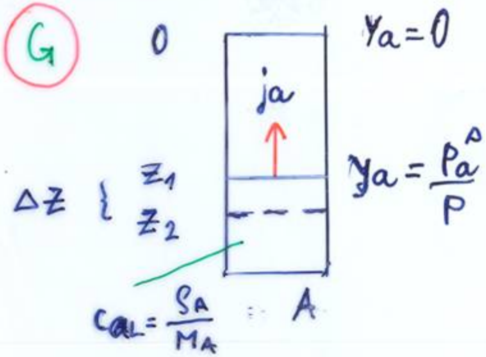
S–M
$$\frac{dy_i}{d\left(\frac{z}{\delta}\right)} = \sum_{k \neq i} \frac{y_i j_k - y_k j_i}{c \frac{D_{ik}}{\delta}}$$

F
$$j_i = \sum_{j}^{c-1} \frac{c D'_{ij}}{\delta} (y_{j0} - y_{j\delta})$$

PSEUDOBIN.
$$j_i = \frac{c D_i}{\delta} (y_{i0} - y_{i\delta})$$

PSEUDOSTAC. STAV (PSS) $\Rightarrow$ D_{ab}

G

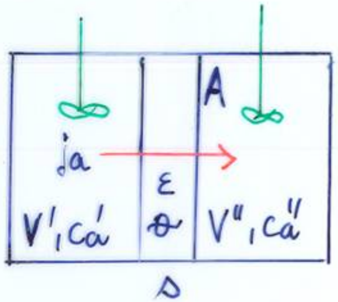


$$\cancel{A}\, j_a = c_{aL} \cancel{A} \frac{dz}{d\tau} \qquad j_a = \frac{c D_{ab}}{z} \frac{(y_a - y_{a0})}{y_{bes}}$$

$$\frac{c D_{ab}}{c_{aL}} \frac{y_a - y_{a0}}{y_{bes}} \int_0^\tau d\tau = \int_{z_1}^{z_2} z\, dz$$

$$\frac{c D_{ab}}{c_{aL}} \frac{y_a - y_{a0}}{y_{bes}} \tau = \frac{1}{2}\left(z_2^2 - z_1^2\right) = \frac{1}{2}\left(z_2 + z_1\right) \Delta z$$

L



$$\left.\begin{aligned} V' \frac{dc_a'}{d\tau} &= - j_a A \\ V'' \frac{dc_a''}{d\tau} &= j_a A \end{aligned}\right\} \quad \frac{d(c_a' - c_a'')}{d\tau} = - j_a A \left(\frac{1}{V'} + \frac{1}{V''}\right)$$

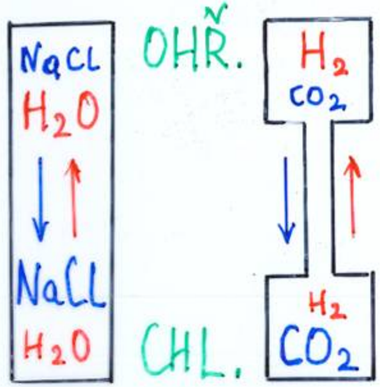
$$j_a = \frac{D_{ab}\, \varepsilon}{\theta\, \delta} \left(c_a' - c_a''\right)$$

$$\frac{d(c_a' - c_a'')}{d\tau} = - D_{ab} \underbrace{\frac{A \varepsilon}{\theta \delta} \left(\frac{1}{V'} + \frac{1}{V''}\right)}_{B} \left(c_a' - c_a''\right)$$

$$\ln \frac{c_a' - c_a''}{c_{a0}' - c_{a0}''} = - D_{ab} B \tau$$

TERMODIFUZE

$(c=2,\ [p],\ \vec{f}_i=0)$



SORET
(1879)

CHAPMAN
DOOTSON
(1917)

FOURIER DUFOUR

$$-\vec{J}_e = \lambda \nabla T + c D_a^D \nabla x_a$$

$$-\vec{J}_a = \frac{D_a^T}{T} \nabla T + c D_{ab} \nabla x_a$$

SORET FICK

$(\vec{J}_b,\ \nabla x_b$ Lin. záv.$)$

k^T

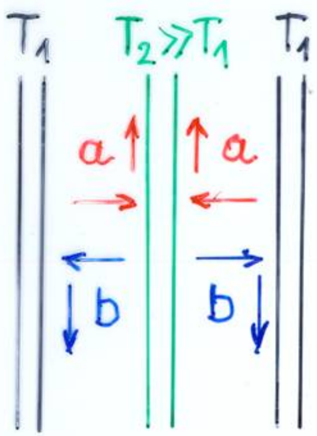
$$-\vec{J}_a = c D_{ab} \left(\nabla x_a + \frac{D_a^T}{c D_{ab}} \frac{\nabla T}{T} \right)$$

$$k^T = \alpha^T x_a x_b = \sigma T x_a x_b$$

T-D POMĚR, T-D FAKTOR (G), SORET (L)

$$\boxed{-\vec{J}_a = c D_{ab} \left(\nabla x_a + \alpha^T x_a x_b \frac{\nabla T}{T} \right)}$$

σT (L)



$\alpha^T (a) < 0$

$\alpha^T (b) > 0$

$G,\ \vec{J}_a^n = 0$:

$$\int_{x_{a1}}^{x_{a2}} \frac{dx_a}{x_a(1-x_a)} = -\alpha^T \int_{T_1}^{T_2} \frac{dT}{T}$$

$$\ln \frac{x_{a2}/x_{b2}}{x_{a1}/x_{b1}} = \alpha^T \ln \frac{T_1}{T_2}$$

PRO $T_{stř.}$