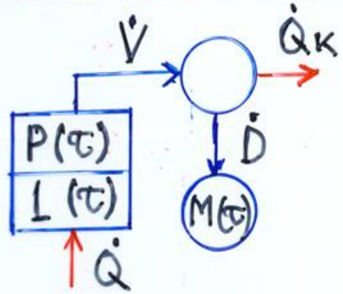
DIF. DESTILACE



$$0 = \dot V + \frac{dL}{d\tau} + \frac{dP}{d\tau}$$

$$P v_P + L v_L = V_Z$$

$$y_i = K_i x_i$$

τ: $\quad 0 = \dot V + \dfrac{dL}{d\tau}$ $\qquad$ $0-\tau$: $\quad L(0) = V + L(\tau)$

$$0 = \dot V_i + \frac{dL_i}{d\tau} \qquad L_i(0) = V_i + L_i(\tau)$$

$$0 = y_i \dot V + \frac{d(x_i L)}{d\tau} \qquad x_i(0)\,L(0) = \bar y_i V + x_i(\tau)\,L(\tau)$$

$$\dot Q = h_V \dot V + \frac{d(h_L L)}{d\tau} \qquad \underbrace{Q + h_L(0)\,L(0)}_{h'_F\,L(0)} = \bar h_V V + h_L(\tau)\,L(\tau)$$

KOND.: $\quad \dot V = \dot D \qquad V = D$

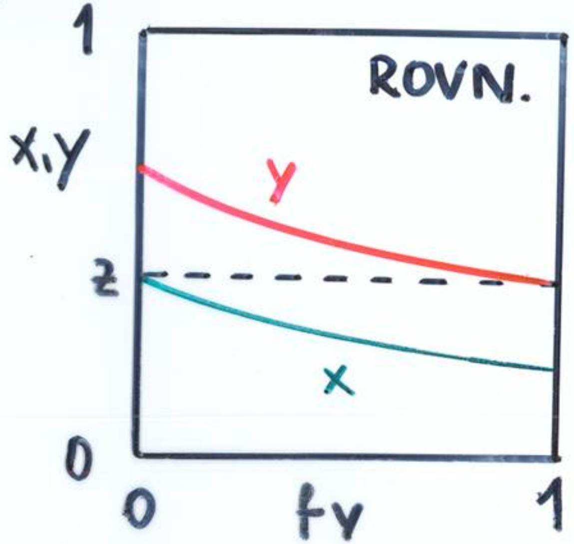
$$y_i \dot V = x_{iD} \dot D \qquad \bar y_i V = \bar x_{iD} D$$

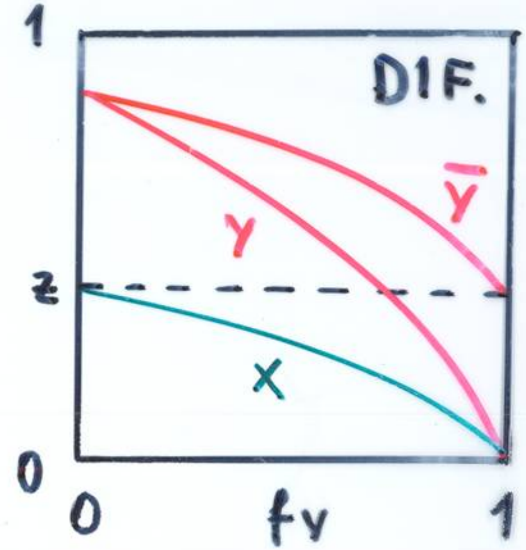
$$h_V \dot V = \dot Q_K + h_D \dot D \qquad \bar h_V V = Q_K + \bar h_D D$$

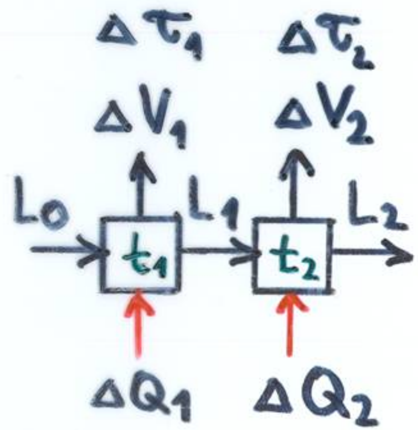
MÍS.: $\quad \dot D = \dfrac{dM}{d\tau} \qquad D = M(\tau) - \cancel{M(0)}$

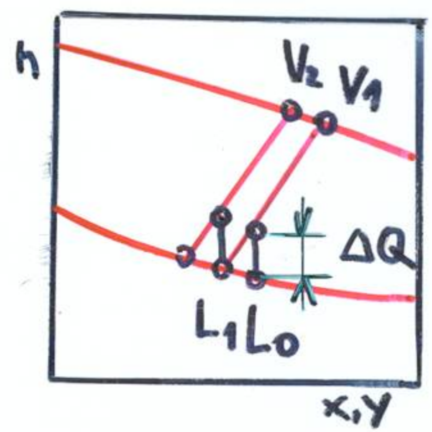
$$x_{iD} \dot D = \frac{d(x_{iM} M)}{d\tau} \qquad \bar x_{iD} D = x_{iM}(\tau)\,M(\tau)$$

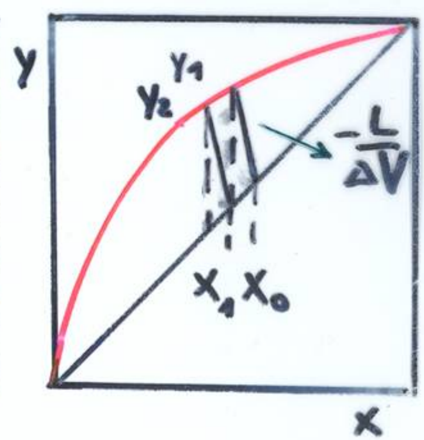
OHŘEV NA b.v.: $\quad h_F F + Q_0 = h_L(0)\,L(0)$







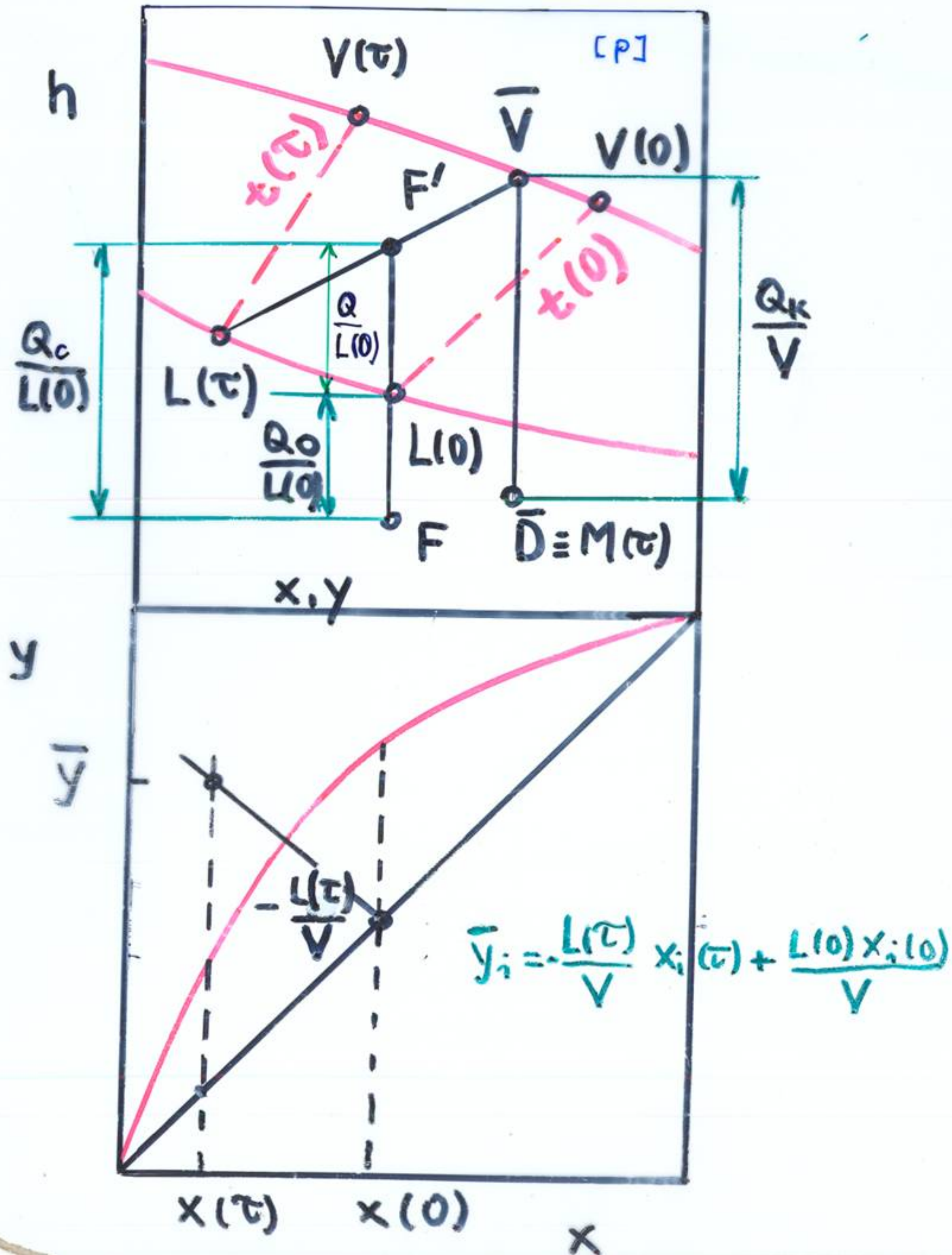




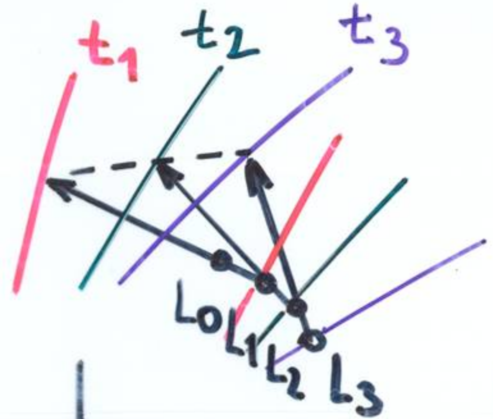
$$Q = n\,\Delta Q$$

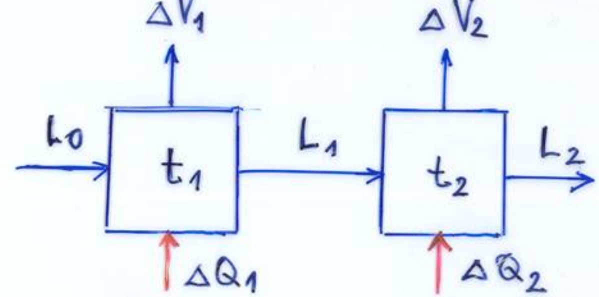
$$V = \sum \Delta V$$

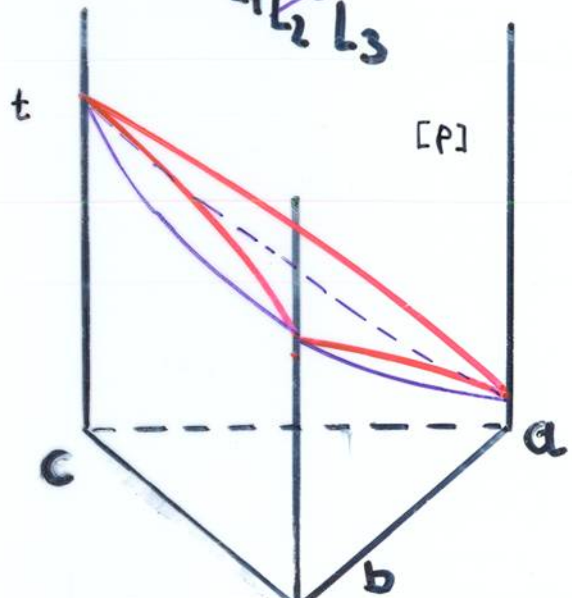
$$V = n\,\Delta V$$

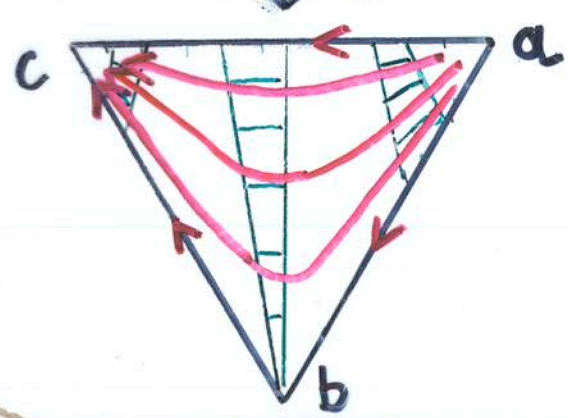


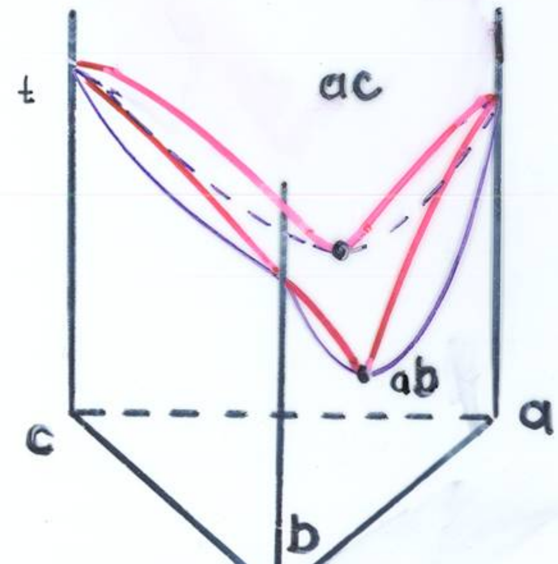
h
V(τ)
[P]
V̄
V(0)
F′
t(τ)
t(0)
$\frac{Q}{L(0)}$
$\frac{Q_c}{L(0)}$
$\frac{Q_K}{V}$
L(τ)
L(0)
$\frac{Q_0}{L(0)}$
F
$\bar{D} \equiv M(\tau)$
x, y
y
$\bar{y}$
$-\frac{L(\tau)}{V}$
$\bar{y}_i = -\frac{L(\tau)}{V} x_i(\tau) + \frac{L(0)\, x_i(0)}{V}$
x(τ)
x(0)
x

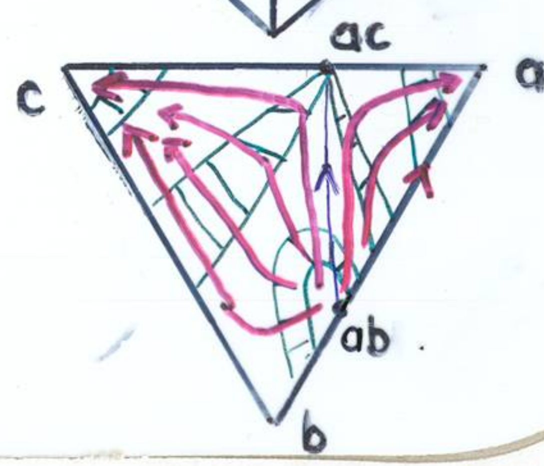

t1
t2
t3
L0
L1
L2
L3


ΔV1
ΔV2
L0
t1
L1
t2
L2
ΔQ1
ΔQ2


t
[p]
c
a
b


c
a
b


t
ac
ab
c
a
b


ac
c
a
ab
b

1

$$0 = \dot{V} + dL/d\tau \qquad 0 = y_i \dot{V} + d(x_i L)/d\tau$$

$$0 = -y_i\, dL + L\, dx_i + x_i\, dL$$

$$\int_{x_i(0)}^{x_i(\tau)} \frac{dx_i}{y_i - x_i} = \int_{L(0)}^{L(\tau)} \frac{dL}{L} = \ln \overset{f_L}{\frac{L(\tau)}{L(0)}}$$

$$y_i = K_i x_i : \ \ln \frac{L(\tau)}{L(0)} = \int_{x_i(0)}^{x_i(\tau)} \frac{dx_i}{(K_i - 1) x_i} \overset{[K_i]}{=} \frac{1}{K_i - 1} \ln \frac{x_i(\tau)}{x_i(0)}$$

$$-dL_i/d\tau = \dot{V}_i$$

$$\left.\begin{aligned} -dL_i &= \dot{V}_i\, d\tau \\ -dL_j &= \dot{V}_j\, d\tau \end{aligned}\right\} \quad \left.\begin{aligned} \frac{dL_i}{dL_j} &= \frac{\dot{V}_i}{\dot{V}_j} \\ \frac{V_i}{V_j} &= \alpha_{ij} \frac{L_i}{L_j} \end{aligned}\right\} \quad \frac{dL_i}{dL_j} = \alpha_{ij} \frac{L_i}{L_j}$$

$$\int_{L_i(0)}^{L_i(\tau)} \frac{dL_i}{L_i} \overset{[\alpha_{ij}]}{=} \alpha_{ij} \int_{L_j(0)}^{L_j(\tau)} \frac{dL_j}{L_j} \qquad \ln \overset{f_{Li}}{\frac{L_i(\tau)}{L_i(0)}} = \alpha_{ij} \ln \overset{f_{Lj}}{\frac{L_j(\tau)}{L_j(0)}}$$

$$f_{Li} = f_{Lj}^{\alpha_{ij}}$$

$$L(\tau) = \sum L_i(\tau)$$

$$x_i(\tau) = L_i(\tau)/L(\tau)$$

$$L(\tau)/K_j(t) = \sum \alpha_{ij} L_i(\tau) \qquad t = t(\tau)$$

$$f_L: \quad \frac{L_i(\tau)}{L_i(0)} \cdot L_i(0) = L_i(\tau) \qquad \sum \overset{f_{Li}}{\frac{L_i(\tau)}{L_i(0)}} x_i(0) = \overset{f_L}{\frac{L(\tau)}{L(0)}}$$

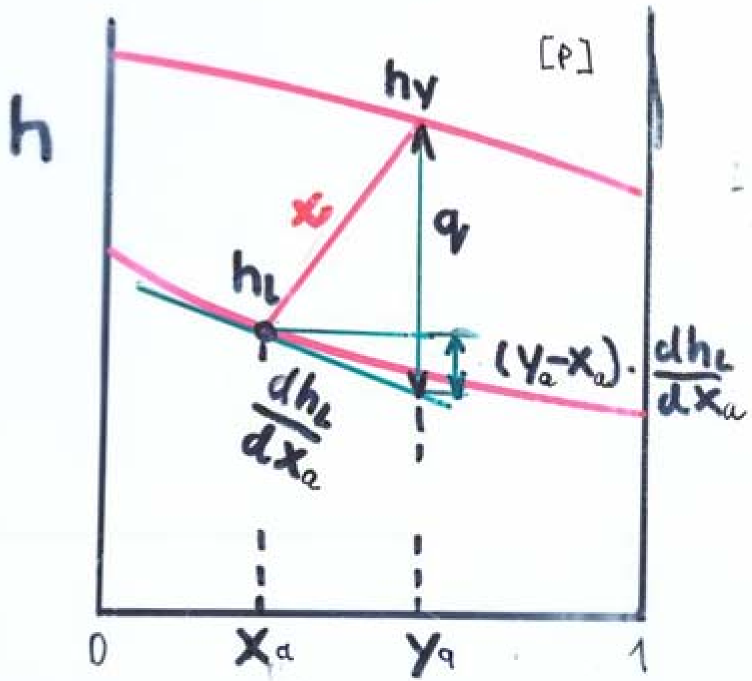
$$L(0)\, x_i(0) \qquad g(f_{Lj}) = \sum f_{Lj}^{\alpha_{ij}} x_i(0) - f_L = 0$$

$$\left.\begin{aligned} 0 &= \dot V + \frac{dL}{d\tau} \\ \dot Q &= h_V \dot V + \frac{d(h_L L)}{d\tau} \end{aligned}\right\} \quad \dot Q = - h_V \frac{dL}{d\tau} + \frac{d(h_L L)}{d\tau} \quad / \cdot d\tau$$

$$dQ = -(h_V - h_L)\, dL + L\, dh_L \frac{dx_i}{dx_i} \frac{dL}{dL} \quad \leftarrow \quad \frac{dx_i}{dL} = \frac{y_i - x_i}{L}$$

$$dQ = -\Big[\underbrace{(h_V - h_L) + (y_i - x_i)\frac{dh_L}{dx_i}}_{q} \Big]\, dL$$

$$Q = - \int_{L(0)}^{L(\tau)} q\, dL$$

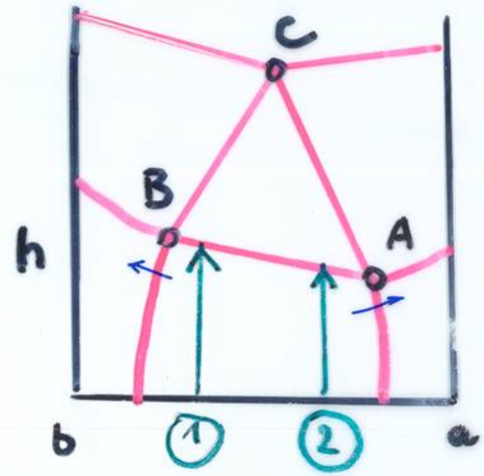


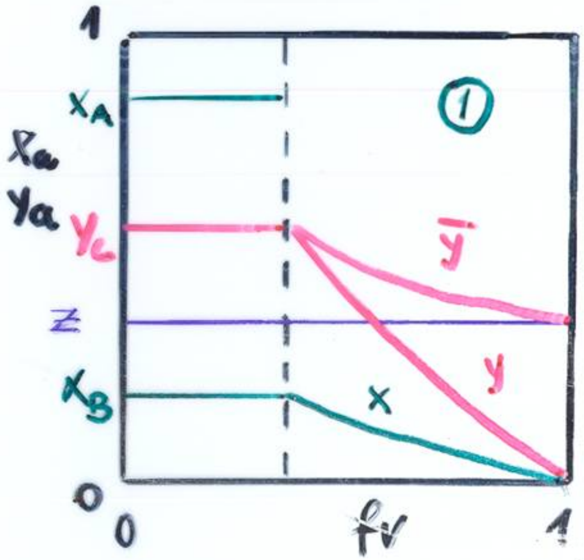
$$0 = \dot{V} + \frac{dL}{d\tau} + \frac{dK}{d\tau}$$

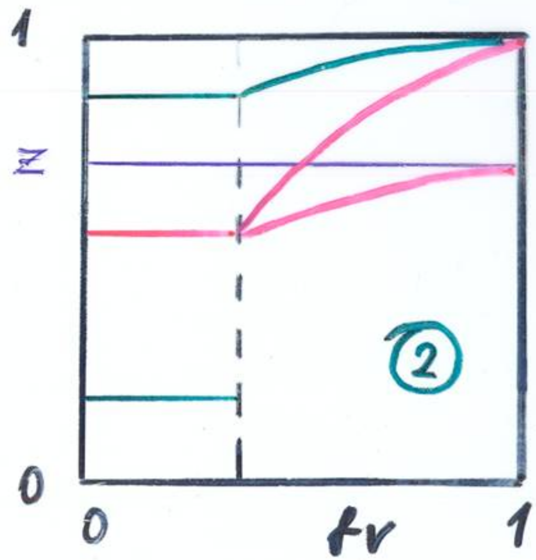
$$0 = y_{ic}\dot{V} + x_{iA}\frac{dL}{d\tau} + x_{iB}\frac{dK}{d\tau}$$

$$\frac{dK}{dL} = \frac{y_{ic} - x_{iA}}{y_{ic} - x_{iB}} = C$$

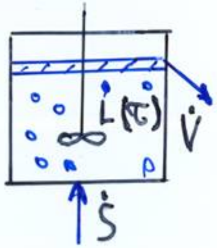
$$K(\tau) - K(0) = C\left[L(\tau) - L(0)\right]$$







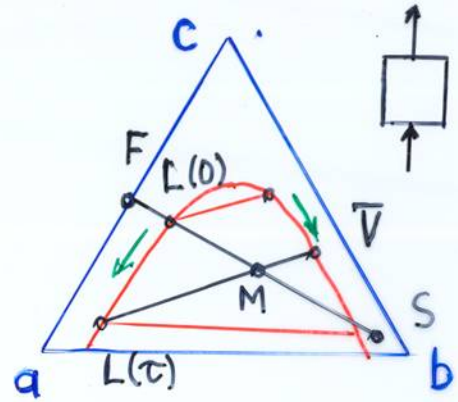
DIF. EXTRAKCE



$$\dot{S} = \dot{V} + \frac{dL}{d\tau}$$

$$y_{is}\dot{S} = y_i \dot{V} + \frac{d(x_i L)}{d\tau}$$

$$y_i = K_i x_i$$



$$S + L(0) = V + L(\tau)$$

$$y_{is} S + x_i(0) L(0) = \bar{y}_i V + x_i(\tau) L(\tau)$$

SYC.: $F + S_0 = L(0)$

$$y_{is} dV + y_{is} dL = y_i dV + x_i dL + L\, d(x_i - y_{is})$$

$$-\underbrace{(y_i - y_{is})}_{y_i'} dV = d[L \underbrace{(x_i - y_{is})}_{x_i'}] \qquad -dV = \frac{d(Lx_i')}{y_i'}$$

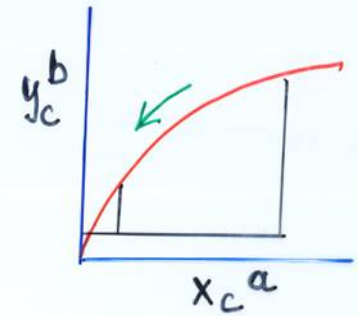
$$\frac{d(Lx_a')}{y_a'} = \frac{d(Lx_c')}{y_c'} \qquad \frac{dL}{L} = -\frac{dx_a'}{\varphi y_a'} + \frac{dx_c'}{\varphi y_c'} \qquad \varphi = \frac{x_a'}{y_a'} - \frac{x_c'}{y_c'}$$

$$\ln \frac{L(\tau)}{L(0)} = -\int_{x_a'(0)}^{x_a'(\tau)} \frac{dx_a'}{\varphi y_a'} + \int_{x_c'(0)}^{x_c'(\tau)} \frac{dx_c'}{\varphi y_c'} \qquad V = -\int_{L(0)x_i'(0)}^{L(\tau)x_i'(\tau)} \frac{d(Lx_i')}{y_i'}$$

$y_{bs} = 1$: $\quad x_i' = x_i, \; y_i' = y_i = K_i x_i \quad (i \neq b) \qquad \varphi = \frac{1}{K_a} - \frac{1}{K_c}$

$\alpha_{ij} = \text{konst.},\; y_{bs} = 1$: $\qquad 0 = \dot{V}_i + \frac{dL_i}{d\tau} \qquad (i \neq b)$

DIF. EXTR. a,b NEMÍS.



$$y_{is}^b \dot{B} = y_i^b \dot{B} + A\frac{dx_i^a}{d\tau} \qquad (i \neq a,b)$$

$$B = -A\int_{x_i(0)}^{x_i(\tau)} \frac{dx_i^a}{y_i^b - y_{is}^b}$$

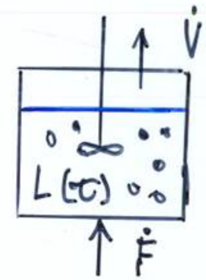
$y_i^b = K_i^R x_i^a$, $K_i^R = konst.$:

$$-\underbrace{\left[\frac{K_i^R B}{A}\right]}_{S_i} = \ln \underbrace{\left[\frac{x_i^a(\tau) - y_{is}^b/K_i^R}{x_i^a(0) - y_{is}^b/K_i^R}\right]}_{C_i}$$

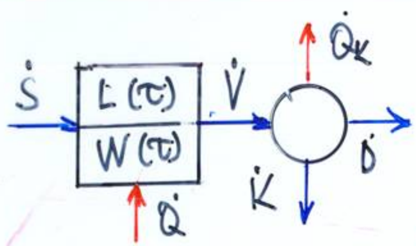
$$C_i = e^{-S_i}$$

DIF. ABSORPCE

$$\dot{F} = \dot{V} + \frac{dL}{d\tau}$$



DIF. PŘEHÁNENÍ PAROU



$$\dot{S} = \dot{V} + \frac{dL}{d\tau} + \cancel{\frac{dW}{d\tau}}$$

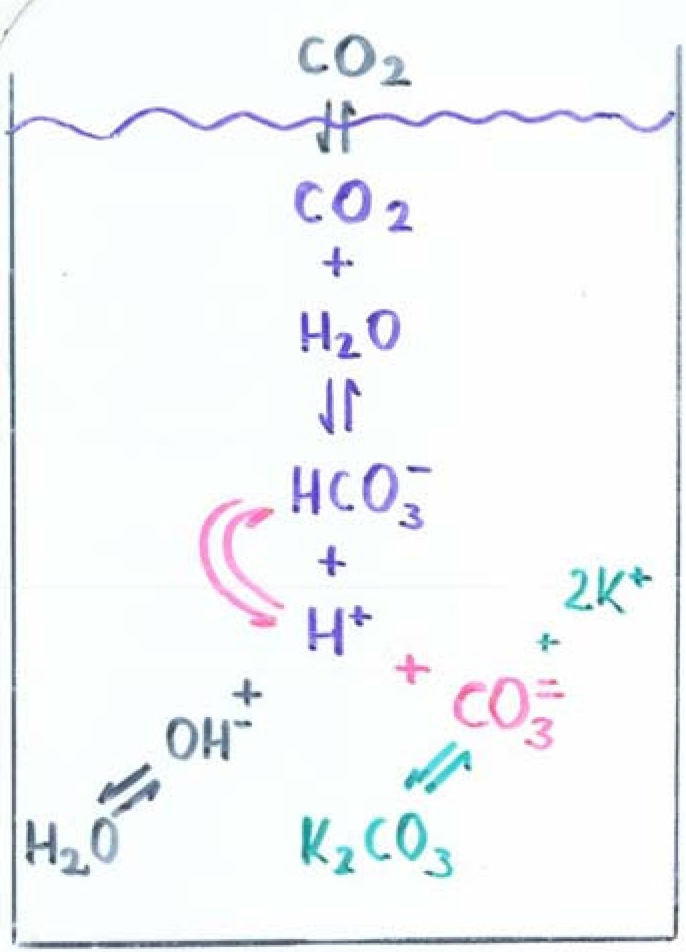
W=0

s: $\dot{S} = y_s \dot{V} + \cancel{\frac{dW}{d\tau}}$

$$\left.\begin{aligned} i \neq s:&\quad 0 = y_i^{-s}\dot{V}^{-s} + \frac{d(x_i L)}{d\tau} \\ -s:&\quad 0 = \dot{V}^{-s} + \frac{dL}{d\tau} \\ &\quad y_i^{-s} = K_i^R x_i \end{aligned}\right\} \text{d.d.}$$

$$K_i^R = K_i\big|_{p - p_s^{\cancel{s}}}$$

ABS. + CH.R.



$$\left.\begin{aligned} K_{R1} &= \frac{a_{H^+}\, a_{HCO_3^-}}{a_{CO_2}\, a_{H_2O}} \\ K_{R2} &= \frac{a_{H^+}\, a_{CO_3^{=}}}{a_{HCO_3^-}} \\ K_V &= \frac{a_{H^+}\, a_{OH^-}}{a_{H_2O}} \end{aligned}\right\} \text{OKAMŽ.}$$

$$a_i = \gamma_i^x c_i = \gamma_{mi}^x m_i$$

$$(c_i \to 0,\ \gamma_i^x \to 1)$$

$$\gamma_i = \mathrm{EXP}\left[-\frac{A z_i^2 I^{1/2}}{1 + B d_i I^{1/2}}\right]$$

$$I = \frac{1}{2}\sum c_i z_i^2$$

$$\mathrm{LOG}\,\frac{H}{H_0} = h I \quad \text{(FÁZ. ROVN.)}$$

$$h = h_+ + h_- + h_g$$

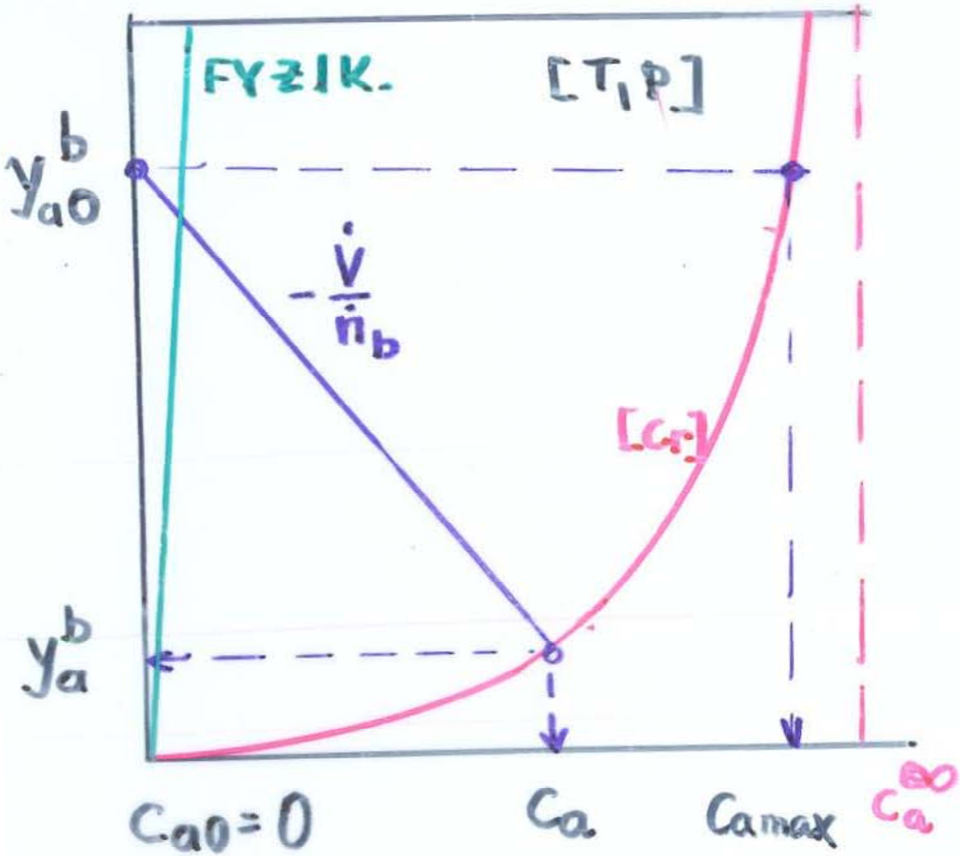
$$c_{H^+} + c_{K^+} = 2c_{CO_3^{=}} + c_{HCO_3^-} + c_{OH^-}$$

(EL. NEUTR.)

DEA:

$$CO_2 + 2R_2NH \rightleftharpoons$$

$$\rightleftharpoons R_2NCOO^- + R_2NH_2^+$$



$$\frac{y_{a0}^b - y_a^b}{c_{a0} - c_a} = -\frac{\dot{V}}{\dot{n}_b}$$

$$c_a = c_{CO_2} + c_{HCO_3^-} + c_{CO_3^=} - c_{CO_3^=,0}$$

c_r

① EXTRAKCE + TVORBA SLOUČENINY

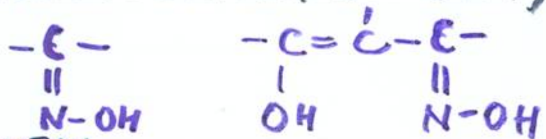
VÝMĚNA KATIONTŮ

ORG. KYS. (SOLI)

DZEHPA

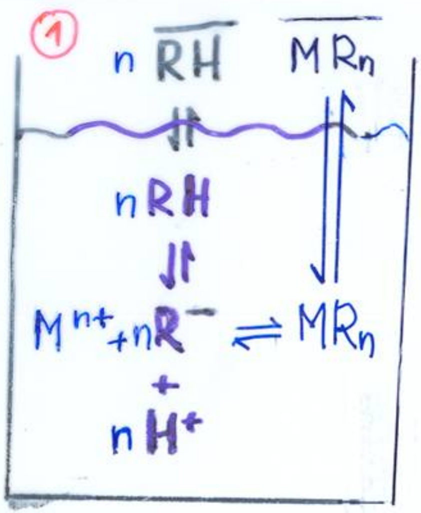
KOMPLEXOTVORNÉ REAG.

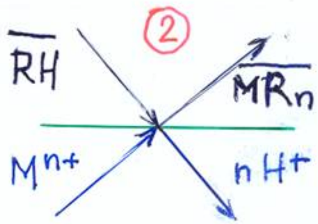
(OXIMY, HYDROXYOXIMY, KETONY)



LIX

KOMPLEX S KOVEM





$$D_i = \frac{\sum c_i'}{\sum c_i}$$

$$K_R = \frac{c'_{MR_n}}{c_{M^{n+}}}\left(\frac{c_{H^+}}{c'_{RH}}\right)^n \qquad \frac{1}{D_H}$$

D_M (úplná dis.)

$$\log D_M = \log K_R + n \log c'_{RH} + pH$$

DIMERISACE, SOLVATACE :

$$M^{n+} + 0{,}5\,(m+s)\,\overline{(HR)_2} \rightleftharpoons \overline{MR_n(HR)_s} + mH^+$$

② TVORBA IONTOVÉHO PÁRU

VÝMĚNA ANIONTŮ

AMINY RNH_2, R_2NH, R_3N, R_4N^+ TOA

R_4N^+:

$$\overline{R_4N^+A^-} + B^- \rightleftharpoons \overline{R_4N^+B^-} + A^-$$

AMINY:

$$\overline{R_3N} + H^+ + A^- \rightleftharpoons \overline{R_3NH^+A^-} \qquad \text{PROTONISACE}$$

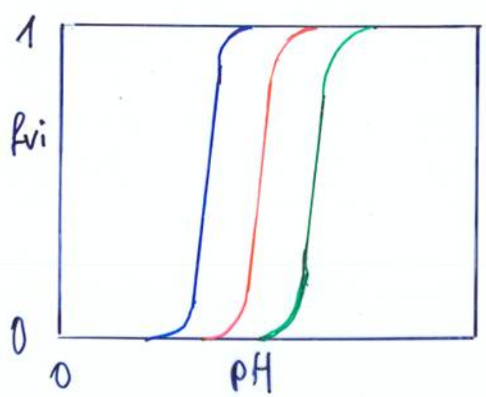
$$\overline{R_3NH^+A^-} + MX^-_{n+1} \rightleftharpoons \overline{R_3NH^+MX^-_{n+1}} + A^-$$

ADICE ($X^- \equiv A^-$)

$$\overline{R_3NH^+X^-} + \underbrace{M^{n+} + nX^-}_{MX_n} \rightleftharpoons \overline{R_3NH^+MX^-_{n+1}}$$

VÝTĚŽEK

$$f_{vM} = \frac{V'c'_M}{V'c'_M + Vc_M} = \frac{D_M}{D_M + \frac{V}{V'}}$$



③ SOLVATACE

EXTR. NEUTR. LÁTEK

ALKOHOLY , KETONY , ESTERY

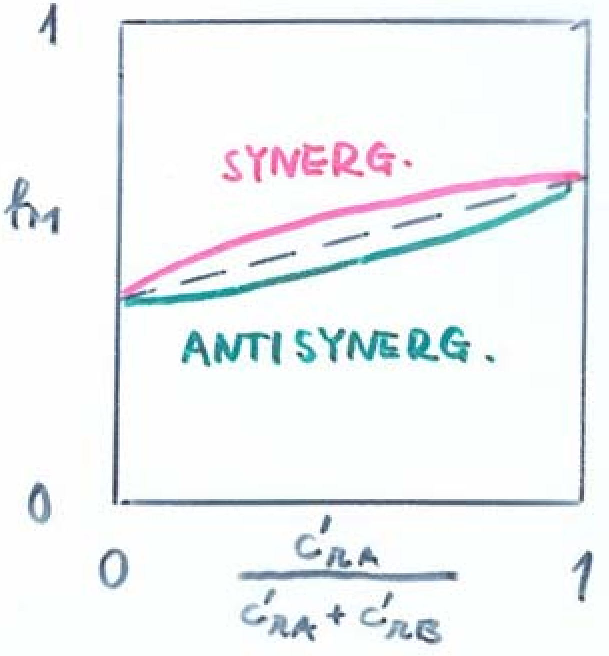
R–OH $\quad CH_3-\underset{\underset{O}{\|}}{C}-C_4H_9$ $\quad (C_4H_9)_3P=O$

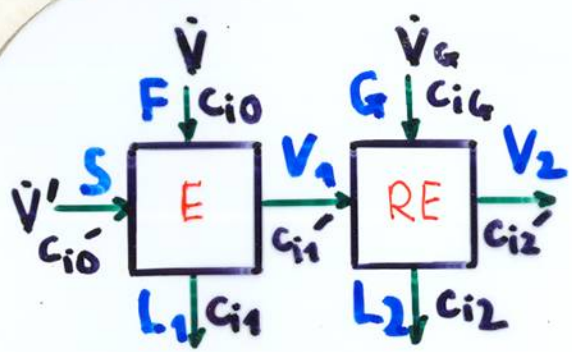
MIK $\quad$ TBP

$$MX_n + y\overline{S} \rightleftharpoons \overline{MX_nS_y}$$

$$UO_2(NO_3)_2 + 2\overline{TBP} \rightleftharpoons \overline{UO_2(NO_3)_2 \cdot 2TBP}$$

SMĚSI :





$$M^{2+}(a) + 2HR = MR_2 + 2H^+(b)$$

$$K_R = \frac{c'_a\, c_b^2}{c_a\, c_b'^2}$$

ÚPLNÁ DIS. $M^{2+}A^{2-}$ ($CuSO_4$)

$H_2^+A^{2-}$ (H_2SO_4)

M^{2+}	H^+	A^{2-}	VODA	MR_2	HR	ROZP.
c_a	c_b	c_c		$2c'_a$	c'_b	

(1) M^{2+}: $\dot{V}c_{a0} + \dot{V}'c'_{a0} = \dot{V}c_{a1} + \dot{V}'c'_{a1}$

H^+ $\dot{V}c_{b0} + \dot{V}'c'_{b0} = \dot{V}c_{b1} + \dot{V}'c'_{b1}$

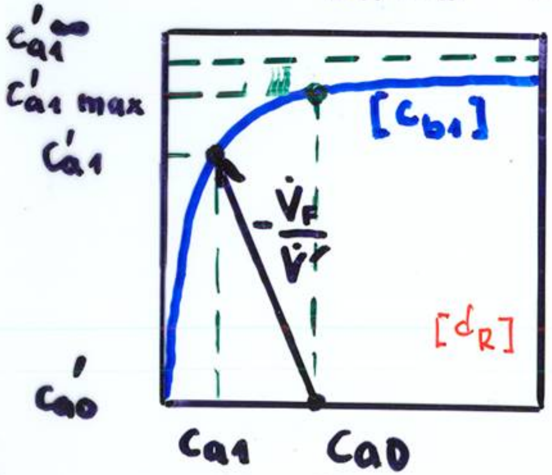
(2) R $2c'_{a0} + c'_{b0} = 2c'_{a1} + c'_{b1} = c'_R$

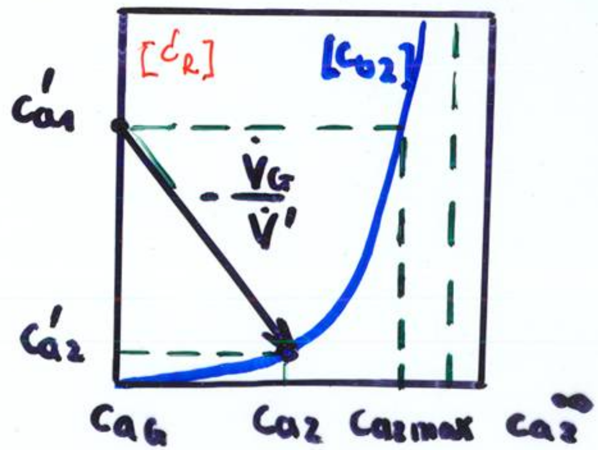
(3) A^{2-}+ELN. $2c_{a0} + c_{b0} = 2c_{a1} + c_{b1} = 2c_c$

(4) ROVN. $c'_{a1}\, c_{b1}^2 = K_R\, c_{a1}\, c_{b1}'^2$

$\Rightarrow c_{a1}, c_{b1}, c'_{a1}, c'_{b1}$

GRAF: $K_R = \frac{c'_a}{c_a}\left(\frac{c_b}{c'_b}\right)^2 = \frac{c'_a}{c_a}\left(\frac{c_b}{c'_R - 2c'_a}\right)^2 \Rightarrow c'_a = f_1(c_a, c_b, c'_R)$





IONEXY

$$Na^+ + \overline{R{-}H} \rightleftharpoons R{-}Na + H^+$$ KATEX

$$Cl^- + \overline{R{-}OH} \rightleftharpoons R{-}Cl + OH^-$$ ANEX

$$|z_B| A^{z_A} + |z_A| \overline{B}^{z_B} \rightleftharpoons |z_B| \overline{A}^{z_A} + |z_A| B^{z_B}$$

ROVN.

R-A
R-B

$a = A^{z_A}$

$b = B^{z_B}$

$$D_i = \frac{\tilde{c}_i}{c_i}$$ ROZD.

$$\alpha_{ij} = \frac{D_i}{D_j}$$ REL. ROZD.

$z_i \sim |z_i|$

$$K_{ij} = \frac{D_i^{z_j}}{D_j^{z_i}}$$ SELEKT.

$$K_R = \frac{\tilde{c}_i^{z_j} c_j^{z_i}}{\tilde{c}_j^{z_i} c_i^{z_j}}$$ ROVN. KONST.

konc.

$= K_{ij}$

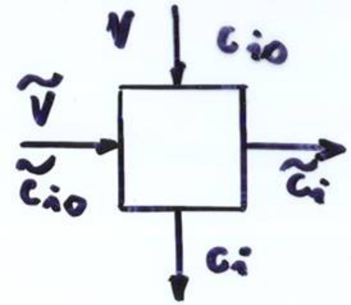
$$\tilde{K}_R = \frac{\tilde{c}_i^{\frac{1}{z_i}} c_j^{\frac{1}{z_j}}}{\tilde{c}_j^{\frac{1}{z_j}} c_i^{\frac{1}{z_i}}}$$ NIKOLSKIJ $= \dfrac{D_i^{1/z_i}}{D_j^{1/z_j}}$

$$\tilde{c}_i = \frac{A_i c_i}{1 + B_i c_i}$$ LANGMUIR

1 STUPEŇ

$$z_a = z_b = 1$$

$$\alpha_{ab} = K_{ab} = K_R = \tilde{K}_R$$



ELNEUTR.

$$c_a + c_b = c_0$$

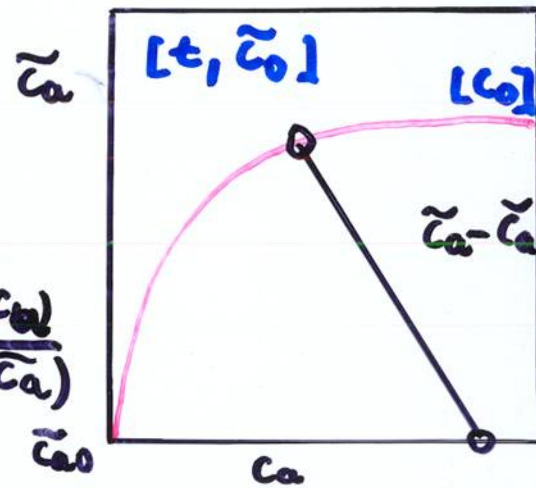
KAPACITA

$$\tilde{c}_a + \tilde{c}_b = \tilde{c}_0$$

ROVN.

$$\alpha_{AB} = \frac{\tilde{c}_a c_b}{c_a \tilde{c}_b} = \frac{\tilde{c}_a (c_0 - c_a)}{c_a (\tilde{c}_0 - \tilde{c}_a)}$$

$$\tilde{c}_a = \frac{\alpha_{ab} \tilde{c}_0 c_a}{c_0 + (\alpha_{ab} - 1) c_a}$$



BIL.

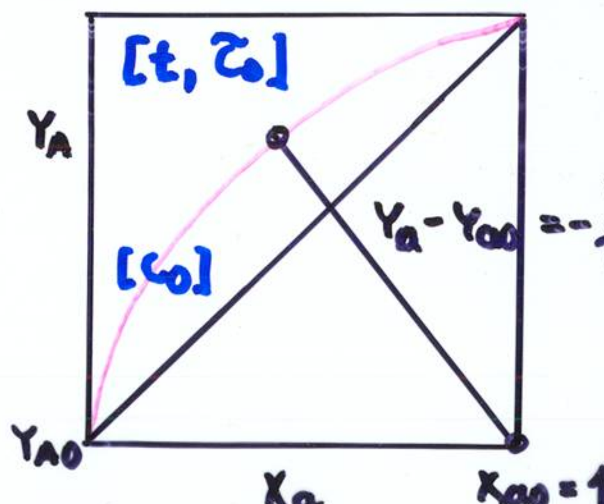
$$\tilde{c}_a - \tilde{c}_{a0} = -\frac{V}{\tilde{V}} (c_a - c_{a0})$$

$$X_A = \frac{c_a}{c_a + c_b} = \frac{c_a}{c_0}$$

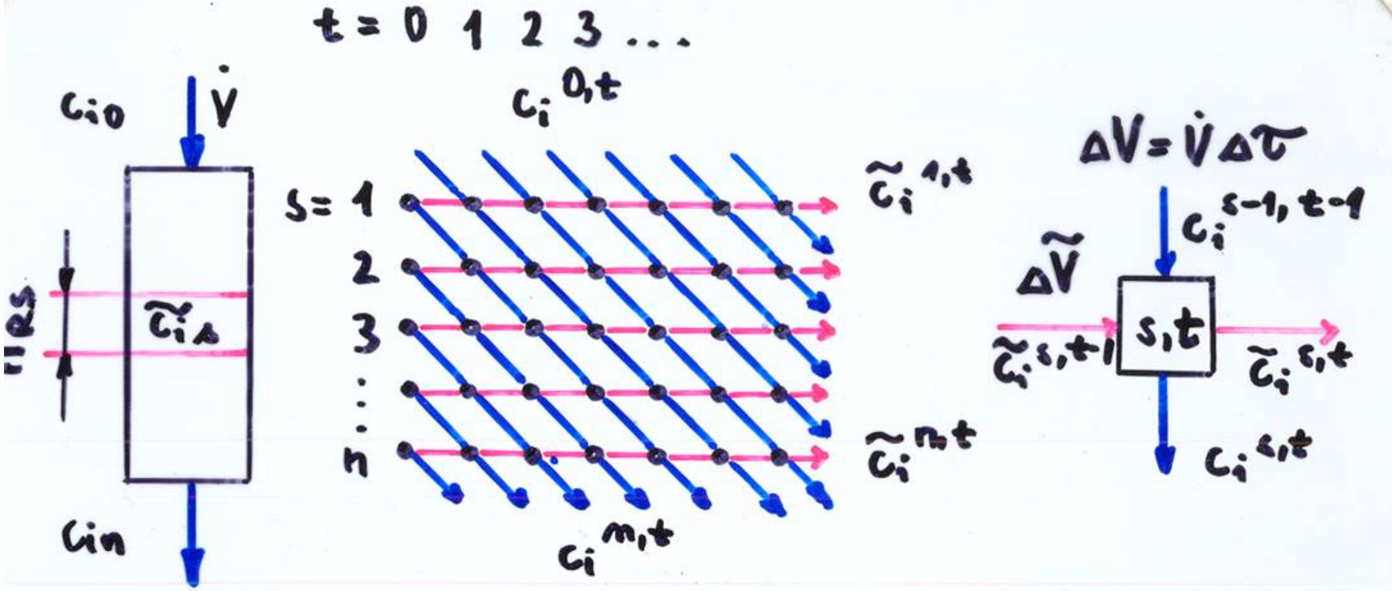
$$Y_A = \frac{\tilde{c}_a}{\tilde{c}_a + \tilde{c}_b} = \frac{\tilde{c}_a}{\tilde{c}_0}$$

$$Y_A = \frac{\alpha_{ab} X_a}{1 + (\alpha_{ab} - 1) X_a}$$

$\tilde{c}_a \left(\frac{mol}{m3}\right) \sim q_a \left(\frac{mol}{kg}\right)$



$$Y_a - Y_{a0} = -\frac{V c_0}{\tilde{V} \tilde{c}_0} (X_a - X_{a0})$$



$$\Delta V\left(c_i^{s-1,t-1} - c_i^{s,t}\right) = -\Delta\tilde{V}\left(\tilde{c}_i^{s,t-1} - \tilde{c}_i^{s,t}\right) \qquad i = 1,\ldots,c$$

$$\sum z_i c_i^{s,t} = \sum z_i c_i^{0,t} = c_0$$

ELN.

$$\sum z_i \tilde{c}_i^{s,t} = \sum z_i \tilde{c}_i^{s,0} = \tilde{c}_0$$

KAP.

$$\tilde{K}_{ij} = \left(\tilde{c}_i^{s,t}\right)^{1/z_i}\left(c_j^{s,t}\right)^{1/z_j} \Big/ \left[\left(\tilde{c}_j^{s,t}\right)^{1/z_j}\left(c_i^{s,t}\right)^{1/z_i}\right] \qquad (i \neq j)$$