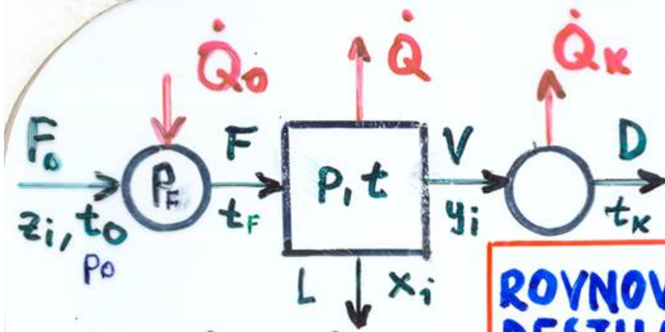


ROVNOVÁŽNÁ DESTILACE

$$\dot{n}_F = \dot{n}_L + \dot{n}_V$$

$$z_i \dot{n}_F = x_i \dot{n}_L + y_i \dot{n}_V$$

$$h_{F0} \dot{n}_F + \dot{Q}_0 = h_F \dot{n}_F$$

$$h_F \dot{n}_F = h_L \dot{n}_L + h_V \dot{n}_V \qquad [\dot{Q}=0]$$

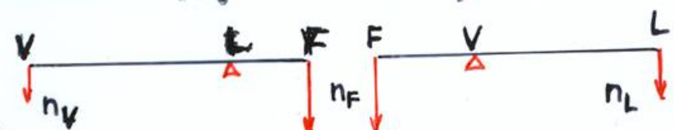
$$h_V \dot{n}_V = \dot{Q}_K + h_D \dot{n}_V$$

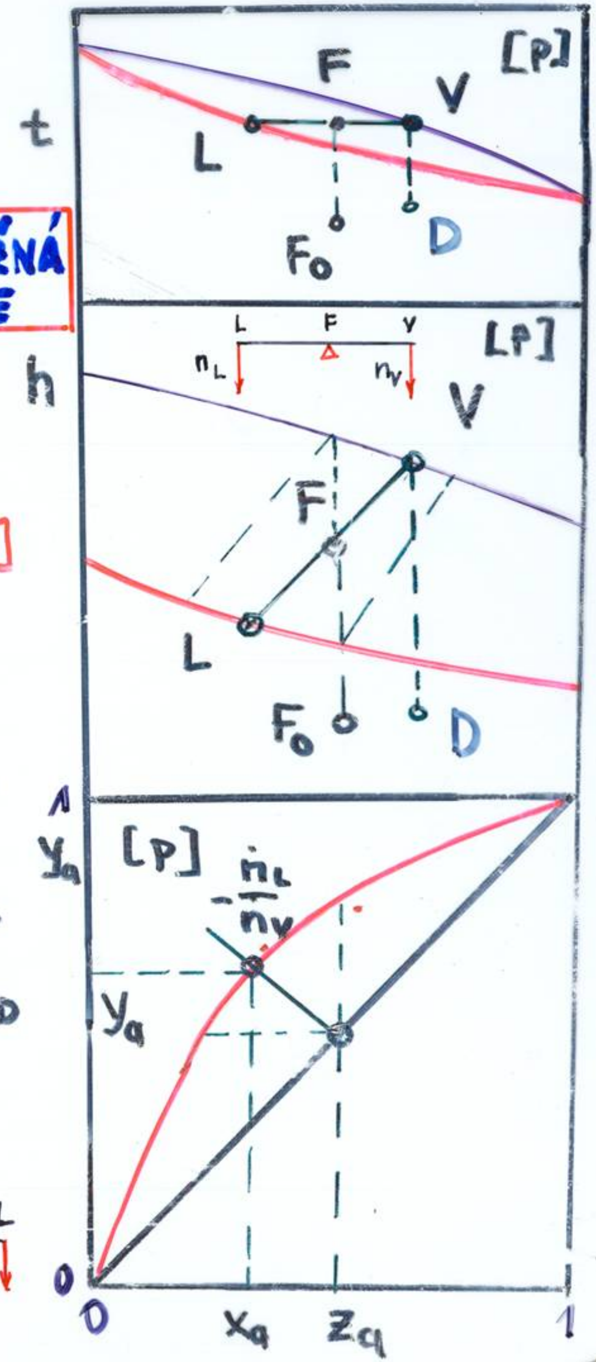
$$\frac{\dot{n}_V}{\dot{n}_L} = \frac{z_i - x_i}{y_i - z_i} = \frac{\overline{FL}}{\overline{VF}} = \frac{h_F - h_L}{h_V - h_F}$$

$$\frac{\dot{n}_V}{\dot{n}_F} = \frac{z_i - x_i}{y_i - x_i} = \frac{\overline{FL}}{\overline{VL}} = \frac{h_F - h_L}{h_V - h_L}$$

$$\frac{\dot{Q}_0}{\dot{n}_F} = h_F - h_{F0} \qquad \frac{\dot{Q}_K}{\dot{n}_V} = h_V - h_D$$

$$y_i = -\frac{\dot{n}_L}{\dot{n}_V} x_i + \frac{z_i \dot{n}_F}{\dot{n}_V}$$

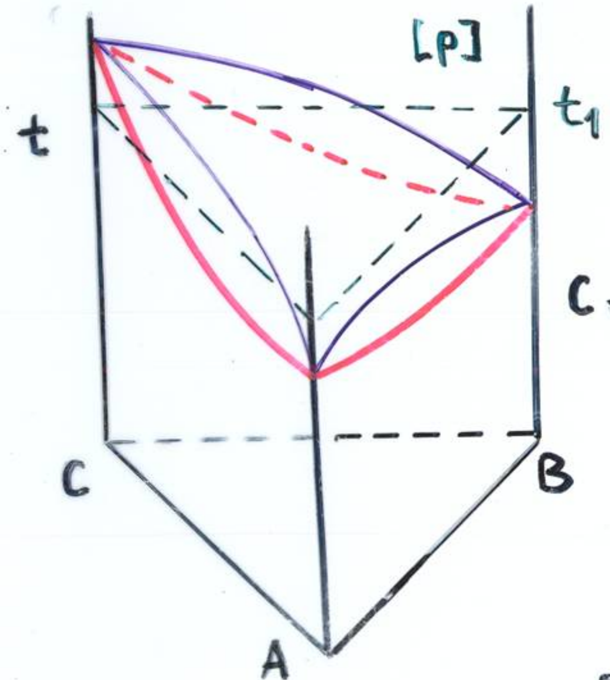


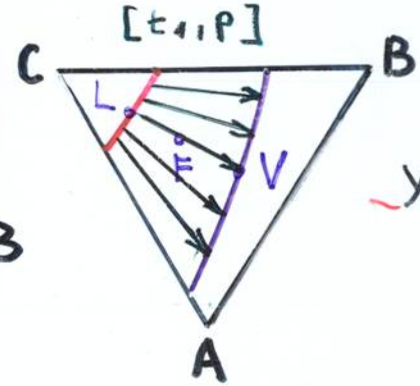


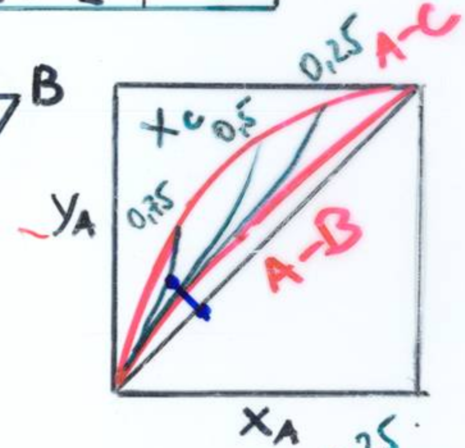
$\boxed{c=3}$

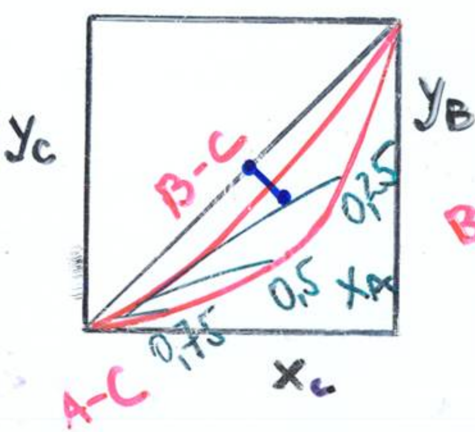
DESTILACE

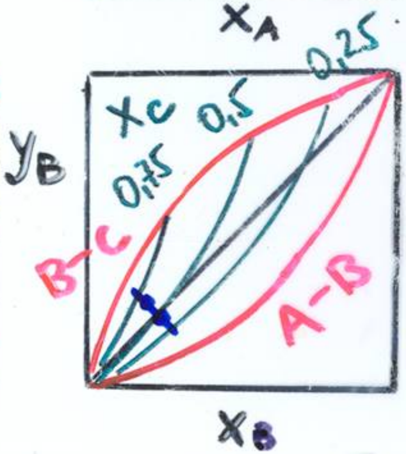
N_f	omez.	N_V
1	-	4
	[p]	3
	[p, t]	2
2	[p]	2
	[p, t]	1











$$y_i = K_i x_i$$

$$K_A x_A + K_B x_B + K_C (1 - x_A - x_B) = 1$$

$$x_A (K_A - K_C) + x_B (K_B - K_C) = 1 - K_C$$

$$x_A = \frac{K_B - K_C}{K_A - K_C} x_B - \frac{1 - K_C}{K_A - K_C}$$

$$y_A = \frac{\frac{1}{K_B} - \frac{1}{K_C}}{\frac{1}{K_A} - \frac{1}{K_C}} y_B - \frac{1 - \frac{1}{K_C}}{\frac{1}{K_A} - \frac{1}{K_C}}$$

$$y_i = -\frac{L}{V} x_i + \frac{F}{V} z_i$$

$f_V = V/F \quad , \quad f_L = L/F \qquad 0 \le f_J \le 1 \quad (J = L, V)$

ROV.: $1 = f_V + f_L$ $\qquad \sum x_i = 1, \ \sum y_i = 1$

$z_i = y_i f_V + x_i f_L \qquad y_i = K_i x_i$

$h_F + \dot{Q}/F = h_V f_V + h_L f_L \qquad (h_{F0} + \dot{Q}_0/F = \dots)$

ELIM. f_L, y_i: $\quad z_i = K_i x_i f_V + x_i (1 - f_V) \qquad x_i = \dfrac{z_i}{1 + f_V (K_i - 1)}$

$\sum x_i = 1 \qquad \boxed{P = \sum \dfrac{z_i}{1 + f_V (K_i - 1)} - 1 = 0} \qquad f_V = 1, \ z_i = y_i \Rightarrow$ r.b.

ELIM. f_V, x_i: $\quad z_i = y_i (1 - f_L) + (y_i / K_i) f_L \qquad y_i = \dfrac{z_i}{1 + f_L \left(\frac{1}{K_i} - 1\right)}$

$\sum y_i = 1 \qquad \boxed{P_L = \sum \dfrac{z_i}{1 + f_L \left(\frac{1}{K_i} - 1\right)} - 1 = 0} \qquad f_L = 1, \ z_i = x_i \Rightarrow$ b.v.

NEBO $\quad \sum y_i - \sum x_i = \sum K_i x_i - \sum x_i = \sum (K_i - 1) x_i = 0$

$\boxed{P^x = \sum \dfrac{z_i (K_i - 1)}{1 + f_V (K_i - 1)} = 0}$ $\qquad f_V = 0, \ z_i = x_i, \ \sum (K_i - 1) x_i = 0 \Rightarrow$ b.v.

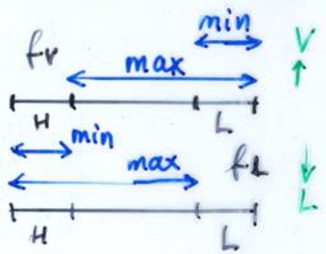
$f_V = 1, \ z_i = y_i, \ \sum \left(1 - \frac{1}{K_i}\right) y_i = 0 \Rightarrow$ r.b.

$K_L \to \infty$

$K_H \to 0$

$1 = \sum\limits_{i \ne L} \dfrac{z_i}{1 + f_V (K_i - 1)} \qquad \sum\limits_{i \ne H} z_i \ge f_V \ge \sum\limits_{i = L} z_i$

$1 = \sum\limits_{i \ne H} \dfrac{z_i}{1 + f_L \left(\frac{1}{K_i} - 1\right)} \qquad \sum\limits_{i \ne L} z_i \ge f_L \ge \sum\limits_{i = H} z_i$



HB: $\quad R = h_V (p, t) f_V + h_L (t) f_L - h_F (t_F) - \dot{Q}/F = 0$

$- h_{F0} (t_0) - \dot{Q}_0/F$

$N_{vr} = 3$

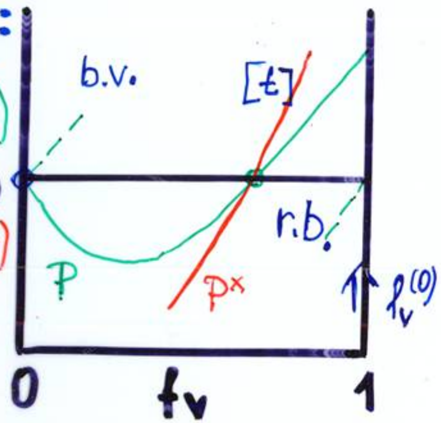
$t_0 \,,\, \dot{Q}_0/F$

A) $P(p, t, f_V) = 0$ $\qquad$ $R(p, t, f_V, t_F, \dot{Q}/F) = 0$

a) **p, t:**

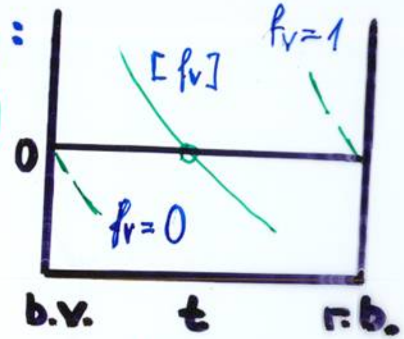
$P(f_V)$

$P^x(f_V)$



b) **p, f_V:**

$P(t)$

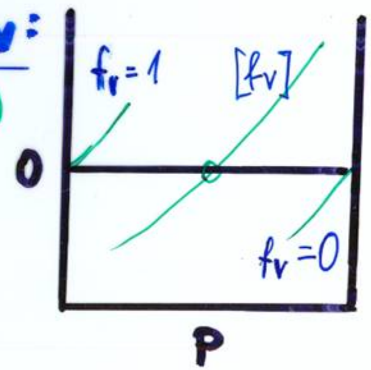


t_F: $\quad R(\dot{Q}/F) = 0$

$\dot{Q}/F$: $\quad R(t_F) = 0$

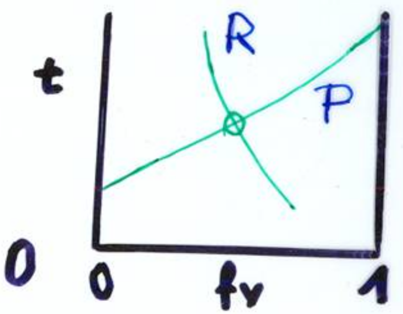
c) **t, f_V:**

$P(p)$



d) **p, t_F, $\dot{Q}/F$:**

$P(t, f_V) = 0 \qquad R(t, f_V) = 0$



$$(1 - f_V)\, h_L(t) + f_V\, h_V(t) - h_F - \dot{Q}/F = 0$$

$$\Sigma x_i h_{iL}(t) \qquad \Sigma y_i h_{iV}(t)$$

$$f_V y_i = z_i - (1 - f_V)\, x_i$$

$$x_i = \frac{z_i}{1 + f_V (K_i - 1)}$$

e) V_j/L_j (místo f_V), p nebo t:

$$y_i = \alpha_{ij} \frac{y_j}{x_j} x_i \qquad V_i = \alpha_{ij} \frac{V_j}{L_j} L_i \qquad L_i = \alpha_{ji} \frac{L_j}{V_j} V_i$$

$$y_i = V_i / V \qquad F_i = \left(\alpha_{ij} \frac{V_j}{L_j} + 1\right) L_i \qquad F_i = \left(\alpha_{ji} \frac{L_j}{V_j} + 1\right) V_i$$

$$x_i = L_i / L$$

$$F_i = V_i + L_i \qquad L_i = \frac{F_i}{1 + \alpha_{ij} V_j / L_j} \qquad V_i = \frac{F_i}{1 + \alpha_{ji} L_j / V_j}$$

$$F = V + L \qquad L = \sum L_i \qquad V = \sum V_i$$

$$\frac{1}{K_j} = \sum \alpha_{ij} x_i \qquad \frac{L}{K_j} = \sum \alpha_{ij} L_i \qquad K_j V = \sum \alpha_{ji} V_i$$

$$K_j = \sum \alpha_{ji} y_i \qquad \boxed{\frac{1}{K_j(t,p)} = \frac{\sum \alpha_{ij} L_i}{\sum L_i}} \qquad \boxed{K_j(t,p) = \frac{\sum \alpha_{ji} V_i}{\sum V_i}}$$

B) SIMULT. ŘEŠENÍ

$$f_1 = K_1 x_1 - y_1 = 0 \qquad f_{c+3} = V y_1 + L x_1 - F z_1 = 0$$

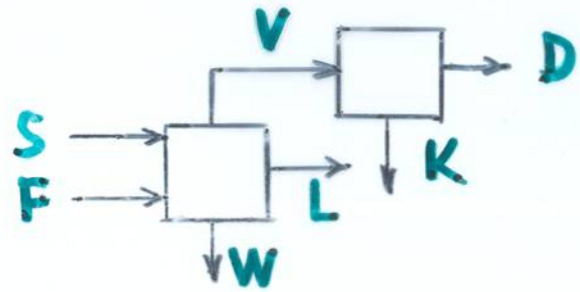
$$\vdots \qquad \vdots$$

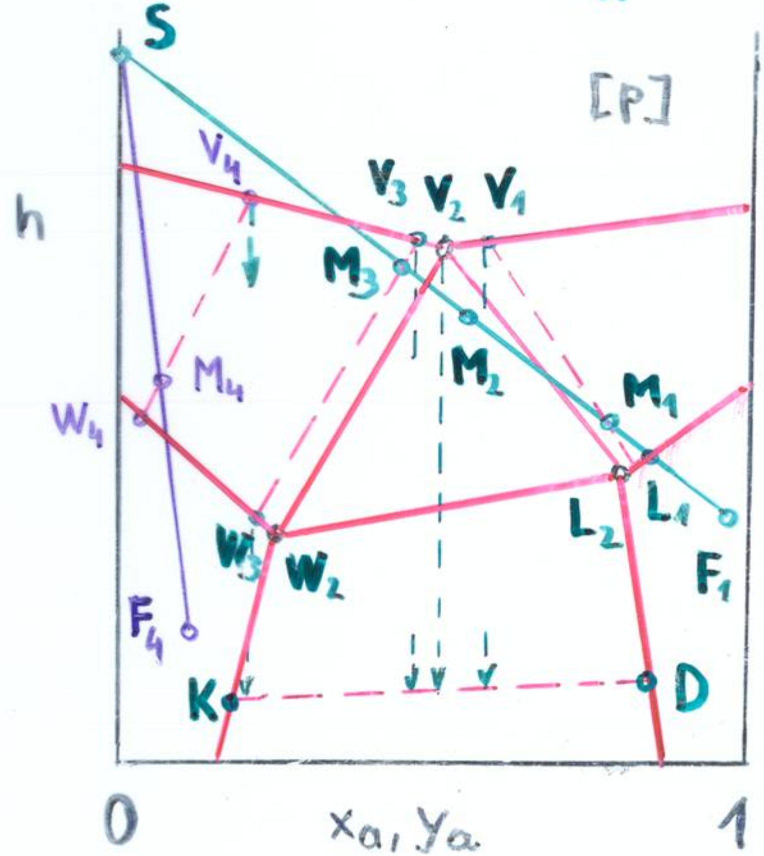
$$f_c = K_c x_c - y_c = 0 \qquad f_{2c+2} = V y_c + L x_c - F z_c = 0$$

$$f_{c+1} = \sum y_i - 1 = 0 \qquad f_{2c+3} = V h_V + L h_L - F h_F - \dot{Q} = 0$$

$$f_{c+2} = \sum x_i - 1 = 0$$

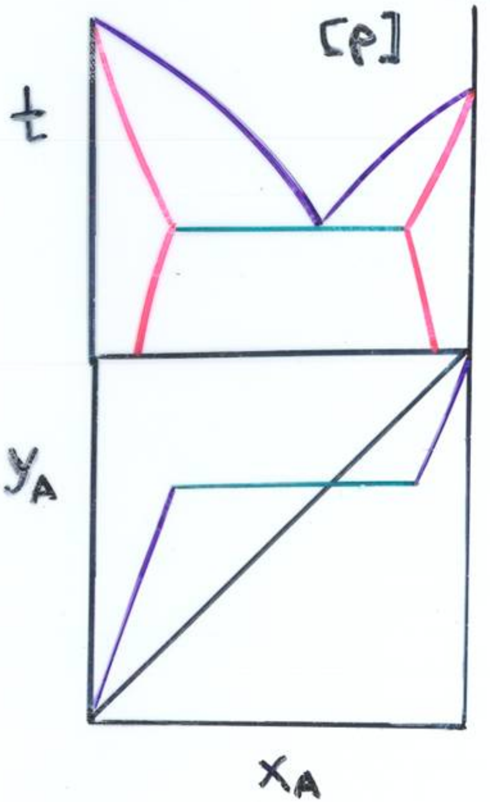
PŘEHÁNĚNÍ PAROU

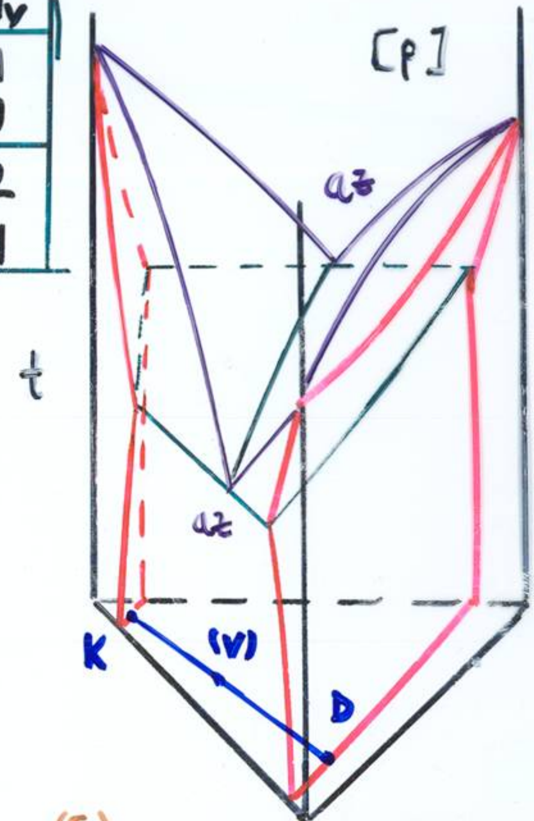


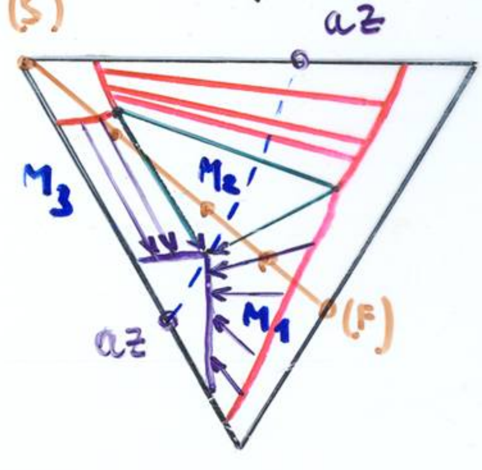


$f = 3$

c	omez.	N_v
2	–	1
	[p]	0
3	[p]	2
	[p, t]	1







$\boxed{s,\ i \neq s \text{ NEMÍS.}}$

BIL.: $F + S = M = V + L + W \qquad z_s = S/M$

$s: \quad S = M_s = V_s + W \qquad M_s = z_s M \qquad M^{-s} = (1 - z_s) M$

$-s: \quad F = M^{-s} = V^{-s} + L \qquad V_s = y_s V \qquad V^{-s} = (1 - y_s) V$

$$h_F F + h_S S = h_M M = h_V V + h_L L + h_W W + \dot{Q}$$

$$h_V V = h_D D + h_K K + \dot{Q}_K$$

$$\sum = \sum_{i \neq s}$$

ROVN. V-L: $y_i = K_i x_i \qquad i \neq s: \ K_i$ koneč.

$x_i = y_i / K_i \qquad i = s: \ K_s \to \infty \ (x_s = 0)$

$$\sum y_i = \sum K_i x_i = 1 - y_s \qquad \sum x_i = \sum y_i / K_i = 1$$

$i \neq s: \quad y_i^{-s} = \dfrac{y_i}{1 - y_s}, \quad y_i^{-s} = K_i^R x_i, \quad K_i^R = \dfrac{K_i}{1 - y_s}, \quad y_s = \dfrac{p_s}{p}$

$$\sum y_i^{-s} = \sum K_i^R x_i = 1 \qquad \sum x_i = \sum y_i^{-s} / K^R = 1$$

V-W: $y_i = K_i' x_{iW} \qquad i \neq s: \ K_i' \to \infty \ (x_{iW} = 0)$

$i = s: \ 1 \cdot K_s' = y_s \ (x_{sW} = 1), \ y_s = \dfrac{p_s^{s}}{p}$

V-L-W: V-W, V-L $(p_s = p_s^{s})$

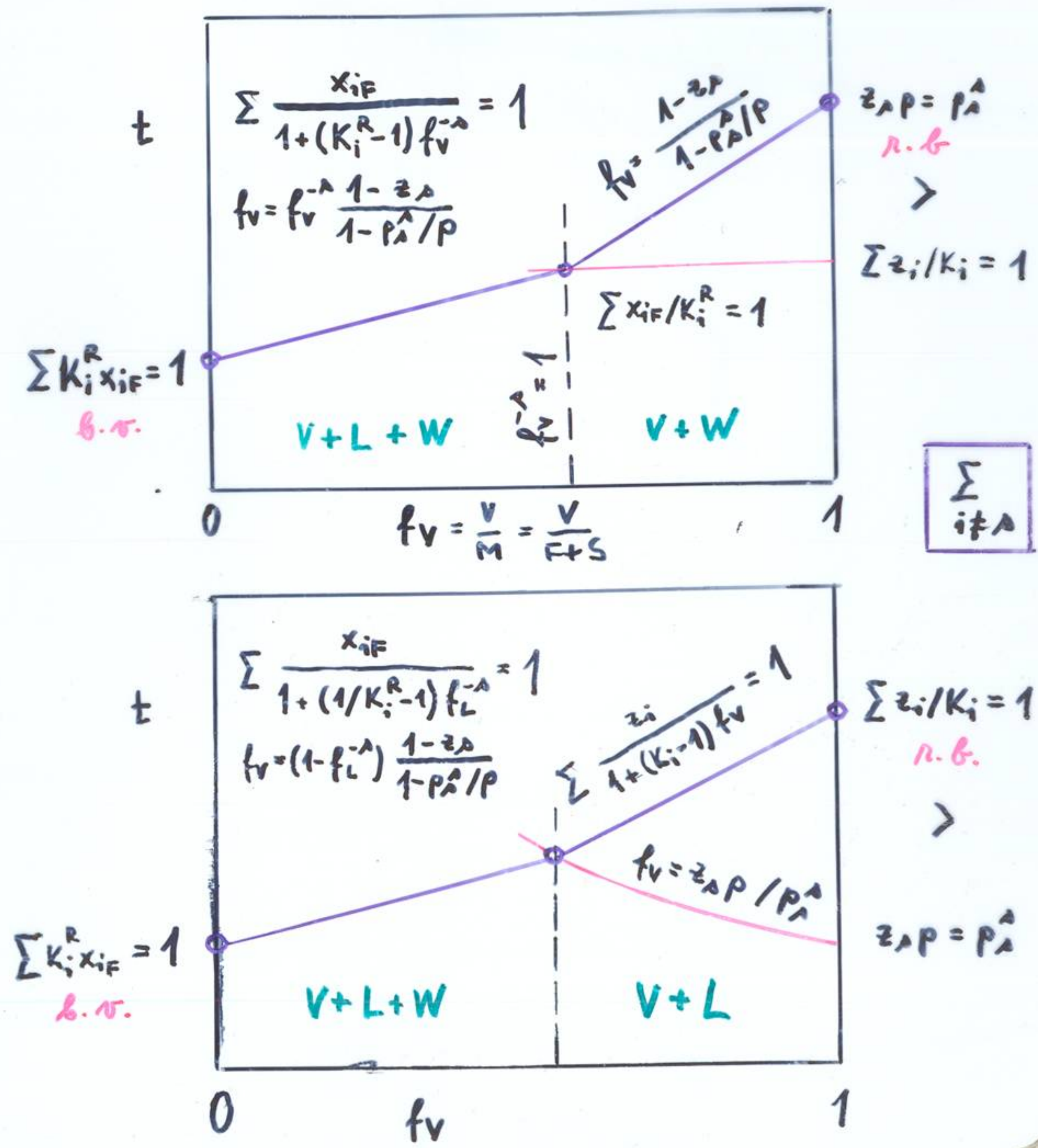
DĚLENÍ V-L, V-L-W:

$$x_i = \frac{z_i}{1 + f_V (K_i - 1)} \qquad = \qquad x_i^{-s} = \frac{x_{iF}}{1 + f_V^{-s} (K_i^R - 1)}$$

$$1 = \sum \qquad\qquad 1 = \sum$$

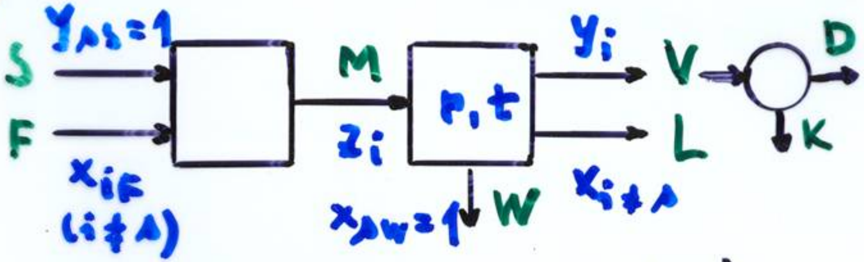
$$y_i = \frac{z_i}{1 + f_L \left(\frac{1}{K_i} - 1 \right)} \qquad y_i^{-s} = \frac{x_{iF}}{1 + f_L^{-s} \left(\frac{1}{K_i^R} - 1 \right)}$$

$$1 - y_s = \sum \qquad\qquad 1 = \sum$$



t
$\sum \frac{x_{iF}}{1+(K_i^R-1)f_V^{-A}} = 1$
$f_V = f_V^{-A}\,\frac{1-z_A}{1-p_A^A/p}$
$f_V = \frac{1-z_A p}{1-p_A^A/p}$
$z_A p = p_A^A$
>
$\sum z_i/K_i = 1$
$\sum x_{iF}/K_i^R = 1$
$\sum K_i^R x_{iF} = 1$
$f_V^{-A} = 1$
V + L + W
V + W
0
1
$f_V = \frac{V}{M} = \frac{V}{F+S}$
$\boxed{\sum_{i\neq A}}$
t
$\sum \frac{x_{iF}}{1+(1/K_i^R-1)f_L^{-A}} = 1$
$f_V = (1-f_L^{-A})\,\frac{1-z_A}{1-p_A^A/p}$
$\sum \frac{z_i}{1+(K_i-1)f_V} = 1$
$\sum z_i/K_i = 1$
>
$f_V = z_A p/p_A^A$
$z_A p = p_A^A$
$\sum K_i^R x_{iF} = 1$
V + L + W
V + L
0
f_V
1

PŘEHÁNĚNÍ PAROU



V	$a, b, \ldots$	A	
L	$a, b, \ldots$	A	W

$$f_V = \frac{V}{M} = \frac{V}{F+S}\ , \quad f_V^{-A} = \frac{V^{-A}}{F}$$

W PŘÍTOMNA

$$\frac{f_V}{f_V^{-A}} = \frac{V/M}{V^{-A}/F} = \frac{V}{V^{-A}}\frac{F}{M} = \frac{V}{V(1-y_A)}\frac{(1-z_A)M}{M} = \frac{1-z_A}{1-\frac{p_A^0}{P}}$$

$$f_L^{-A} = \frac{L}{F}\ , \quad f_L = \frac{L}{M}\ , \quad \frac{f_L}{f_L^{-A}} = \frac{L}{M}\frac{F}{L} = 1-z_A$$

$$f_L^{-A} = 1 - f_V^{-A}$$

W → V: $f_L^{-A} = 0$, $f_V^{-A} = 1$

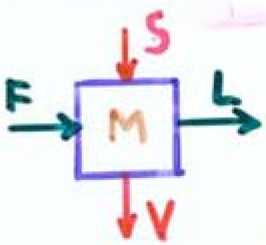
$$f_V = \frac{V}{M} = \frac{V^{-A}}{M} + \frac{V_A}{M} = \left(\frac{V^{-A}}{V_A} + 1\right)\frac{V_A}{M} = \left(\frac{1-y_A}{y_A} + 1\right)\frac{V_A}{M} =$$

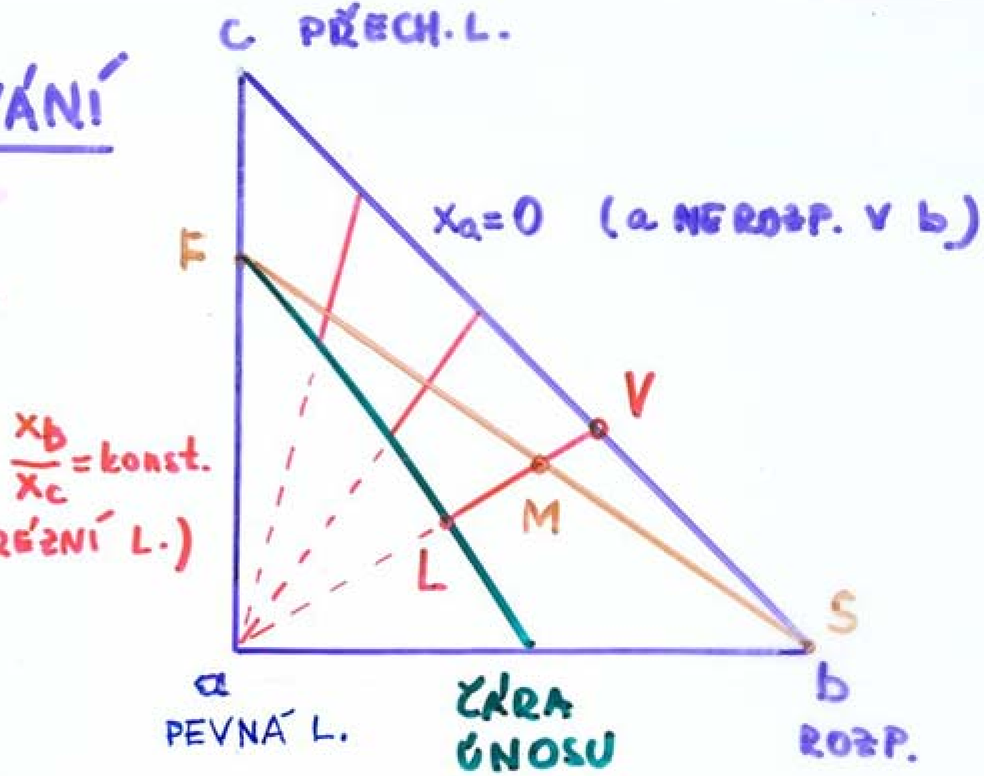
$$= \frac{1}{y_A}\frac{V_A}{M} = \frac{z_A}{y_A} = \frac{P}{p_A^0} z_A$$

VŠECHNA (A) PŘEŠLA DO (V)

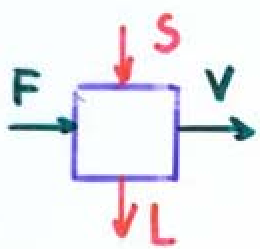
KAPKA (A)

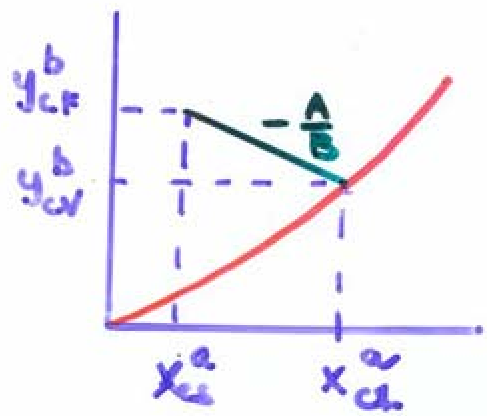
VYLUHOVÁNÍ





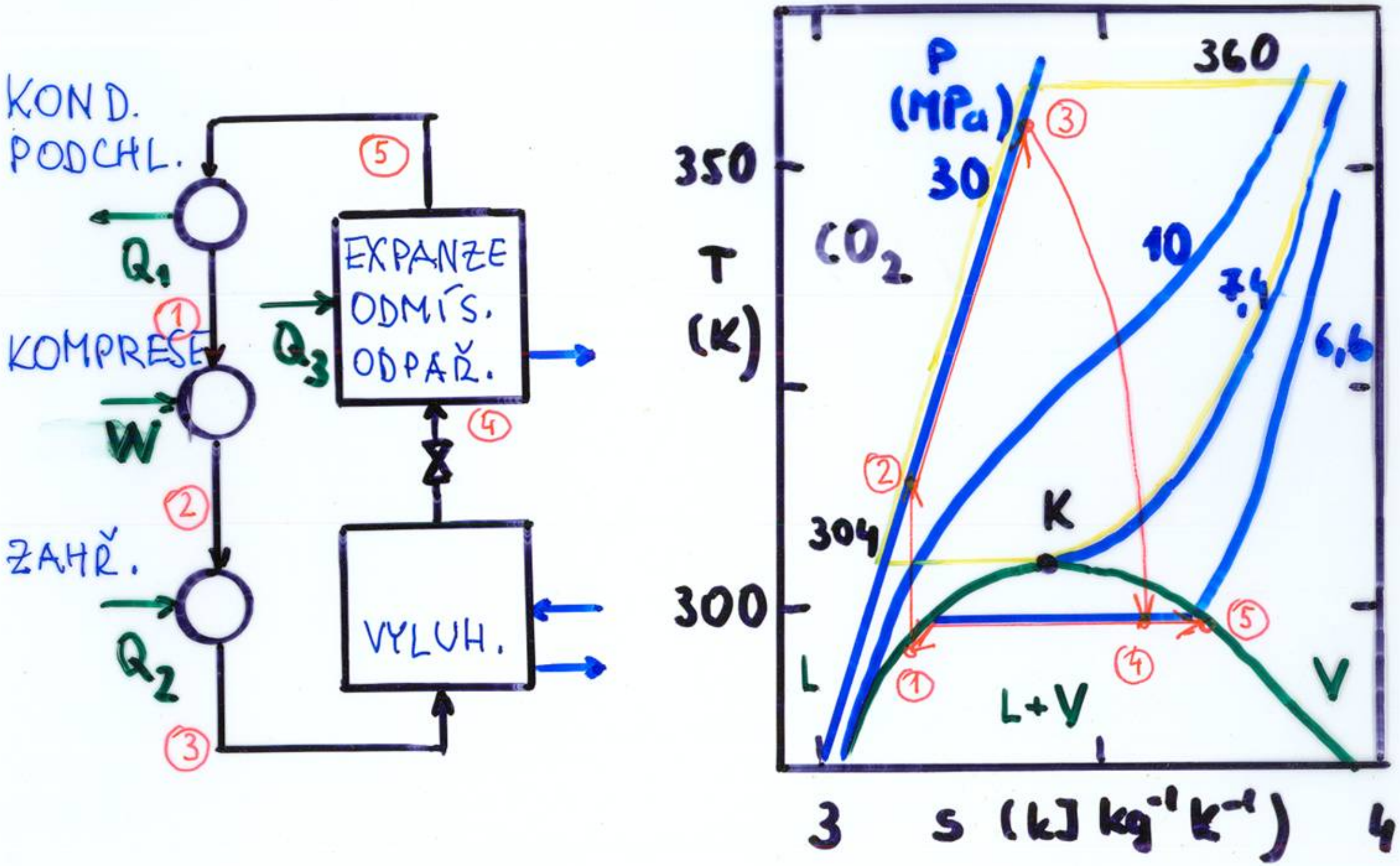
ABSORPCE





a - NETĚK. ROZP.
b - INERT. PLYN

SCE

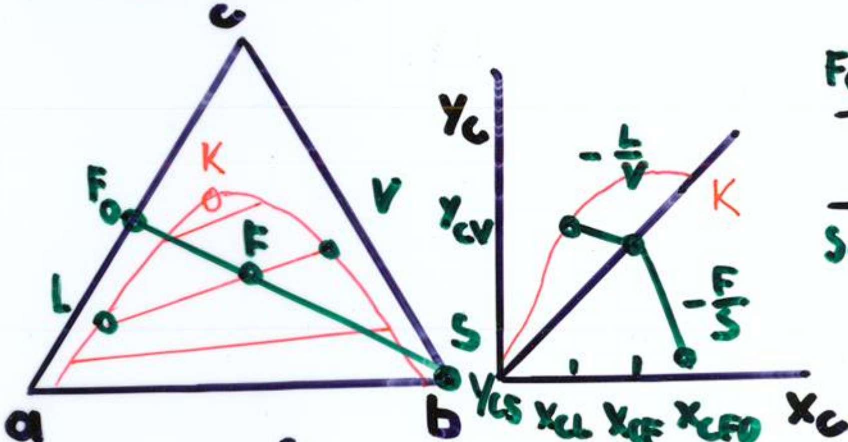


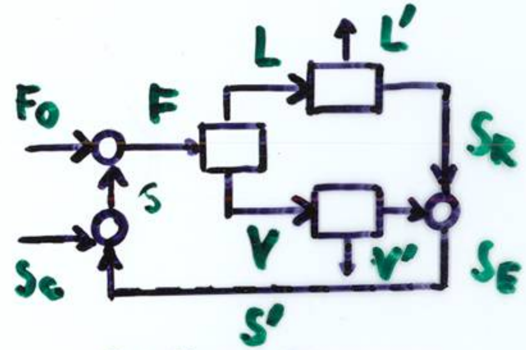
KOND.
PODCHL.
Q_1
KOMPRESE
W
ZAHŘ.
Q_2
EXPANZE
ODMÍS.
ODPAŘ.
Q_3
VYLUH.
1
2
3
4
5
P (MPa)
30
10
7,4
6,6
360
350
304
300
T (K)
CO_2
K
L
L+V
V
3
s (kJ kg^{-1} K^{-1})
4

$\boxed{c=3}$

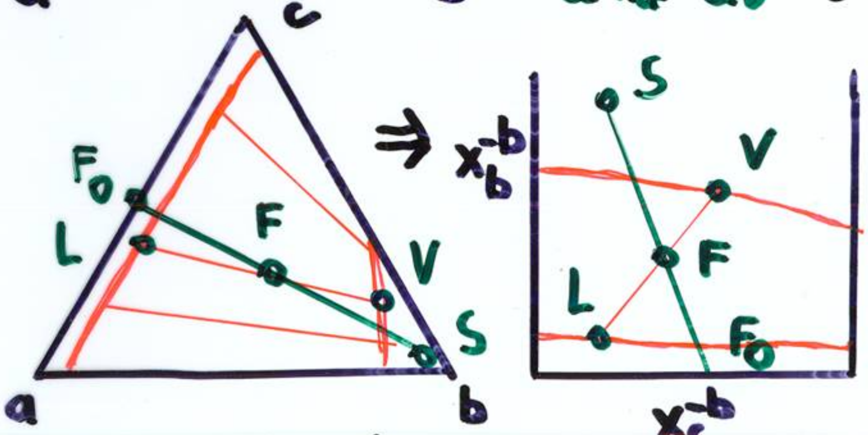
f	podm.	N_V
1	T, p	2
2		1

EXTRAKCE





$$S + F_0 = F$$
$$F = V + L$$

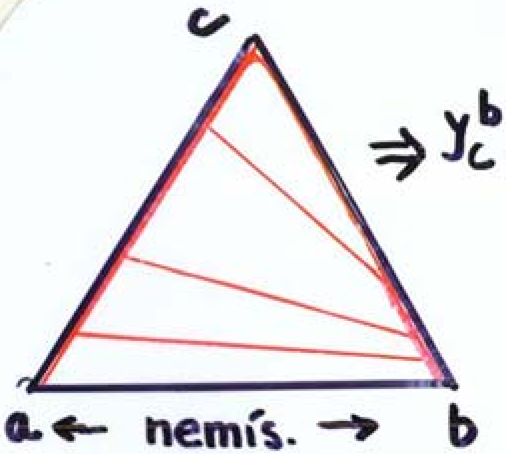


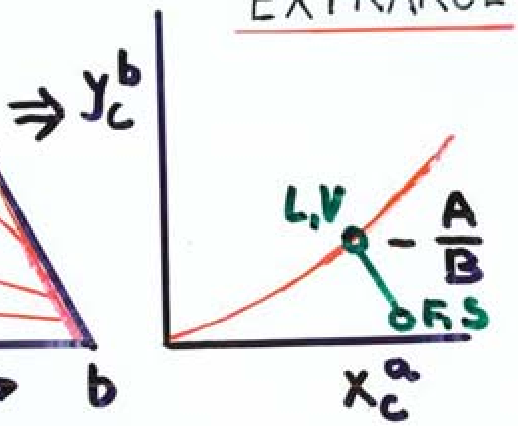
$$x_i^{-b} = \frac{x_i}{1-x_b}$$
$$n^{-b} = n_a + n_c$$

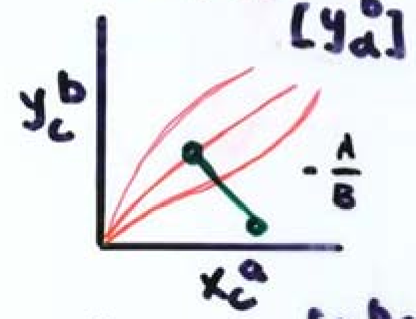
$$i=b \quad x_{iF0}^{-b} n_{F0}^{-b} + \underbrace{y_{iS}^{-b} n_S^{-b}}_{n_S} = z_{iF}^{-b} n_F^{-b}$$

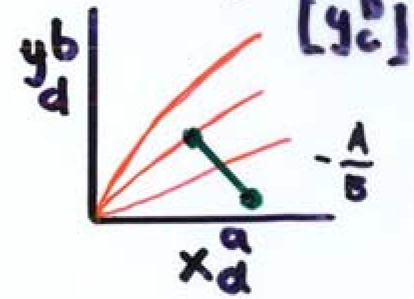
EXTRAKCE

V: b, c, d
L: a, c, d

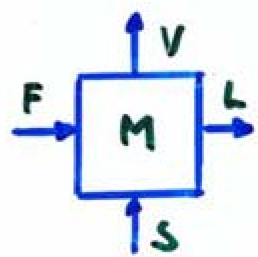






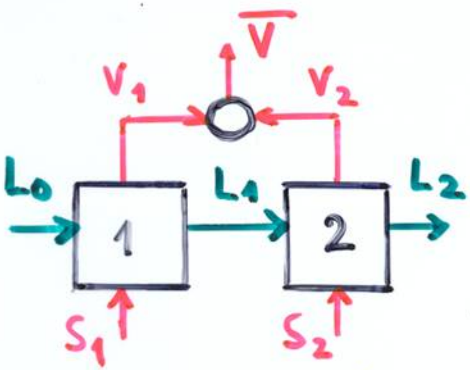


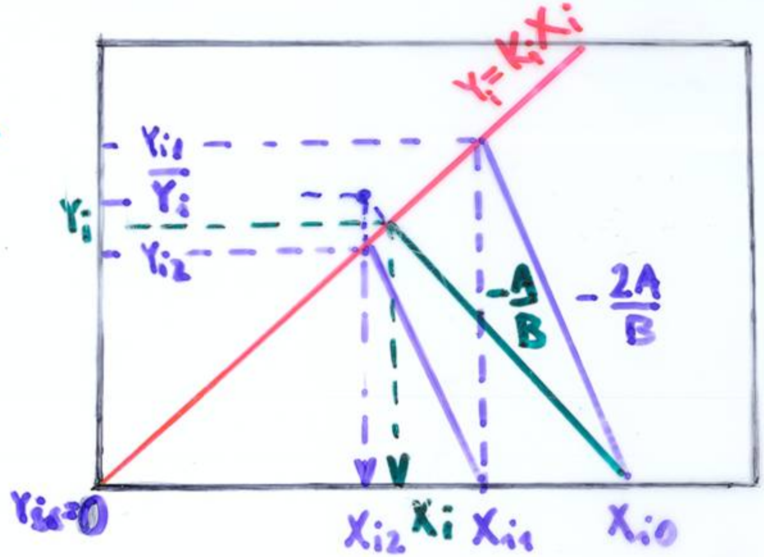
$$x_i^a = \frac{x_i}{x_a} \equiv X_i \qquad y_i^b = \frac{y_i}{y_b} \equiv Y_i$$



$$X_{iF} A + Y_{iS} B = X_{iL} A + Y_{iV} B$$

$$Y_{iV} - Y_{iS} = -\frac{A}{B}(X_{iL} - X_{iF})$$





$X_{ik} = x_{ik}^{a}$, $Y_{ik} = y_{ik}^{b}$

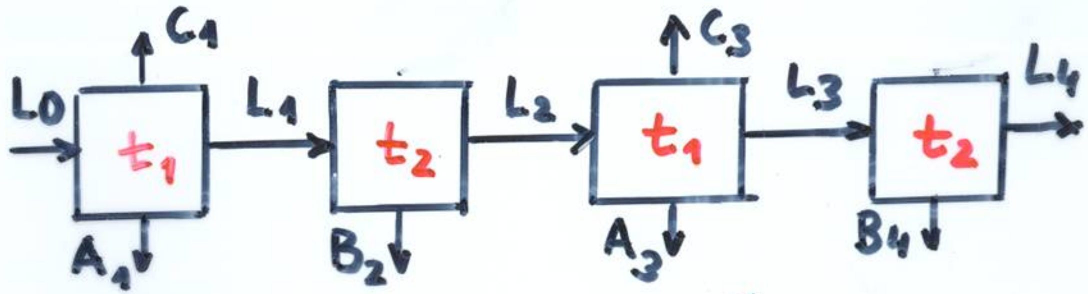
a, b nem/s.

$$A X_{i\,k-1} + B_k Y_{is} = A X_{ik} + B_k Y_{ik}$$

$$B(\bar{Y}_i - Y_{is}) = A(X_{i0} - X_{in})$$ $B = \sum B_k$

MIN. S PRO DANÉ X_{i2} $\Rightarrow$ $B_1 = B_2$ [K_i = konst]

KRYSTALIZACE



ODPAŘ. C

S_1 v HET.

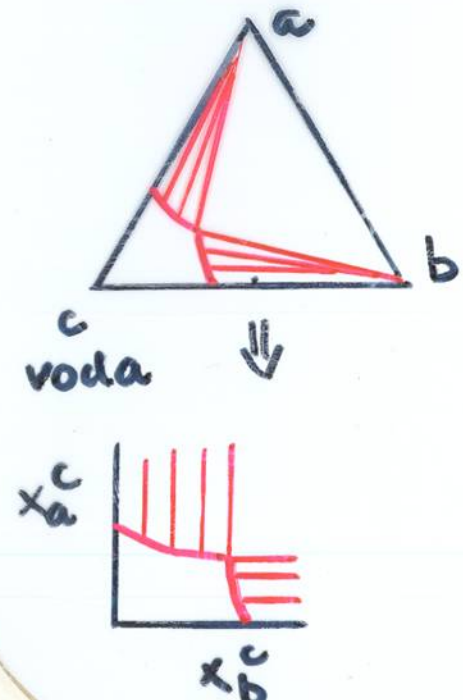
$A_1 + L_1$

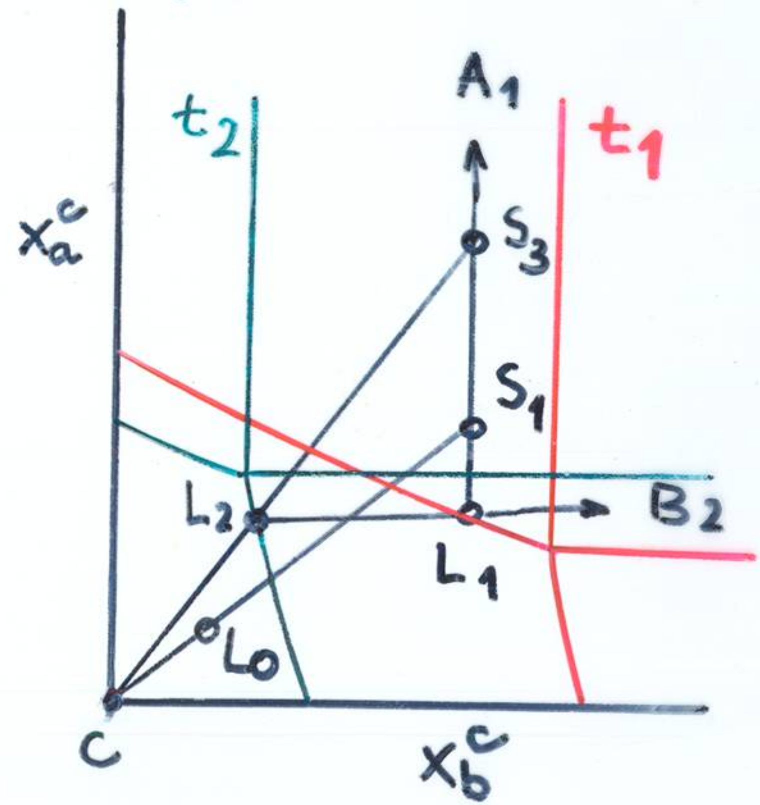
L_1 v HET.

$B_2 + L_2$

ODPAŘ. C

atd



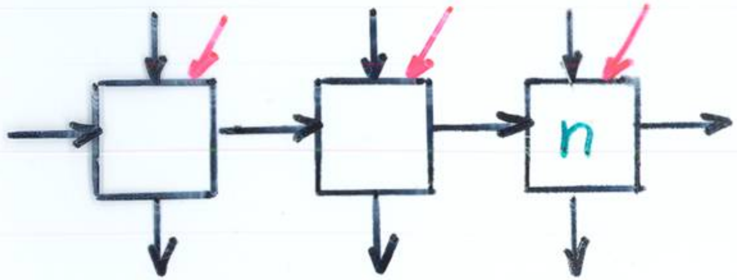


SLOŽ. CELKY

$$N_v = \sum_e N_v^e - N_i + N_o$$

$$N_i = N_{mi}\,(c+2) + N_{Qi}$$

KŘÍŽ. STYK



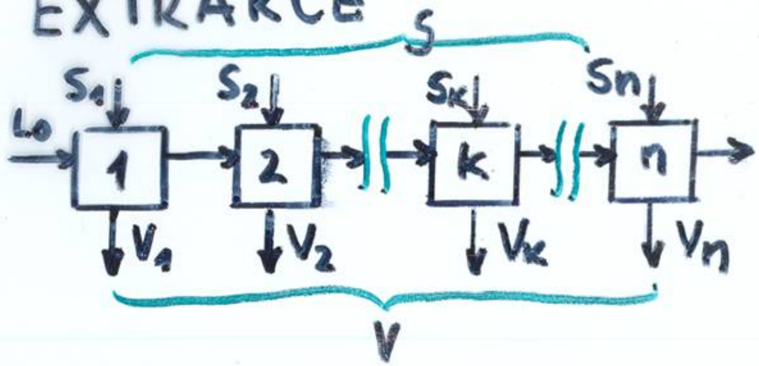
$$\sum N_v^e = n\,(2c+6)$$

$$N_i = (n-1)(c+2)$$

$$N_o = 1$$

$$N_v = 2n + 2c + 5$$

EXTRAKCE



L_o	$c+2$
S_{int}	$n(c+1)$
Q_k	n
p_k	n

$$S = n(c+3) + c + 2$$

$$N_{vr} = n + 1$$

$\dot{n}_{sk}$, n, x_{an} ....