$\boxed{16\text{-}6}$ etanol – butanol
tovn. vařák
totální kondenzátor

$R = 2 R_{min}$ $\eta = 0,55$

$\dot{m}_D = 2400 \ kg/h$ $x_D = 0,95 \ mol \%$

$\dot{m}_F = 6400 \ kg/h$ $x_F = 0,5 \ mol \%$

a) kapalina $20°C$

$$q = \frac{h_{VF} - h_F}{h_{VF} - h_{LF}}$$

$0,5 \ mol \% \longrightarrow$ bod varu $\underline{90,65°C}$

$\longrightarrow$ rosný bod $\quad 0,44 \dots 106,18 \qquad \Delta x = 0,09$

$\quad 0,53 \dots 103,26 \qquad \Delta \vartheta = -2,92$

$$T = 106,18 + \left(\frac{-2,92}{0,09} \cdot (0,5 - 0,44)\right) = \underline{\underline{104,2°C}}$$

$T_{AVG,1} = \dfrac{20 + 90,65}{2} = 55,3$

$T_{AVG,2} = 90,65 + 104,2 = 97,4$

$C_p(eth, 1) = 136,45 \ J/mol \ k \qquad C_p(but, 1) = 231,61 \ J/mol \ k$

$C_p(eth, 2) = 162,38 \ J/mol \ k \qquad C_p(but, 2) = 279,94 \ J/mol \ k$

$\Delta h_{vyp, eth, 104,2} = 36160 \ J/mol$

$\Delta h_{vyp, but, 104,2} = 44907,8 \ J/mol$

$h_F = 0$

$h_{LF} = \displaystyle\int_{20}^{90,65} C_{p,AVG1} \ dT = (0,5 \cdot 136,45 + 0,5 \cdot 231,61)(90,65 - 20) = 13002 \ J/mol$

$h_{VF} = h_{LF} + \displaystyle\int_{90,65}^{104,2} C_{p,AVG2} \ dT + \Delta h_{vyp} = 13002 + (0,5 \cdot 162,38 + 0,5 \cdot 279,94)(104,2 - 90,65) + \dots$

$\dots + 0,5 \cdot 36160 + 0,5 \cdot 44907,8 = 13002 + 2996,7 + 40533,9 = 56532,6 \ J/mol$

$$q = \frac{56,532}{56,532 - 13002} = 1,30$$

směrnice q-přímka $\quad \dfrac{\Delta \vartheta}{\Delta x} = \dfrac{q}{q-1} = \dfrac{1,3}{0,3} = 4,3$

$$w_F = \frac{x_F \, M_A}{x_F \, M_A + (1-x_F) \, M_B} = \frac{0,5 \cdot 46,07}{0,5 \cdot 46,07 + 0,5 \cdot 74,12} = 0,3833$$

$M_A = 46,07 \ \text{kj/kal}$

$M_B = 74,12$

$$w_D = \frac{0,95 \cdot 46,07}{0,95 \cdot 46,07 + 0,05 \cdot 74,12} = 0,9219$$

bilance:

$$w_F \, \dot{m}_F = \dot{w}_D \, \dot{m}_D + \dot{w}_w \, \dot{m}_w$$

$$\dot{m}_w = \dot{m}_F - \dot{m}_D = 6400 - 2400 = 4000 \ \text{kj/h}$$

$$w_w = \frac{w_F \, m_F - w_D \, m_D}{\dot{m}_w} = \frac{0,3833 \cdot 6400 - 0,9219 \cdot 2400}{4000} = 0,06014$$

$$x_w = \frac{w_w / M_A}{w_w / M_A + (1-w_w) \, M_B} = \frac{0,06014 / 46,07}{0,06014 / 46,07 + 0,93986 / 74,12} = 0,0933 \ \text{mol \%}$$

$$\frac{x_D}{k+1}_{MIN} = 0,735 \implies \frac{0,95}{0,735} - 1 = R_{MIN} = 0,2925$$

$$R = 0,585 \implies \frac{0,95}{1,585} = 0,60$$

6 stupňů (včetně vařáku)

5 stupňů (ideálních)

$5 / 0,55 = 9,09 \doteq 10 \ \text{pater}$
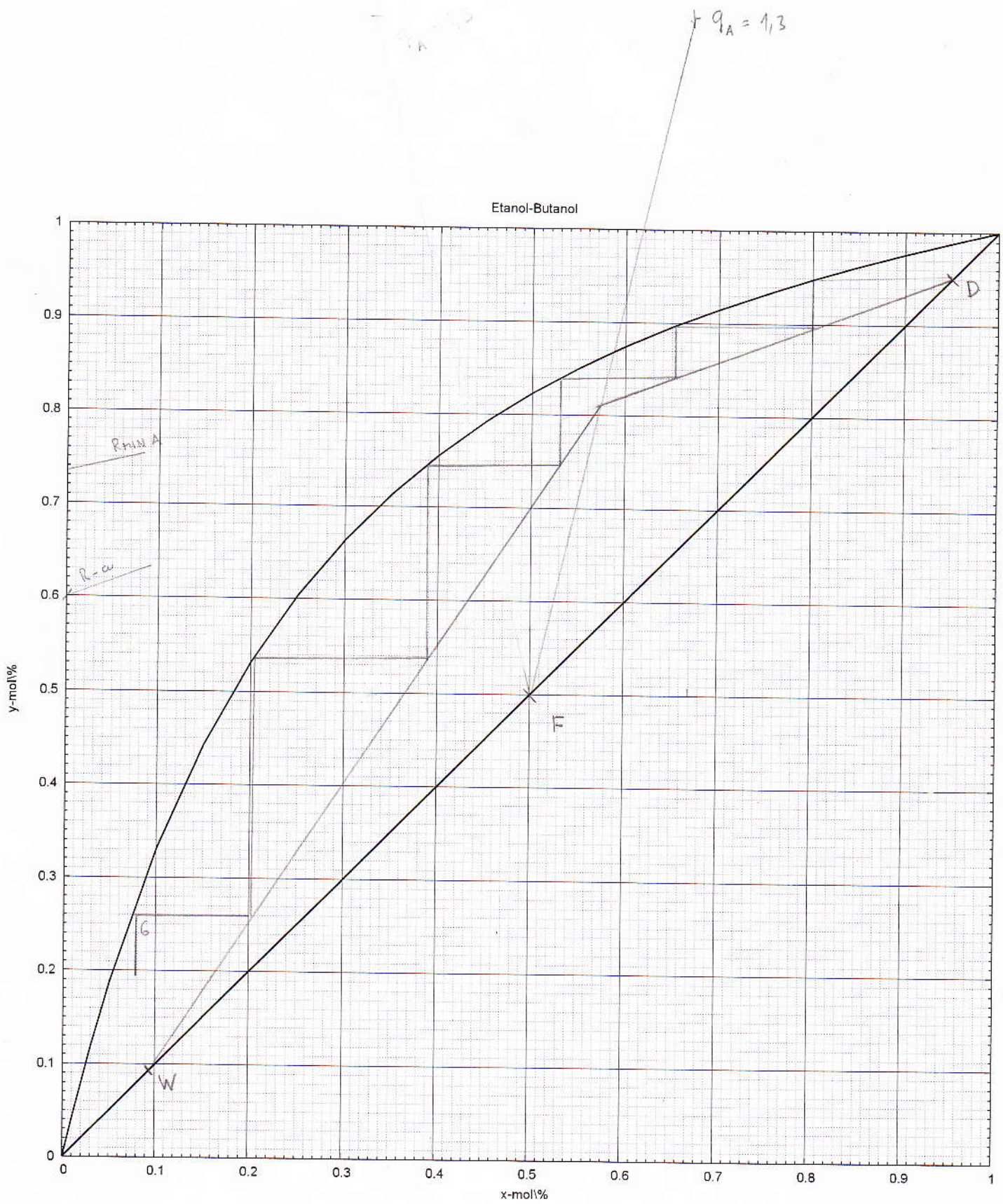
b) $q = -1$

$$\frac{q}{q-1} = \frac{-1}{-2} = 0,5$$

$R = 6,26$

$$0,23 = \frac{0,95}{R_{MIN}+1} \implies R_{MIN} = \frac{0,95}{0,23} - 1 = 3,13 \qquad \frac{0,95}{7,26} = 0,13$$

4 stupně s vařákem

3 stupně ideální $\implies$ ②3 / 0,55 = 5,45 = 6 pater

Etanol-Butanol

Etanol-Butanol

B

y-mol\%

x-mol\%

D

F

W