

37. ZADATAK

Za sustav metanol(1) – tetraklormetan(2) određeni su parametri ravnotežnog stanja pri temperaturi od 20 °C:

x_1	0,00	0,20	0,30	0,60	0,80	0,90	1,00
y_1	0,00	0,45	0,46	0,49	0,55	0,66	1,00
p/mmHg	92,1	158,0	159,5	159,9	152,0	135,5	96,9

Izračunati koeficijent aktivnosti obiju komponenata u azeotropnoj točki, uz pretpostavku da je standardno stanje a) čista tvar, b) beskonačno razrijeđena otopina.

Parametre azeotropne točke odrediti na temelju xy - i pxy -dijagrama.

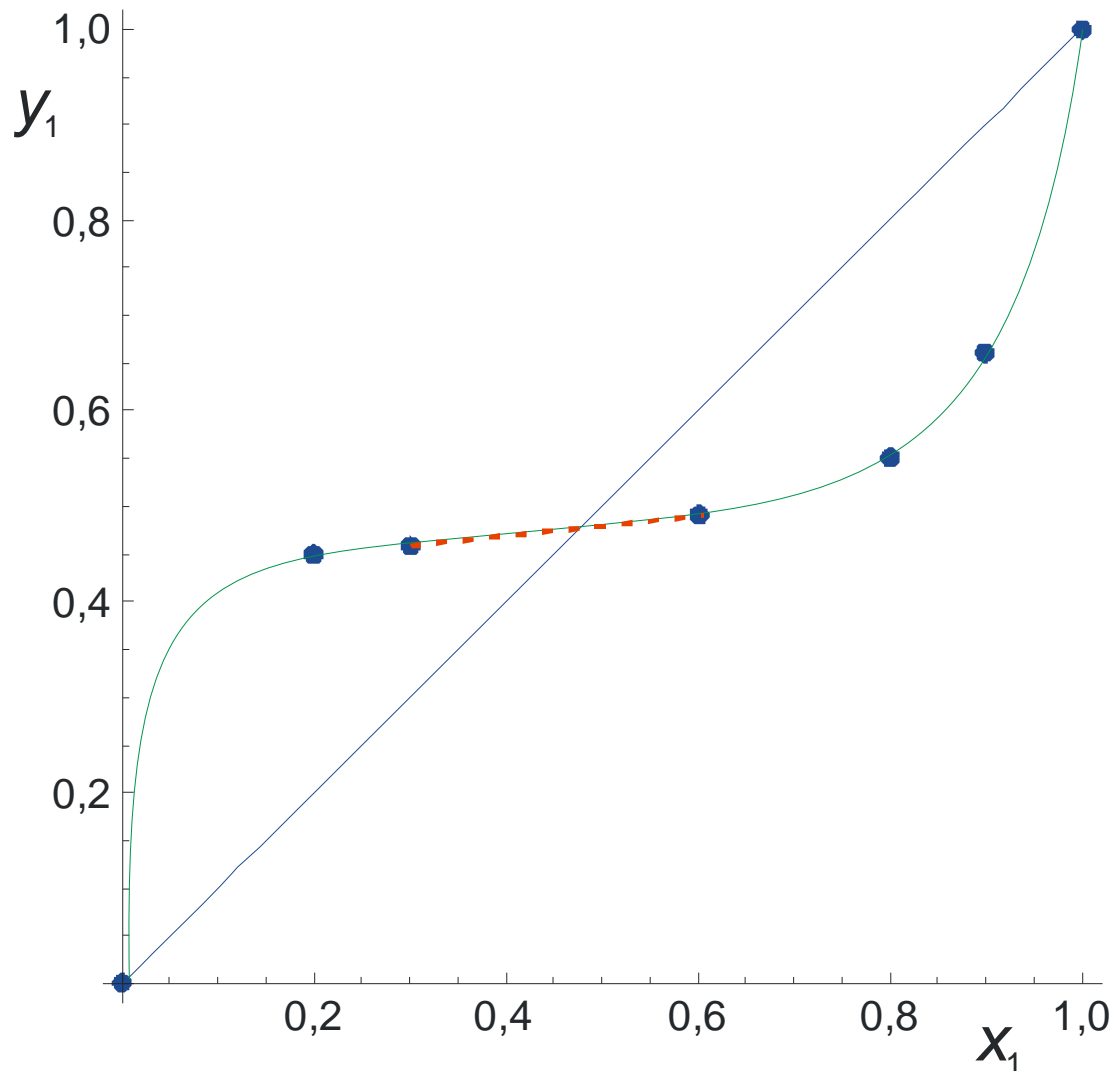
RJEŠENJE

$\gamma = ?$

metanol(1) – tetraklormetan(2)

Standardna stanja

xy -dijagram:

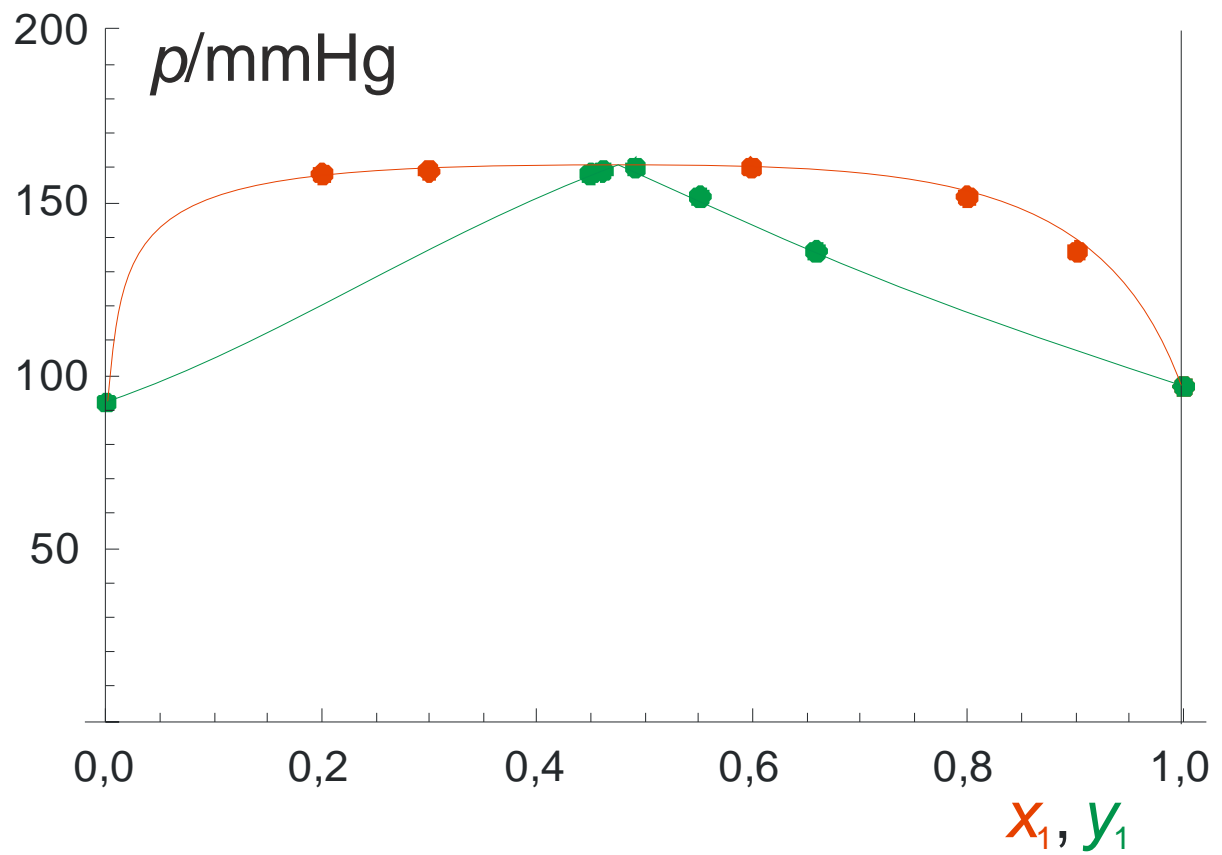


Linearnom interpolacijom:

$$x_{az} = 0,30 + \frac{0,60 - 0,30}{0,49 - 0,46} (y_{az} - 0,46)$$

$$x_{az} = y_{az} = 0,477778$$

Dijagram vrenja:



$$p_{\text{az}} \approx \max p = 159,9 \text{ mmHg}$$

Čista tvar, x_{az}

$$p_1^\bullet = 96,9 \text{ mmHg}$$

$$p_2^\bullet = 92,1 \text{ mmHg}$$

$$\frac{y_i}{x_i} = \frac{\gamma_i^L p_i^\bullet}{p} \exp\left[\frac{v_i^L (p - p_i^\bullet)}{RT}\right] \approx \frac{\gamma_i^L p_i^\bullet}{p}$$

$$p y_i = x_i \gamma_i^L p_i^\bullet$$

$$\gamma_1 = \frac{y_{1az} p_{az}}{x_{1az} p_1^\bullet} = \frac{p_{az}}{p_1^\bullet} = \frac{159,9}{96,9} = 1,65015$$

$$\gamma_2 = \frac{y_{2az} p_{az}}{x_{2az} p_2^\bullet} = \frac{p_{az}}{p_2^\bullet} = \frac{159,9}{92,1} = 1,73616$$

Beskonačno razrijeđena otopina, x_{az}

$$y_i p = \gamma_{Hi} x_i k_H$$

$$\gamma_{Hi} = \frac{y_i p}{x_i k_H}$$

$$k_{Hi} = \lim_{x_i \rightarrow 0} \frac{y_i p}{x_i}$$

$$k_{H1} = \lim_{x_1 \rightarrow 0} \frac{y_1 p}{x_1} \approx \frac{0,45 \cdot 158,0}{0,20} = 355,5 \text{ mmHg}$$

$$k_{H2} = \lim_{x_2 \rightarrow 0} \frac{y_2 p}{x_2} = \lim_{x_2 \rightarrow 0} \frac{(1 - y_1) p}{1 - x_1} \approx \frac{(1 - 0,66) 135,5}{1 - 0,90} = 460,7 \text{ mmHg}$$

$$\gamma_{H1} = \frac{y_{1az} p_{az}}{x_{1az} k_{H1}} = \frac{p_{az}}{k_{H1}} = \frac{159,9}{355,5} = 0,449789$$

$$\gamma_{H2} = \frac{y_{2az} p_{az}}{x_{2az} k_{H2}} = \frac{p_{az}}{k_{H2}} = \frac{159,9}{460,7} = 0,347081$$