

36. ZADATAK

Za sustav ciklopentan (1) – benzen (2) određeni su parametri ravnotežnog stanja pri tlaku od 101325 Pa:

x_1	0,017	0,210	0,412	0,615	0,818	0,901
y_1	0,056	0,450	0,664	0,802	0,910	0,954
$T/^{\circ}\text{C}$	78,8	68,1	60,9	56,2	52,3	49,6

Ravnotežni tlakovi para čistih komponenata izračunavaju se Antoineovim izrazom:

$$\log_{10}(p^{\bullet}/\text{mmHg}) = A - \frac{B}{(T/^{\circ}\text{C}) + C},$$

uz parametre:

	A	B	C
(1)	6,88676	1124,162	231,361
(2)	6,90565	1211,033	220,790

Izračunati koeficijente aktiviteta obiju komponenata za otopinu sastava $x_1=0,615$, uz pretpostavku da je standardno stanje a) čista tvar, b) beskonačno razrijeđena otopina.

RJEŠENJE

$\gamma = ?$

ciklopentan (1) – benzen (2)

Standardna stanja

a) čista tvar

$$p_1^\bullet = 10^{A_1 - \frac{B_1}{(T/^\circ\text{C}) + C_1}} = 10^{6,88676 - \frac{1124,162}{56,2 + 231,361}} = 949,425 \text{ mmHg}$$

$$p_2^\bullet = 10^{A_2 - \frac{B_2}{(T/^\circ\text{C}) + C_2}} = 10^{6,905651 - \frac{1211,033}{56,2 + 220,790}} = 341,611 \text{ mmHg}$$

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

$$py_i = x_i \gamma_i^L p_i^\bullet$$

$$\gamma_1 = \frac{y_1 p}{x_1 p_1^\bullet} = \frac{0,802 \cdot 760}{0,615 \cdot 949,425} = 1,04388$$

$$\gamma_2 = \frac{y_2 p}{x_2 p_2^\bullet} = \frac{(1 - 0,802) \cdot 760}{(1 - 0,615) \cdot 341,611} = 1,14416$$

b) beskonačno razrijeđena otopina

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

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

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

$$k_{H1} = \lim_{x_1 \rightarrow 0} \frac{y_1 p}{x_1} \approx \frac{0,056 \cdot 760}{0,017} = 2503,53 \text{ mmHg}$$

$$k_{H2} = \lim_{x_2 \rightarrow 0} \frac{y_2 p}{x_2} = \lim_{x_2 \rightarrow 0} \frac{(1 - y_1) p}{1 - x_1} \approx \frac{(1 - 0,954) 760}{1 - 0,901} = 353,131 \text{ mmHg}$$

$$\gamma_{H1} = \frac{y_1 p}{x_1 k_{H1}} = \frac{0,802 \cdot 760}{0,615 \cdot 2503,53} = 0,395877$$

$$\gamma_{H2} = \frac{(1 - y_1) p}{(1 - x_1) k_{H2}} = \frac{(1 - 0,802) \cdot 760}{(1 - 0,615) \cdot 353,131} = 1,10683$$