

22. ZADATAK

Izračunati specifične (po jedinici mase) funkcije odstupanja entalpije i entropije prema Lee-Kesslerovom postupku za propen pri 125 °C i 10 MPa, uz referentni tlak od 1 bar.

Podaci:

$$T_K=365 \text{ K}; \quad p_K=45,6 \text{ atm}; \quad \omega=0,148, \quad M=42,081 \text{ g mol}^{-1}$$

FUNKCIJE ODSTUPANJA I NAČELO TERMODINAMIČKE SLIČNOSTI

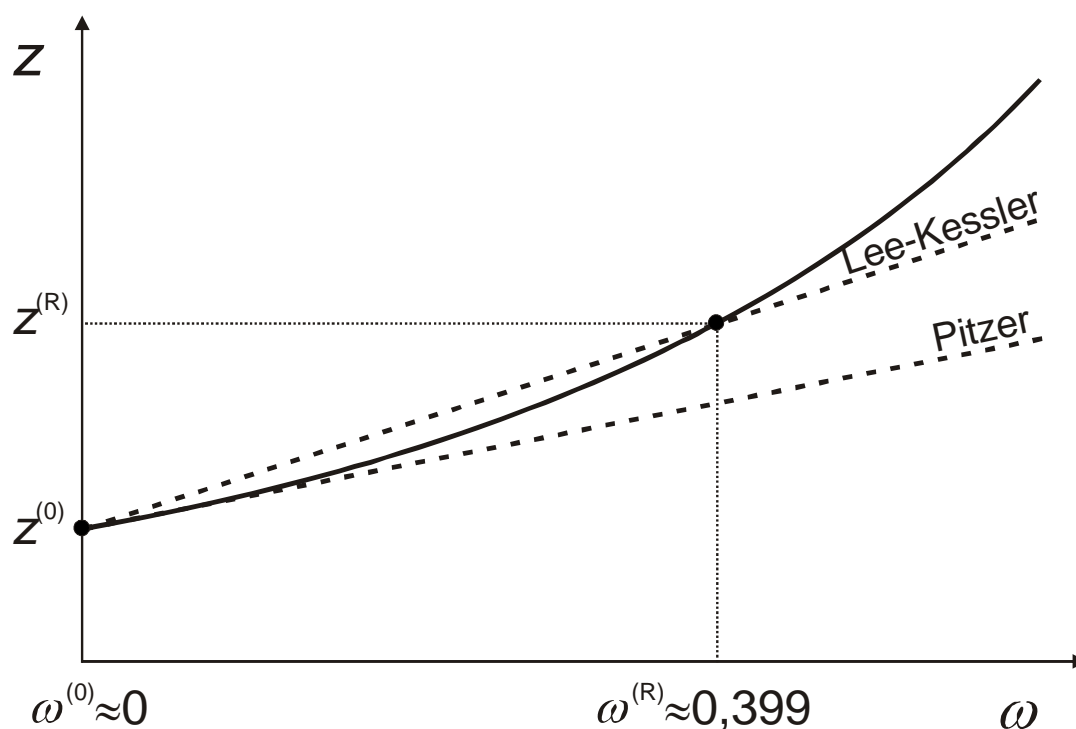
Lee i Kessler (1975)

Podloga: SBWR jednađžba stanja za argon i n -oktan

Odstupanje volumena:

$$z = \frac{pv}{RT} = f(p_r, T_r, \omega)$$

$$z = z^{(0)} + \frac{\omega}{\omega^{(0)}} \left(z^{(R)} - z^{(0)} \right) = z^{(0)} + \omega z^{(1)}$$



Odstupanje entalpije:

$$\left(\frac{h^\circ - h}{RT_K} \right) = \left(\frac{h^\circ - h}{RT_K} \right)^{(0)} + \omega \left(\frac{h^\circ - h}{RT_K} \right)^{(1)}$$

$$\left(\frac{s^\circ - s}{R} \right) = \left(\frac{s^\circ - s}{R} \right)^{(0)} + \omega \left(\frac{s^\circ - s}{R} \right)^{(1)} - \ln \frac{p^\circ}{p}$$

Definira razliku entalpije (entropije) realnog fluida pri nekoj temperaturi i tlaku od entalpije (entropije) **idealnog** fluida pri **istoj** temperaturi i referentnom tlaku p° !

Zadatak (propen):

$$t = 125 \text{ }^{\circ}\text{C}$$

$$p = 10 \text{ MPa}$$

$$p^{\circ} = 1 \text{ bar}$$

$$T_r = \frac{T}{T_K} = \frac{398,15}{365} = 1,091 \Big|_{1,05}^{1,10}$$

$$p_r = \frac{p}{p_K} = \frac{10 \cdot 10^6}{45,6 \cdot 101325} = 2,164 \Big|_{2,00}^{3,00}$$

$$y = y_1 + \frac{y_2 - y_1}{x_2 - x_1} (x - x_1) \quad \text{Linearna interpolacija}$$

$$\left(\frac{h^{\circ} - h}{RT_K} \right)^{(0)} (T_R = 1,05) = 3,398 + \frac{3,583 - 3,398}{3,00 - 2,00} (2,164 - 2,00)$$

$$\left(\frac{h^{\circ} - h}{RT_K} \right)^{(0)} (T_R = 1,05) = 3,428$$

$$\left(\frac{h^{\circ} - h}{RT_K} \right)^{(0)} (T_R = 1,10) = 2,965 + \frac{3,353 - 2,965}{3,00 - 2,00} (2,164 - 2,00)$$

$$\left(\frac{h^{\circ} - h}{RT_K} \right)^{(0)} (T_R = 1,10) = 3,029$$

$$\left(\frac{h^{\circ} - h}{RT_K} \right)^{(0)} (T_R = 1,091) = 3,428 + \frac{3,029 - 3,428}{1,10 - 1,05} (1,091 - 1,05)$$

$$\left(\frac{h^{\circ} - h}{RT_K} \right)^{(0)} (T_R = 1,091) = 3,101$$

$$\left(\frac{h^\circ - h}{RT_K}\right)^{(1)} (T_R = 1,05) = 2,381 + \frac{2,800 - 2,381}{3,00 - 2,00} (2,164 - 2,00)$$

$$\left(\frac{h^\circ - h}{RT_K}\right)^{(1)} (T_R = 1,05) = 2,450$$

$$\left(\frac{h^\circ - h}{RT_K}\right)^{(1)} (T_R = 1,10) = 1,261 + \frac{2,167 - 1,261}{3,00 - 2,00} (2,164 - 2,00)$$

$$\left(\frac{h^\circ - h}{RT_K}\right)^{(1)} (T_R = 1,10) = 1,410$$

$$\left(\frac{h^\circ - h}{RT_K}\right)^{(1)} (T_R = 1,091) = 2,450 + \frac{1,410 - 2,450}{1,10 - 1,05} (1,091 - 1,05)$$

$$\left(\frac{h^\circ - h}{RT_K}\right)^{(1)} (T_R = 1,091) = 1,597$$

$$\left(\frac{s^\circ - s}{R}\right)^{(0)} (T_R = 1,05) = 2,483 + \frac{2,415 - 2,483}{3,00 - 2,00} (2,164 - 2,00)$$

$$\left(\frac{s^\circ - s}{R}\right)^{(0)} (T_R = 1,05) = 2,472$$

$$\left(\frac{s^\circ - s}{R}\right)^{(0)} (T_R = 1,10) = 2,081 + \frac{2,202 - 2,081}{3,00 - 2,00} (2,164 - 2,00)$$

$$\left(\frac{s^\circ - s}{R}\right)^{(0)} (T_R = 1,10) = 2,100$$

$$\left(\frac{s^\circ - s}{R}\right)^{(0)} (T_R = 1,091) = 2,472 + \frac{2,100 - 2,472}{1,10 - 1,05} (1,091 - 1,05)$$

$$\left(\frac{s^\circ - s}{R}\right)^{(0)} (T_R = 1,091) = 2,167$$

$$\left(\frac{s^\circ - s}{R}\right)^{(1)}(T_R = 1,05) = 2,283 + \frac{2,655 - 2,283}{3,00 - 2,00}(2,164 - 2,00)$$

$$\left(\frac{s^\circ - s}{R}\right)^{(1)}(T_R = 1,05) = 2,344$$

$$\left(\frac{s^\circ - s}{R}\right)^{(1)}(T_R = 1,10) = 1,241 + \frac{2,067 - 1,241}{3,00 - 2,00}(2,164 - 2,00)$$

$$\left(\frac{s^\circ - s}{R}\right)^{(1)}(T_R = 1,10) = 1,376$$

$$\left(\frac{s^\circ - s}{R}\right)^{(1)}(T_R = 1,091) = 2,344 + \frac{1,376 - 2,344}{1,10 - 1,05}(1,091 - 1,05)$$

$$\left(\frac{s^\circ - s}{R}\right)^{(1)}(T_R = 1,091) = 1,550$$

$$\begin{aligned} (h^\circ - h)_{\text{sp}} &= \frac{RT_K}{M} \left[\left(\frac{h^\circ - h}{RT_K} \right)^{(0)} + \omega \left(\frac{h^\circ - h}{RT_K} \right)^{(1)} \right] = \\ &= \frac{8,314 \cdot 365}{42,081} [3,101 + 0,148 \cdot 1,597] = \\ &= \mathbf{240,669 \text{ J g}^{-1}} \end{aligned}$$

$$\begin{aligned} (s^\circ - s)_{\text{sp}} &= \frac{R}{M} \left[\left(\frac{s^\circ - s}{R} \right)^{(0)} + \omega \left(\frac{s^\circ - s}{R} \right)^{(1)} - \ln \frac{p^\circ}{p} \right] = \\ &= \frac{8,314}{42,081} \left[2,167 + 0,148 \cdot 1,550 - \ln \frac{10^5}{10^7} \right] = \\ &= \mathbf{1,38331 \text{ J g}^{-1} \text{K}^{-1}} \end{aligned}$$