22. ZADATAK

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

Podaci:

T_K=365 K; p_K=45,6 atm; ω=0,148, M=42,081 g mol^{-1}

FUNKCIJE ODSTUPANJA I NAČELO TERMODINAMIČKE SLIČNOSTI

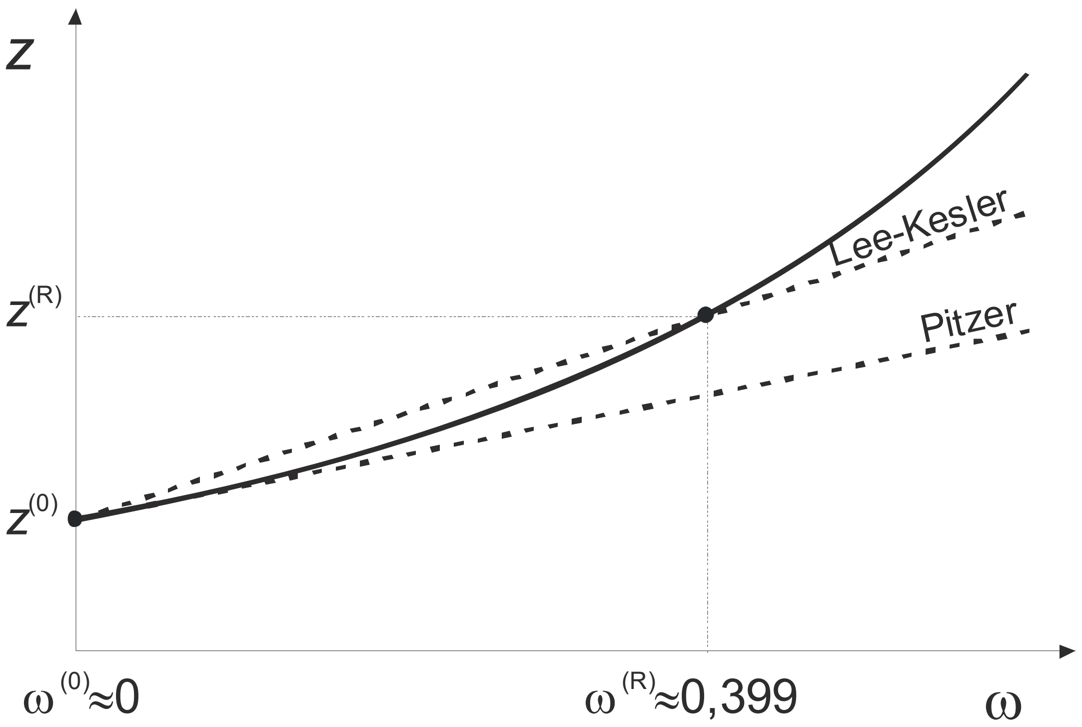
Lee i Kesler (1975)

Podloga: SBWR jednadžba stanja za argon i *n*-oktan

Odstupanje volumena:

$$z = \frac{pv}{RT} = f\left(p_{\mathrm{r}}, T_{\mathrm{r}}, \omega\right)$$

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



Odstupanje entalpije:

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

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

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):

$$t = 125\ °\mathrm{C}$$

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

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

$$T_{\mathrm{r}} = \frac{T}{T_{\mathrm{K}}} = \frac{398{,}15}{365} = 1{,}091\Big|_{1{,}05}^{1{,}10}$$

$$p_{\mathrm{r}} = \frac{p}{p_{\mathrm{K}}} = \frac{10 \cdot 10^{6}}{45{,}6 \cdot 101325} = 2{,}164\Big|_{2{,}00}^{3{,}00}$$

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

$$\left(\frac{h^{\circ} - h}{RT_{\mathrm{K}}}\right)^{(0)}(T_{\mathrm{R}} = 1{,}05) = 3{,}398 + \frac{3{,}583 - 3{,}398}{3{,}00 - 2{,}00}(2{,}164 - 2{,}00)$$

$$\left(\frac{h^{\circ} - h}{RT_{\mathrm{K}}}\right)^{(0)}(T_{\mathrm{R}} = 1{,}05) = 3{,}428$$

$$\left(\frac{h^{\circ} - h}{RT_{\mathrm{K}}}\right)^{(0)}(T_{\mathrm{R}} = 1{,}10) = 2{,}965 + \frac{3{,}353 - 2{,}965}{3{,}00 - 2{,}00}(2{,}164 - 2{,}00)$$

$$\left(\frac{h^{\circ} - h}{RT_{\mathrm{K}}}\right)^{(0)}(T_{\mathrm{R}} = 1{,}10) = 3{,}029$$

$$\left(\frac{h^{\circ} - h}{RT_{\mathrm{K}}}\right)^{(0)}(T_{\mathrm{R}} = 1{,}091) = 3{,}428 + \frac{3{,}029 - 3{,}428}{1{,}10 - 1{,}05}(1{,}091 - 1{,}05)$$

$$\left(\frac{h^{\circ} - h}{RT_{\mathrm{K}}}\right)^{(0)}(T_{\mathrm{R}} = 1{,}091) = 3{,}101$$

$$\left(\frac{h^{\circ}-h}{RT_{\mathrm{K}}}\right)^{(1)}\left(T_{\mathrm{R}}=1,05\right)=2,381+\frac{2,800-2,381}{3,00-2,00}\left(2,164-2,00\right)$$

$$\left(\frac{h^{\circ}-h}{RT_{\mathrm{K}}}\right)^{(1)}\left(T_{\mathrm{R}}=1,05\right)=2,450$$

$$\left(\frac{h^{\circ}-h}{RT_{\mathrm{K}}}\right)^{(1)}\left(T_{\mathrm{R}}=1,10\right)=1,261+\frac{2,167-1,261}{3,00-2,00}\left(2,164-2,00\right)$$

$$\left(\frac{h^{\circ}-h}{RT_{\mathrm{K}}}\right)^{(1)}\left(T_{\mathrm{R}}=1,10\right)=1,410$$

$$\left(\frac{h^{\circ}-h}{RT_{\mathrm{K}}}\right)^{(1)}\left(T_{\mathrm{R}}=1,091\right)=2,450+\frac{1,410-2,450}{1,10-1,05}\left(1,091-1,05\right)$$

$$\left(\frac{h^{\circ}-h}{RT_{\mathrm{K}}}\right)^{(1)}\left(T_{\mathrm{R}}=1,091\right)=1,597$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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