Thermische Zustandsgleichung eines idealen Gemischs

Vor der Mischung: $p \cdot V_i = n_i R T = m_i \cdot R_i \cdot T$

p, T konstant bei Mischung

$$p V_g = p \sum_i V_i = \sum_i m_i \cdot R_i \cdot T = \sum_i \mu_i \cdot m_g R_i T = \left(\sum_i \mu_i \cdot R_i\right) m_g T = m_g R_g T$$

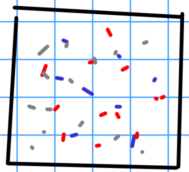
spezif. Gaskonstante des Gemischs

$$R_g := \sum_i \mu_i R_i$$

Partialdruck p_i^*

Modell

$i: V, T$



$$p_i^* = \frac{n_i R T}{V_g}$$

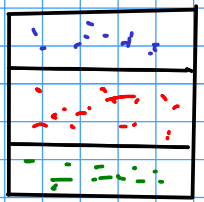
$$p = \frac{n_g R T}{V_g} = \sum_i \frac{n_i R T}{V_g} = \sum_i p_i^*$$

$$\frac{p_i^*}{p} = \frac{n_i}{n_g} = y_i$$

Volumen und Dichte

Volumenanteil r_i:

Modell: $i: T, p$



$$r_i := \frac{V_i}{V_g} = \frac{p V_i}{p V_g} = \frac{n_i R T}{n_g R T} = \frac{n_i}{n_g} = y_i$$

Dichte des Gemischs:

$$\rho_g = \frac{m_g}{V_g} = \sum_i \frac{m_i}{V_g} = \sum_i \rho_i^*$$

$$\frac{1}{\rho_g} = \frac{V_g}{m_g} = \sum_i \frac{V_i}{m_g} = \sum_i \frac{V_i}{m_i} \frac{m_i}{m_g} = \sum_i \mu_i \frac{1}{\rho_i}$$

$$p_i^* V_g = m_i R_i T \Rightarrow \rho_i^* = \frac{m_i}{V_g} = \frac{p_i^*}{R_i T}$$

$$\rightarrow \rho_g = \sum_i \frac{p_i^*}{R_i T}$$

Extensive Größe Z_i

$$Z_g = \sum_i Z_i$$

$$z_g = \frac{Z_g}{m_g} = \sum_i \frac{Z_i}{m_g} = \sum_i \frac{Z_i}{m_i}\frac{m_i}{m_g} = \sum_i \mu_i z_i$$

molar statt spezifisch

$$Z_{m,g} = \sum_i y_i Z_{m,i}$$

Entropie

$$\underbrace{U_2 - U_1}_{=0} = W_{V12} + \underbrace{Q_{12}}_{=0} + W_{diss12}$$

T=const, kalor. Zustandsgl.

$$W_{diss,i} = -W_{V12}$$

$$= \int_1^2 p\,dV = \int_1^2 \frac{n_i RT}{V}\,dV$$

$$= -n_i RT \ln\frac{V_i}{V_g} = -n_i RT \ln y_i$$

$$\Delta S_i = \frac{W_{diss,i}}{T} = -n_i R \ln y_i$$

Mischungsentropie $S_{Mi} = -R\sum_i n_i \ln y_i$

Gesamtentropie des Gemischs

$$S_g = \sum_i S_i + S_{Mi}$$