1 Physik

1.1 Druck

Schweredruck:

$$p = \frac{\rho V g}{A} = h\rho g$$

Hydraulik:

$$\frac{F_1}{F_2} = \frac{A_1}{A_2}$$

Ausflussgeschwindigkeit:

$$v = \sqrt{2gh} \quad L = 2\sqrt{h_1 h_2}$$

Bernoullische Gleichung:

$$p_1 + \frac{1}{2}\rho v_1^2 + h_1\rho g = p_2 + \frac{1}{2}\rho v_2^2 + h_2\rho g$$

$$\frac{p_1}{\rho g} + \frac{v_1^2}{2g} + h_1 = \frac{p_2}{\rho g} + \frac{v_2^2}{2g} + h_2$$

Kontinuitaetsgleichung:

$$v_1 A_1 = v_2 A_2$$

Dynamischer Druck:

$$p_d = \frac{1}{2}\rho v^2$$

1.2 Gasgleichung und Waermelehre

Allgemeine Gasgleichung:

$$pV = \frac{2}{3}W_{\mathrm{Kin}} = nRT = mR_{\mathrm{i}}T$$

$$R = kN_{\mathrm{A}}$$

Spezifische Waerme:

$$q = \frac{Q}{m}$$

Waermekapazitaet:

$$C = \frac{\Delta Q}{\Delta T} \quad C = mc$$

Adiabatenkoeffizient:

$$\kappa = \frac{c_p}{c_v} \quad c_v + R = c_p \quad c_p = \frac{R\kappa}{\kappa - 1} \quad c_v = \frac{R}{\kappa - 1}$$

1.3 Zustands Aenderrungen

Isotherm: $T = \text{const.}$

$$\frac{p_1}{p_2} = \frac{V_2}{V_1} \quad \Delta Q = -\Delta W \quad \Delta U = 0 \quad \Delta S = c_p \ln\left(\frac{V_2}{V_1}\right) + c_v \ln\left(\frac{p_2}{p_1}\right)$$

Isobar: $p = \text{const.}$

$$\frac{V_1}{V_2} = \frac{T_1}{T_2} \quad \Delta Q = c_p\,(T_2 - T_1) \quad \Delta U = c_v\,(T_2 - T_1) \quad \Delta S = c_p \ln\left(\frac{T_2}{T_1}\right) = c_p \ln\left(\frac{V_2}{V_1}\right)$$

Isochor: $V = \text{const.}$

$$\frac{p_1}{p_2} = \frac{T_1}{T_2} \quad \Delta Q = c_v\,(T_2 - T_1) \quad \Delta U = c_v\,(T_2 - T_1) \quad \Delta S = c_v \ln\left(\frac{T_2}{T_1}\right) = c_v \ln\left(\frac{p_2}{p_1}\right)$$

Adiabatisch / Isentrop: $Q = \text{const.} \quad S = \text{const.}$

$$\frac{p_1}{p_2} = \left(\frac{V_2}{V_1}\right)^{\kappa} \quad \Delta Q = 0 \quad \Delta U = \Delta W = c_v\,(T_2 - T_1) \quad \Delta S = 0$$

Polytrop: $pV^n = \text{const.}$

$$\frac{p_1}{p_2} = \left(\frac{V_2}{V_1}\right)^{n} \quad \Delta Q = c_v \frac{n-\kappa}{n-1}\,(T_2 - T_1) \quad \Delta U = c_v\,(T_2 - T_1) \quad \Delta S = c_v \frac{n-\kappa}{n-1} \ln\left(\frac{T_2}{T_1}\right)$$

1.4 Entropie

Deffinition:

$$S_2 = S_1 + \int_1^2 \frac{\mathrm{d}Q}{T} = c_v \ln\left(\frac{T_2}{T_1}\right) + nRT \ln\left(\frac{V_2}{V_1}\right)$$

Claussische Ungleichung:

$$\mathrm{d}S \geq \frac{\mathrm{d}q}{T}$$

Anederrung von T:

$$\mathrm{d}S = \frac{C\mathrm{d}T}{T} \Rightarrow \Delta S = -\frac{|Q|}{T_R}$$

Phasenuebergang:

$$\Delta S = \frac{\Delta H}{T}$$

Reversibler Prozess:

$$\Delta S = c_v \ln\left(\frac{T_2}{T_1}\right) \quad \Delta S = R \ln\left(\frac{p_1}{p_2}\right) \quad \Delta S = R \ln\left(\frac{V_{M,2}}{V_{M,1}}\right)$$