

Entalpia

$$H = U + PV$$

funzione di stato \swarrow \searrow gas ideale
 $PV = nRT$

ES: GAS IDEALE

$$U = f(T) ; PV = nRT \xrightarrow{K!} PV = g(T) \Rightarrow H = f(T)$$

$$\hookrightarrow \text{diff } dH = dU + d(PV) = \underbrace{nc_v dT}_{\text{GAS PERFETTO } nc_v dT} + \underbrace{d(nRT)}_{\substack{\text{gas ideale} \\ PV = nRT}} = nc_p dT$$

$c_p = c_v + R$ (Mayer)

$$\Delta H = n \int_{T_a}^{T_b} c_p dT$$

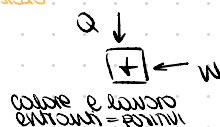
$$Q = \Delta H$$

EQUAZIONI TDS

- consideriamo una trasformazione internamente reversibile in un sistema compressibile

$$(\delta Q)_{\text{int, rev}} = dU - (\delta W)_{\text{int, rev}}$$

$(\delta Q)_{\text{int, rev}} = Tds$ $(\delta W)_{\text{int, rev}} = -PdV$



$$Tds = dU + PdV \rightarrow \text{I eq del Tds}$$

$$H := U + PV \quad dH = dU + d(PV) = \underbrace{dU + PdV}_{\text{I eq}} + \underbrace{PdV}_{\text{II eq}}$$

$$\rightarrow dU + PdV = dH - d(PV)$$

$$Tds = dH - d(PV) \rightarrow \text{II eq del Tds}$$

ΔS per un GAS IDEALE

$$\begin{cases} dU = c_v dT \\ dH = c_p dT \\ PV = nRT \end{cases}$$

\rightarrow GAS IDEALE

I eq: $Tds = dU + PdV$ generica

$$Tds = c_v dT + PdV$$

$$ds = c_v \frac{dT}{T} + \left(\frac{P}{T}\right) dV \xrightarrow{\frac{R}{V}} ds = c_v \frac{dT}{T} + \frac{R}{V} dV$$

$$S(T_2, V_2) - S(T_1, V_1) = \int_{T_1}^{T_2} c_v(T) \frac{dT}{T} + R \ln \frac{V_2}{V_1}$$

GAS IDEALE

II eq: $TdS = dH - VdP$ → $PV = nRT$

$$dS = \frac{C_P dT}{T} - \frac{V}{T} dP$$

$$dS = \frac{C_P dT}{T} - \frac{R}{P} dP$$

$$S(T_2, P_2) - S(T_1, P_1) = \int_{T_1}^{T_2} C_P(T) \frac{dT}{T} - R \ln \frac{P_2}{P_1}$$

GAS
IDEALE

C_V, C_P costanti

$$\left. \begin{aligned} S_2(T_2, V_2) - S_1(T_1, V_1) &= C_V \ln \frac{T_2}{T_1} - R \ln \frac{V_2}{V_1} \\ S_2(T_2, P_2) - S_1(T_1, P_1) &= C_P \ln \frac{T_2}{T_1} - R \ln \frac{P_2}{P_1} \end{aligned} \right\} \left[\frac{J}{mol \cdot K} \right] \times G.P.$$

$$\Delta S = C_V \ln \frac{T_2 V_2^{\gamma-1}}{T_1 V_1^{\gamma-1}} \quad \gamma = \frac{C_P}{C_V} \quad \Delta S = C_P \ln \frac{T_2 P_2^{\gamma-1}}{T_1 P_1^{\gamma-1}} \rightarrow \Delta S = C_V \ln \frac{P_2 V_2^{\gamma}}{P_1 V_1^{\gamma}}$$

TRASFORMAZIONE ISENTROPICA $S_2 = S_1 \Rightarrow$ ADIABATICA REVERSIBILE

$$0 = C_V \ln \frac{P_2 V_2^{\gamma}}{P_1 V_1^{\gamma}} \Rightarrow P_2 V_2^{\gamma} = P_1 V_1^{\gamma} \quad \text{color: orange} \rightarrow PV^{\gamma} = \text{cost}$$

POLOTROPICA CON γ
INDICE $\gamma = C_P/C_V = n$
ADIABATICA REVERSIBILE

ΔS FLUIDO INCOMPRESSIBILE $\rho = \text{costante}$ $C_V = C(T)$

$$dS = C(T) \frac{dT}{T} + \frac{\rho dV}{T} \xrightarrow{\text{color: orange}} \xrightarrow{\text{color: orange}} 0 \text{ (incompressibile)}$$

$$\rightarrow dS = C(T) \frac{dT}{T}$$

densità
[kg/m³]

GAS IDEALE
 $PV = \frac{R}{M} T$
 $P \rightarrow [Pa]$ $V \rightarrow [m^3/kg]$
 massa $\frac{kg}{mol}$ $R \rightarrow \frac{J}{mol \cdot K}$
 molare $\frac{kg}{mol}$ $T \rightarrow K$

