CALORE LATENTE → CAMBIAM FASE
CALORE SPECIFICO → CAMBIAM TEMP.

$Q = c(T_2 - T_1)$

$1°C = 1K$

$1°F = 30°C + \frac{5}{9}°C$

(1)

LEGGE DI GIBBS : $N = 2 + n - f$

$dL^* = F\,ds = P\,dV \rightarrow dL = P\,dv \rightarrow L = \int P\,dv \left[\frac{J}{kg}\right]$ SOLO SUTMSF. IDEALI

$\rho = \frac{1}{v}$ $\quad \gamma = \rho g$ PESO SPECIFICO

I PRINCIPIO TERMODINAMICA (SIST. CHIUSI)

$dq - dL = du$

$q_{1,2} - L_{1,2} = \Delta u$

$du = \left(\frac{\partial u}{\partial T}\right)_v dT + \left(\frac{\partial u}{\partial v}\right)_T dv$ (DEF)

$\rightarrow dq = \left(\frac{\partial u}{\partial T}\right)_v dT + \left[P + \left(\frac{\partial u}{\partial v}\right)_T\right] dv \rightarrow \left[c_v = \left|\frac{dq}{dT}\right| = \left(\frac{\partial u}{\partial T}\right)_v\right] \rightarrow \left[\frac{J}{kg K}\right]$

$\left[du = du_T + de_{CIN} + de_{POT}\right]$

$du_T = du' + du_{CHIMICA}$ (EN. INT. TERMODIN.)

I PRINCIPIO TERMODINAMICA (SIST. APERTI)

NON SI CONSERVA QUELLA IN VOLUME!!

$L_{TOT} = L_{PULSIONE} + L_{EXT.\,VERO}$, $\dot{m} = cost$ (PORTATA DI MASSA)

$dL_{TOT} = P\,dv$, $dL_{TOT} = dL_e' + dL_{PULS}$

$\left[\dot{m} = \rho \cdot A \cdot w\right]$ ρ = DENSITÀ $[kg/m^3]$, w = VELOCITÀ $[m/s]$, A = SEZIONE $[m^2]$

PORTATA IN VOLUME: $\left[\dot{V} = w \cdot A\right] = G$

$dL_e' + \underbrace{P\,dv + v\,dP}_{du = dq + d(Pv)} = P\,dv \Rightarrow dL_e' = -v\,dP$

$h = u + Pv$ ENTALPIA

$E = E_{CIN} + E_{POT} + U_T$
$U_T = U + U_X$
U_T = EN. INTERNA TOT
U = EN. INTERNA
U_X = EN. INTERNA CHIMICA

$dh = du + P\,dv + v\,dP$ (CASO REV.) $\longrightarrow dh = \left(\frac{\partial h}{\partial T}\right)_P dT + \left(\frac{\partial h}{\partial P}\right)_T dP$ (DEF)

$dq - dL_P - dL_e' = du + de_{CIN} + de_{POT}$

$\rightarrow dq = \left(\frac{\partial h}{\partial T}\right)_P dT + \left[\left(\frac{\partial h}{\partial P}\right)_T - v\right] dP$

$q_{12} - L'_{e\,1,2} = \Delta h + \Delta e_{CIN} + \Delta e_{POT}$

$q_{1,2} - L'_{e\,1,2} = \Delta h + \frac{1}{2}(w_2^2 - w_1^2) + g(z_2 - z_1)$

$\left[c_P = \left|\frac{dq}{dT}\right| = \left(\frac{\partial h}{\partial T}\right)_P dT\right] \rightarrow \left[\frac{J}{kg K}\right]$

ENERGIE VARIE

$c_{P\,H_2O\,liquida} = 4{,}186 \frac{kJ}{kg K} \simeq c_{V\,H_2O\,liquida}$

I PRINCIPIO TERMODINAMICA IN TERMINI DI POTENZA (SIST. APERTI)

REGIME PERMANENTE $\Rightarrow w_1 = w_2$

$\left[q^F_{1,2} - P_{1,2\,e}' = \sum_{USC.} \dot{m}_{USC}\left(h + \frac{1}{2}w^2 + gz\right)_{USC} - \sum_{ENTR} \dot{m}_{ENTR}\left(h + \frac{1}{2}w^2 + gz\right)_{ENTR}\right] \rightarrow q^F_{12} - P_{12} = \dot{m}\left[\Delta h_{12} + \frac{1}{2}\Delta w^2_{12} + g\Delta z_{12}\right]$

EQ.NE DI STATO GAS PERFETTI

$PV = mR_1T$

$PV = nRT \rightarrow M = \frac{m}{n} \rightarrow PV = \frac{m}{M}RT = mR_1T \rightarrow R_1 = \frac{R}{M}$ COSTANTE PARTICOLARE DEI GAS , $R = 8314 \frac{J}{KmolK} = 0{,}8314 \frac{kJ}{kmolK}$

$Pv = R_1T$, $v = \frac{1}{\rho} = \frac{V}{m}$, $\rho = \frac{m}{V}$, $v = \frac{V}{m}\left[\frac{m^3}{kg}\right]$

TITOLO
$X = \frac{m_V}{m_L + m_V}$

LEGGE DI DALTON

$P_{TOT} = \sum_{i=1}^n P_i$ $\quad \pi_i = \frac{M_i}{\sum_{i=1}^n M_i} = \frac{M_i}{M_{TOT}}$ FRAZIONE PONDERALE. INVNAMISCELA $R_i = \pi_i R_1$

$R_1^m = \sum_{i=1}^n \pi_i R_{1i}$

ISOCORA : $Pv = R_1T$, $\frac{T}{P} = cost$, $Q_{1,2} = u_2 - u_1 = \Delta u$

ISOBARA : $Pv = R_1T$, $\frac{T}{v} = cost$, $L_{1,2} = P(v_2 - v_1) = P\Delta v$ $\quad q_{12} = \Delta h_{12}$ $\quad du = 0$

ISOTERMA $Pv = R_1T$, $Pv = cost$, $\left[L_{1,2} = R_1T \ln\frac{v_2}{v_1}\right]$, $\left[P_1V_1 = P_2V_2\right]$, $dq = dL$

ADIABATICA : $Pv^k = cost$, $k = \frac{c_P}{c_V} > 1$, $dq = 0$, $\left[L_{1,2} = -\Delta u = u_1 - u_2\right]$

$\Delta S = 0$

RELAZ DI MAYER

$dh = du + d(Pv)$
$dh = du + d(R_1T)$
$\frac{dh}{dT} = \frac{du}{dT} + R_1\frac{dT}{dT} \rightarrow \left[c_P = c_V + R_1\right]$

$Pv^k = cost$
$P^{\frac{1-k}{k}} \cdot T = cost$

POLITROPICA : $Pv^e = cost$ (*)

(*) $e = k \Rightarrow$ ADIABATICA
$e = 1 \Rightarrow$ ISOTERMA
$e = 0 \Rightarrow$ ISOBARA
$e = \infty \Rightarrow$ ISOCORA

- $L_{1,2} = \frac{P_1V_1 - P_2V_2}{e - 1}$
- $Q_{1,2} = \frac{k - e}{1 - e} c_V (T_2 - T_1)$ — non vale per $e = 1$

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