

Assistente de Termodinâmica

Manual Técnico

(versão temporária)

<http://code.google.com/p/asstermo/>
<http://asstermo.no.sapo.pt>

Introdução

Este é o manual técnico temporário que contém os scans das páginas de rascunho do manual técnico. Este manual ainda tem muitas gralhas e serve apenas como uma referência de quais os métodos utilizados pelo Asstermo.

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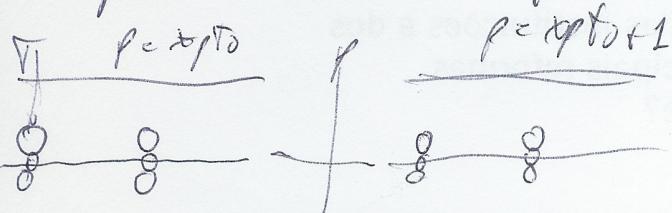
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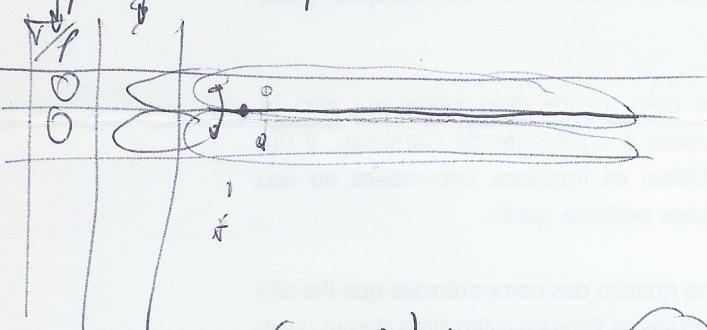
• Água, Amônia, R22, R134a:

- provar por P/T
- provar por h e P
- provar por se P (Tdb)
- provar por v e P
- provar por u e P
- provar por se P (Líquido saturado)



Líquido comprimido ou vapor sobre aquecido

Vapor, sobre aquecido:



$$r = (v_g - v_f) \text{ ou } v_f \quad (2) \quad r = \frac{v_g - v_f}{(v_g - v_f)}$$

Líquido comprimido

Líquido comprimido, evolução por

$$h_i + V(p_f - p_i) - \delta_f$$

$$h_f = h_i + V(p_f - p_i) \rightarrow \text{pressão inicial}$$

Gravidade constante

Volume constante, considerando constante

$$dU = Tds - pdV$$

$$H = U + PV \rightarrow dH = Tds + Vdp \quad (2) \quad dh = Tds + Vdp$$

$$dh = Vdp$$

vector \rightarrow $dh = Vdp$

Aqui: • A-5 - Líquido saturado
• A-2 ou 3 - Água saturada
• A-4 - Vapor sobre aquecido

Amônia: • A-3 e 14 - Amônia saturada

• A-15 - Amônia vapor sobre aquecido

R22: • A-7 e 8 - R22 saturado

• A-9 - R22 R22 vapor sobre aquecido

R134a: • A-10 e 11 - R134a saturado
• A-12 - Vapor sobre aquecido
propano: - A-16 e 17 - Propano saturado
- A-18 - Propano - Vapor sobre aquecido

Intercâmbio

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

Massas molaras e R's - Tabelas A-2

①

$M \rightarrow$ mass molar van de tabels
Termische gevoeligheid \rightarrow tabels
 R_2
 R_3

$$R_{molar} = \frac{8,314}{M} \rightarrow \text{constante los gases perfectos}$$

$$\frac{R_2}{R_3 K} \quad \frac{R_2}{K mol, K}$$

Ar - Tabelas A-22

Interpolado na mesma



Temps - T

Entropie - S

Energia interna - U

Varia de pressão - Pv

Varia de volume - V

Δ entropie = 0

Ass. Psicrométrica:

- Represente um pressão de trabalho do ar
- Estado de W-humidade seca ($\frac{P_{V,ap}}{P_{ar}}$)

$$W = \frac{0,622 \times P_{V,ap}}{P_{ar} - P_{V,ap}} \quad \text{tendo } P_{V,ap}$$

$$W = \frac{0,622 \times P_{V,ap}}{P_{ar} - P_{V,ap}} \quad \left. \begin{array}{l} \text{tendo } HR \\ \text{tendo } HR \text{ e } T \end{array} \right\}$$

$$P_V = P_{sat}(T) \times HR$$

$$W = \frac{m_{V,ap}}{m_{ar}}$$

$$0,622 = \frac{R_2}{R_V} = \frac{18}{28,8}$$

$$\frac{M_2}{M_{V,ap}}$$

Pression de Tabelas A-2

Estado de HR (humidade relativa):

$$HR = \frac{W \times P_{ar}}{(0,622) \times (P_{sat}(T) \times (0,622W))} \quad \text{tendo } T \text{ e } w$$

Gláculos de AR (cont.):

③

- $AR = \frac{Pr}{Pr_{sat}(T)}$, tendo T e Pr_{sat}

- $AR = \frac{Pr}{Pr_{sat}}$, tendo Pr_{sat} e Pr_{sat}

- Calcular h com Te w:

- $h = 1.005 + \Delta T + w \cdot (2501 + 1.86 \Delta T)$ *(faz)*
 $(kJ/kg\cdot K) \quad (\Delta T) \quad 2501 + C_p T$

$$C_p = 1.005 \text{ kJ/kg}\cdot\text{K} \quad h_{sat} (T=0^\circ) \quad (h_2 - h_1 = C_p (T - 0^\circ))$$
$$C_p = 1.86 \text{ kJ/kg}\cdot\text{K}$$

- Calcular Pr_{sat} com T ou vice versa:

• Ampla e por consultas da tabela A-2.

- Calcular Pr_{sat}:

- $Pr = H_{Re} \cdot Pr_{sat}(T)$, com T e AR

- $Pr = \frac{w \cdot Par}{0.622 + w}$, tendo w

- Gláculos de massa:

- $m_{total} = m_v + m_s$

$$w = \frac{m_v}{m_s}$$

Com estas 2 fórmulas, podem-se efetuar as 3 formas de cálculo que estão no Asterisco.

- Diagrama psicrométrico:

- trabalha com 3 pressões de ar diferentes

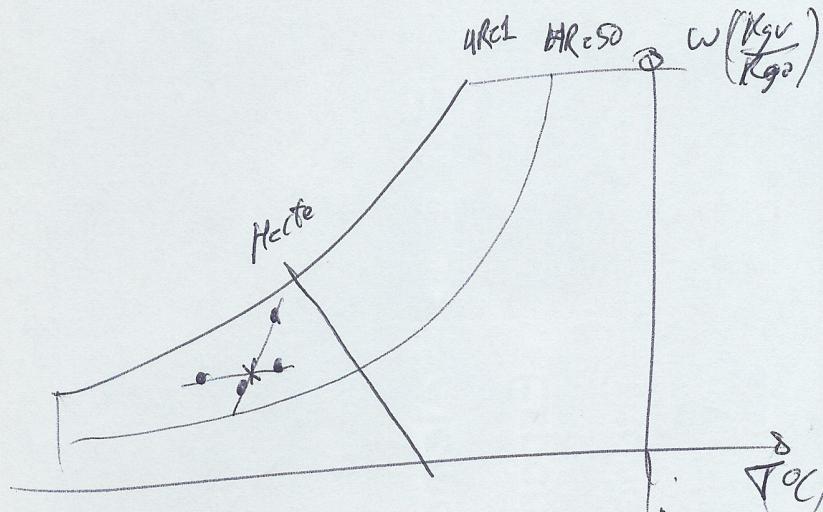
- os fatores são dependentes por: AR e T; w e ρ_{air} ; h_{fg} .

• Estes fatores são dependentes por T_{ew} , tal como nas diagramas em papel

as regras São as mesmas que as encontradas anteriormente

- Interseção de retas:

Rege-se pelas equações das retas $y = m_1x + b_1$ e $y = m_2x + b_2$, sendo $x \in \mathbb{R}$ e $y \in \mathbb{R}$.
Tendo as 2 retas, achase o ponto de interseção.



$$w_i = m_1 T_i + b_1$$

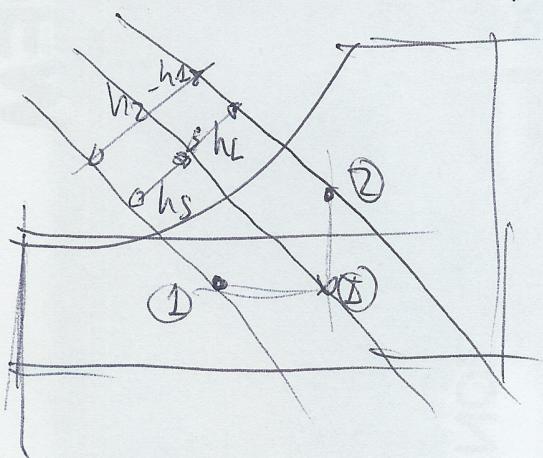
$$w_i = m_2 T_i + b_2$$

$$0 = m_1 T_i + b_1 - m_2 T_i - b_2 \quad (1)$$

$$(1) \quad T_i = \frac{b_2 - b_1}{m_1 - m_2}$$

$$(w_i) = m_1 T_i + b_1$$

- cálculo de h_S e h_L (antidiáspora seca e latente)



Assim sendo, com a eleição dos pontos ① e ②, obtém-se o ponto que forma um triângulo retângulo, com o $w_2, T_2 \rightarrow h_S$.

Com o h_S e h_L é h_2 , $h_S = h_2 - h_1$ e $h_L = h_2 - h_S$.

Ass. Combustão

(5)

Tabelas A-23

- Propriedades das fases:

- mesmo conceito de interpolação aplicado no 1º capítulo com base em $T(K)$, $h(kJ/kmol)$, $v(km³/kmol)$, $s(kJ/(kmol \cdot K))$
- Deve-se ter $h_f^0(kJ/kmol)$, T_f^0 , $h_f^0 + h_{298K}^0(kJ/kmol)$ e $\Delta H_f^0(kJ/kmol)$
- Entalpia de formação
- entalpia para separação

- Propriedades Termoquímicas (298K e 1 atm): Tabelas A-25

Retorna: Massa molar (M), entalpia de formação (h_f^0), Função de Gibbs de Formação (G_f^0), entropia (S^0), HHV , LHV .

$(kg/kmol)$, $KJ/kmol$, $KJ/kmol$, $KJ(kmol \cdot K)$, KJ/kg , KJ/kg
e constante de formação e nome.

- Log₁₀R - constante de Boltzmann : Tab A-27

Para uma fórmula tabelada, procurando por: $T(K)$, $\log_{10}(R)/K$

Deve-se: Fórmula, Temp, $\log_{10}(K)$, K

Kelvin
constante R

Sendo $\log_{10}(K)$ o valor tabelado, é empregado da fórmula e temperatura, e $K \approx 10^{10}$ val

Solver sistemas:

~~Depende-se em 3 componentes:~~

- Desenvolver as equações químicas, com auxílio de cálculo de parâmetros não definidos, quer seja para o equilíbrio das reações, quer para ~~a massa~~.

~~É com base~~ é efectuado com o auxílio de funções sobre os ~~cálculos~~ cálculos.

- Cálculo de entalpia dos reagentes e dos produtos, das moléculas e íons. ~~Cálculo~~

- Cálculo de entalpia dos reagentes, para outras temperaturas.

• Basicamente, caso vez que se tenham as equações químicas bem definidas, ~~estas podem ser~~ efectuado o cálculo entorópico das entalpias das reagentes e dos produtos.
• Simplemente, por estes temperaturas definidas para as entalpias "consultando" ~~as tabelas~~ A-23 e multiplicando pelas concentrações de ambos nas equações químicas (i.e., a qtd de moléculas/átomos).

• A fase de iteração, ~~fazemos como algo~~ tem em conta o seguinte conceito:



$$\Delta H_{\text{Resq}} (T=500K) = -62674 \text{ kJ/mol}$$

$$\frac{\Delta H_{\text{O}_2} = -24850 \text{ kJ/mol}}{T=500K}; \quad \Delta H_{\text{O}_2} = 6088 \text{ kJ/mol}$$

$$\frac{T=800K}{\Delta H_{\text{prod}} = -818361 \text{ kJ/mol}}$$

$$\Delta H_{\text{CO}_2} = -370705 \text{ kJ/mol}$$

$$\Delta H_{\text{H}_2\text{O}} = -223828 \text{ kJ/mol}$$

$$T=900K$$

$$\Delta H_{\text{prod}} = -866248 \text{ kJ/mol}$$

$$\Delta H_{\text{CO}_2} = -389512 \text{ kJ/mol}$$

$$\Delta H_{\text{H}_2\text{O}} = -238368 \text{ kJ/mol}$$

Compreende-se que $\Delta H_{\text{prod}}(T=800K)$ com $\Delta H_{\text{prod}}(T=900K)$,

para obter $\Delta H_{\text{resq}}(T=500K)$. No entanto, visto que

não estão tabelados todos os gases, é necessário comparar

~~moléculas de resquício~~ com ~~moléculas de produto~~, e como pode-se definir a temperatura de cada ~~resquício~~ produto/resquício, entre escolher-se usar como referência apenas para o produto ^{como} resquício.

Assim sendo, tendo os 2 ΔH_{prod} e o ΔH_{resq} , e as 2 temp das ΔH_{prod} , obtém-se a temperatura estimada por interpolação ~~extrapolação~~. Neste exemplo, de $T=712.2K$, que não estão tabelados para os produtos.

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