C.01.01.Z1 – Biblioteca Simplificada de Gás Ideal

Aplicação em FTHA – Finite Time Heat Addition Otto Engine Model

Prof. C. Naaktgeboren, PhD



https://github.com/CNThermSci/ApplThermSci Compiled on 2020-09-09 06h45m17s UTC





$$Pv = RT$$

$$P\bar{v} = \bar{R}T$$
 \rightarrow





$$Pv = RT$$

$$P = \frac{RT}{v}$$

$$P\bar{v} = \bar{R}T$$

$$P = rac{RT}{ar{v}}$$
 —





$$Pv = RT$$

$$P = \frac{RT}{v}$$

$$T = \frac{Pv}{R}$$

$$P\bar{v} = \bar{R}T$$

$$P = rac{ar{R}T}{ar{v}}$$
 —

$$T = \frac{P\bar{\nu}}{\bar{R}}$$





$$Pv = RT$$

$$P = \frac{RT}{v}$$

$$T = \frac{Pv}{R}$$

$$RT$$

$$P\bar{v} = \bar{R}T$$
 \rightarrow
 $P = \frac{\bar{R}T}{\bar{v}}$ \rightarrow
 $T = \frac{P\bar{v}}{\bar{R}}$ \rightarrow
 $\bar{v} = \frac{\bar{R}T}{\bar{R}}$ \therefore





$$Pv = RT$$
 $P\bar{v} = \bar{R}T$ \neg

$$P = \frac{RT}{v}$$
 $P = \frac{\bar{R}T}{\bar{v}}$ \neg

$$T = \frac{Pv}{R}$$
 $T = \frac{P\bar{v}}{\bar{R}}$ \neg

$$v = \frac{RT}{P}$$
 $\bar{v} = \frac{\bar{R}T}{P}$ \vdots

Cada equação com forma nas bases mássica, e molar, com $R = \bar{R}/M$ — armazenar \bar{R} e M!





$$\bar{c}_p(T) = \sum_{i=1}^4 a_i T^{i-1},$$

$$T_{min} \leqslant T \leqslant T_{max}$$
 \rightarrow





$$\bar{c}_p(T) = \sum_{i=1}^4 a_i T^{i-1},$$

$$\bar{c}_p(T) = a_1 + a_2 T + a_3 T^2 + a_4 T^3,$$

$$T_{min} \leqslant T \leqslant T_{max}$$
 -

$$T_{min} \leqslant T \leqslant T_{max}$$
 \neg





$$\bar{c}_p(T) = \sum_{i=1}^4 a_i T^{i-1}, \qquad T_{min} \leqslant T \leqslant T_{max}$$

$$\bar{c}_p(T) = a_1 + a_2 T + a_3 T^2 + a_4 T^3, \qquad T_{min} \leqslant T \leqslant T_{max}$$

$$\bar{c}_v(T) = \bar{c}_p(T) - \bar{R} = \sum_{i=1}^4 b_i T^{i-1}, \qquad T_{min} \leqslant T \leqslant T_{max}$$





$$ar{c}_p(T) = \sum_{i=1}^4 a_i T^{i-1}, \qquad T_{min} \leqslant T \leqslant T_{max} - ar{c}_p(T) = a_1 + a_2 T + a_3 T^2 + a_4 T^3, \qquad T_{min} \leqslant T \leqslant T_{max} - ar{c}_v(T) = ar{c}_p(T) - ar{R} = \sum_{i=1}^4 b_i T^{i-1}, \qquad T_{min} \leqslant T \leqslant T_{max} - ar{c}_v(T) = a_1 - ar{R}.$$





$$\bar{c}_p(T) = \sum_{i=1}^4 a_i T^{i-1}, \qquad T_{min} \leqslant T \leqslant T_{max} \qquad \overline{c}_p(T) = a_1 + a_2 T + a_3 T^2 + a_4 T^3, \qquad T_{min} \leqslant T \leqslant T_{max} \qquad \overline{c}_p(T) = \bar{c}_p(T) - \bar{R} = \sum_{i=1}^4 b_i T^{i-1}, \qquad T_{min} \leqslant T \leqslant T_{max} \qquad \overline{c}_p(T) = a_1 - \bar{R}, \qquad b_{i>1} = a_{i>1} \qquad \vdots$$

Armazenar a_i , T_{min} e T_{max} e saber as conversões (i) $a_i \to b_i$ e (ii) $\bar{c}_{p,v}(T) \to c_{p,v}(T)$





Modelo de $\bar{c}_p(T)$ Polinomial: $\bar{u}(T)$

$$ar{u}(T) = \int_{T_{mf}}^T ar{c}_{\scriptscriptstyle \mathcal{V}}(T)\, \dot{m{T}} = \int_{T_{mf}}^T \sum_{i=1}^4 b_i T^{i-1}\, \dot{m{T}}, \qquad \qquad T_{min} \leqslant T \leqslant T_{max} \qquad -$$





Modelo de $\bar{c}_n(T)$ Polinomial: $\bar{u}(T)$

$$ar{u}(T) = \int_{T_{ref}}^T ar{c}_{\scriptscriptstyle \mathcal{V}}(T)\, \dot{m{\Tau}} = \int_{T_{ref}}^T \sum_{i=1}^4 b_i T^{i-1}\, \dot{m{\Tau}},$$

$$\bar{u}(T) = \left(b_1 T + \frac{b_2 T^2}{2} + \frac{b_3 T^3}{3} + \frac{b_4 T^4}{4}\right)_{T}^T, \qquad T_{min} \leqslant T \leqslant T_{max}$$

$$T_{min} \leqslant T \leqslant T_{max}$$

 $T_{min} \leqslant T \leqslant T_{max}$





Modelo de $\bar{c}_p(T)$ Polinomial: $\bar{u}(T)$

$$ar{u}(T) = \int_{T_{ref}}^{T} ar{c}_{v}(T) \, \dot{\mathbf{T}} = \int_{T_{ref}}^{T} \sum_{i=1}^{4} b_{i} T^{i-1} \, \dot{\mathbf{T}}, \qquad T_{min} \leqslant T \leqslant T_{max}$$
 $ar{u}(T) = \left(b_{1} T + \frac{b_{2} T^{2}}{2} + \frac{b_{3} T^{3}}{3} + \frac{b_{4} T^{4}}{4}\right)_{T_{ref}}^{T}, \qquad T_{min} \leqslant T \leqslant T_{max}$

• Armazenar T_{ref} ,





Modelo de $\bar{c}_p(T)$ Polinomial: $\bar{u}(T)$

$$ar{u}(T) = \int_{T_{ref}}^T ar{c}_{\scriptscriptstyle \mathcal{V}}(T) \, \dot{\mathbf{T}} = \int_{T_{ref}}^T \sum_{i=1}^4 b_i T^{i-1} \, \dot{\mathbf{T}}, \qquad T_{min} \leqslant T \leqslant T_{max} \qquad -$$

$$\bar{u}(T) = \left(b_1 T + \frac{b_2 T^2}{2} + \frac{b_3 T^3}{3} + \frac{b_4 T^4}{4}\right)_{T=1}^T, \qquad T_{min} \leqslant T \leqslant T_{max}$$

- Armazenar T_{ref} ,
- Compor eficientemente a soma de produtos, e





Modelo de $\bar{c}_n(T)$ Polinomial: $\bar{u}(T)$

$$\bar{u}(T) = \int_{T_{ref}}^{T} \bar{c}_{\nu}(T) \,\dot{\mathbf{T}} = \int_{T_{ref}}^{T} \sum_{i=1}^{4} b_{i} T^{i-1} \,\dot{\mathbf{T}},$$

$$\bar{u}(T) = \left(b_1 T + \frac{b_2 T^2}{2} + \frac{b_3 T^3}{3} + \frac{b_4 T^4}{4}\right)_T^T, \qquad T_{min} \leqslant T \leqslant T_{max}$$

$$T_{min} \leqslant T \leqslant T_{max}$$
 —

$$T_{min} \leqslant T \leqslant T_{max}$$

- Armazenar T_{ref} ,
- Compor eficientemente a soma de produtos, e
- Saber as conversões $\bar{u}(T) \to u(T)$.





$$ar{h}(T) = \int_{T_{ref}}^T ar{c}_p(T) + ar{R}T = \int_{T_{ref}}^T \sum_{i=1}^4 a_i T^{i-1} + ar{R}T, \qquad T_{min} \leqslant T \leqslant T_{max} \qquad ext{ } ext{ }$$





$$ar{h}(T) = \int_{T_{ref}}^T \bar{c}_p(T) + \bar{R}T = \int_{T_{ref}}^T \sum_{i=1}^4 a_i T^{i-1} + \bar{R}T, \qquad T_{min} \leqslant T \leqslant T_{max}$$

$$\bar{h}(T) = \left(a_1 T + \frac{a_2 T^2}{2} + \frac{a_3 T^3}{3} + \frac{a_4 T^4}{4}\right)_{T_{ref}}^T + \bar{R}T, \qquad T_{min} \leqslant T \leqslant T_{max}$$





$$ar{h}(T) = \int_{T_{ref}}^{T} ar{c}_p(T) + ar{R}T = \int_{T_{ref}}^{T} \sum_{i=1}^{4} a_i T^{i-1} + ar{R}T, \qquad T_{min} \leqslant T \leqslant T_{max} - ar{h}(T) = \left(a_1 T + \frac{a_2 T^2}{2} + \frac{a_3 T^3}{2} + \frac{a_4 T^4}{4}\right)^T + ar{R}T, \qquad T_{min} \leqslant T \leqslant T_{max}$$

• Compor eficientemente a soma de produtos, e





$$ar{h}(T) = \int_{T_{ref}}^{T} ar{c}_p(T) + ar{R}T = \int_{T_{ref}}^{T} \sum_{i=1}^{4} a_i T^{i-1} + ar{R}T, \qquad T_{min} \leqslant T \leqslant T_{max}$$

$$ar{h}(T) = \left(a_1 T + \frac{a_2 T^2}{2} + \frac{a_3 T^3}{2} + \frac{a_4 T^4}{2}\right)^T + ar{R}T, \qquad T_{min} \leqslant T \leqslant T_{max} \qquad \therefore$$

- Compor eficientemente a soma de produtos, e
- Saber as conversões $\bar{h}(T) \rightarrow h(T)$.





