General Expression for the internal energy U and the enthalpy H

$$dU = Cv \cdot dT + \left[T \cdot \left(\frac{d}{dT}P\right) - P\right] \cdot dV$$

$$dH = Cp \cdot dT + \left[V - T \cdot \left(\frac{d}{dT}V\right)\right] \cdot dP$$

Special cases: 1) ideal gases
2) constant volume and pressure processes

1 ideal gases: the second term on both expression is zero

$$dU = Cv \cdot dT$$

$$dH = Cp \cdot dT$$

2. Constant volume the second term in dU equals zero and at constant pressure the second term in dH equals zero

$$dU = Cv \cdot dT$$

$$dH = Cp \cdot dT$$

To calculate the enthalpy from the heat capacity at constant pressure Cp
you need to integrate the expression of Cp in the range of temperatures.

$$\Delta H = \int_{T1}^{T2} Cp(T)\, dT$$

Finally for real gases the internal energy U has two terms; the first term is U0 (standard internal energy and the second term is called the imperfection internal energy Ui.
This latter term is given by

$$U_i = \int_{\infty}^{V} \left[T \cdot \left(\frac{\delta P}{\delta T}\right) - P\right] dV$$

If you use the Redlich-Kwong expression for P in the following form and use Symbolics and the differentiate you will get

$$P(V,T) = \frac{R \cdot T}{V - b} - \frac{a}{\sqrt{T} \cdot V \cdot (V - b)}$$

$$\frac{d}{dT}P(V,T) = \frac{R}{V - b} + \frac{1}{2} \cdot \frac{a}{T^{\frac{3}{2}} \cdot V \cdot (V - b)}$$

then U_i is given by

$$U_i = \int_{\infty}^{V} \left[T \cdot \left[\frac{R}{V - b} + \frac{1}{2} \cdot \frac{a}{T^{\frac{3}{2}} \cdot V \cdot (V - b)} \right] \right] - P \, dV$$

and the final eqaution for U_i is

$$U_i(V,T) = \frac{3}{2} \cdot \frac{a}{\sqrt{T} \cdot b} \cdot \ln\left(\frac{V}{V + b} \right)$$