# CH365 Chemical Engineering Thermodynamics

Lesson 16

Sensible Heat Effects

# Ethylene Glycol Process

- Sensible heat effects are associated with temperature change
- Latent heat (phase changes) – no temperature change
- Heat of Reaction
- Heat of Mixing

# "Sensible" Heat Effects

Sensible = No phase transitions, no chemical reactions, and no change in composition.

$$U = U(T, V)$$

Total differential introduced in L10, Slide 9, page 138

$$dU = \left(\frac{\partial U}{\partial T}\right)_V dT + \left(\frac{\partial U}{\partial V}\right)_T dV$$

0 for constant volume process, ideal gases, or incompressible fluids

L11, Slide 3

$$dU = C_V dT$$

Eq. 4.1

$$Q = \Delta U = \int_{T_1}^{T_2} C_V dT$$

$Q=\Delta U$ for mechanically reversible, constant volume process (why? $\Delta U=Q+W$)

# Mean Heat Capacity

Integral evaluated forms – “user-defined functions” – simplifies working with mixtures

These forms are used in later derivations in the textbook.

# Ideal Gas Heat Capacity in Simulators

## Improved function – used in professional simulators such as CC and Aspen+

F. A. Aly and L. L. Lee, "Self-Consistent Equations for calculating the Ideal Gas Heat Capacity, Enthalpy, and Entropy," *Fluid Phase Equilibria*, 1981, Vol. 6, Issues 3-4, pp. 169-179.

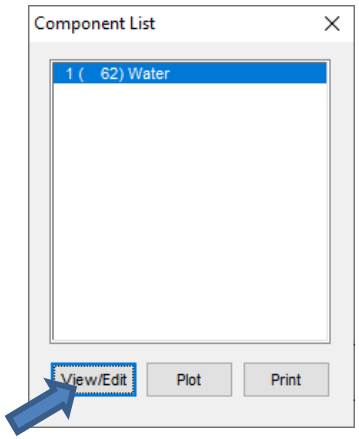
a, b, c, d & e are constants published and maintained by DIPPr (link on course web site).

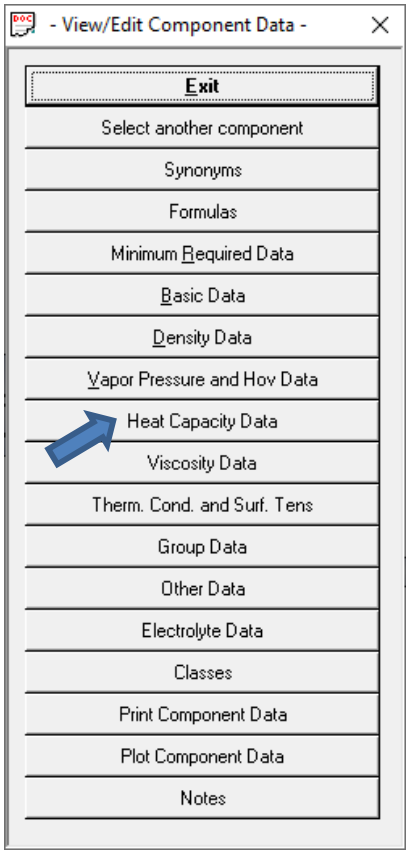
$$C_P = C_P(T) = a + b\cdot\left(\frac{c/T}{\mathrm{Sinh}[c/T]}\right)^2 + d\cdot\left(\frac{e/T}{\mathrm{Cosh}[e/T]}\right)^2$$

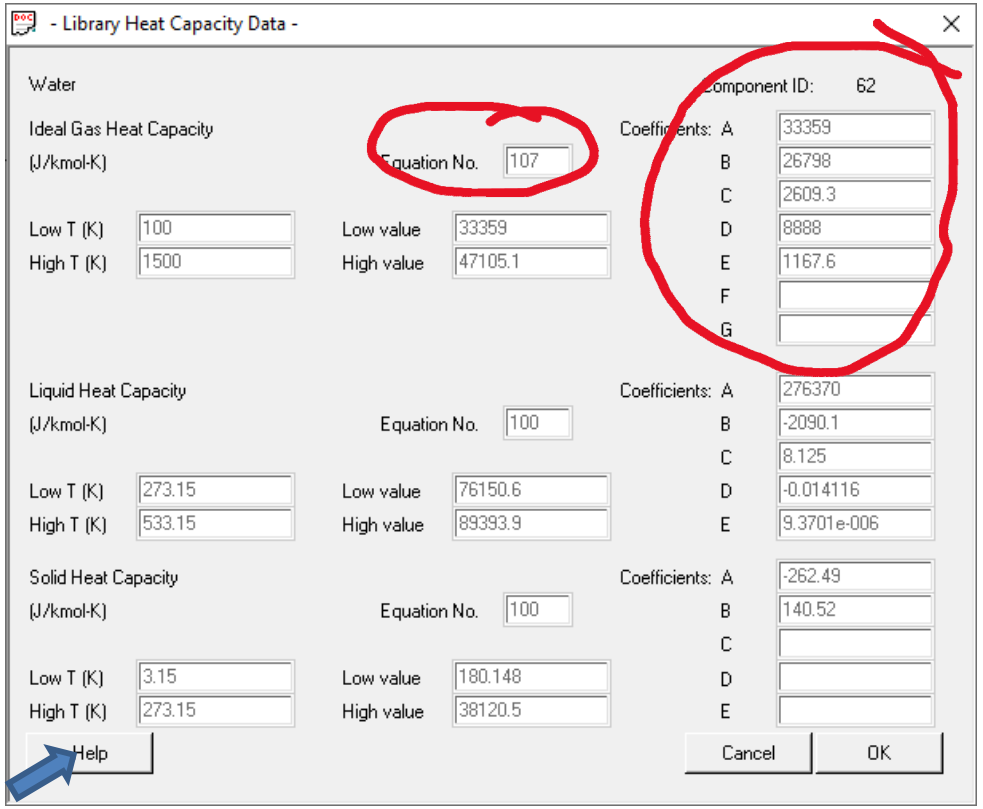
DIPPr Eq 107

hyperbolic sine

hyperbolic cosine




CC/DIPPr eq 107 found here

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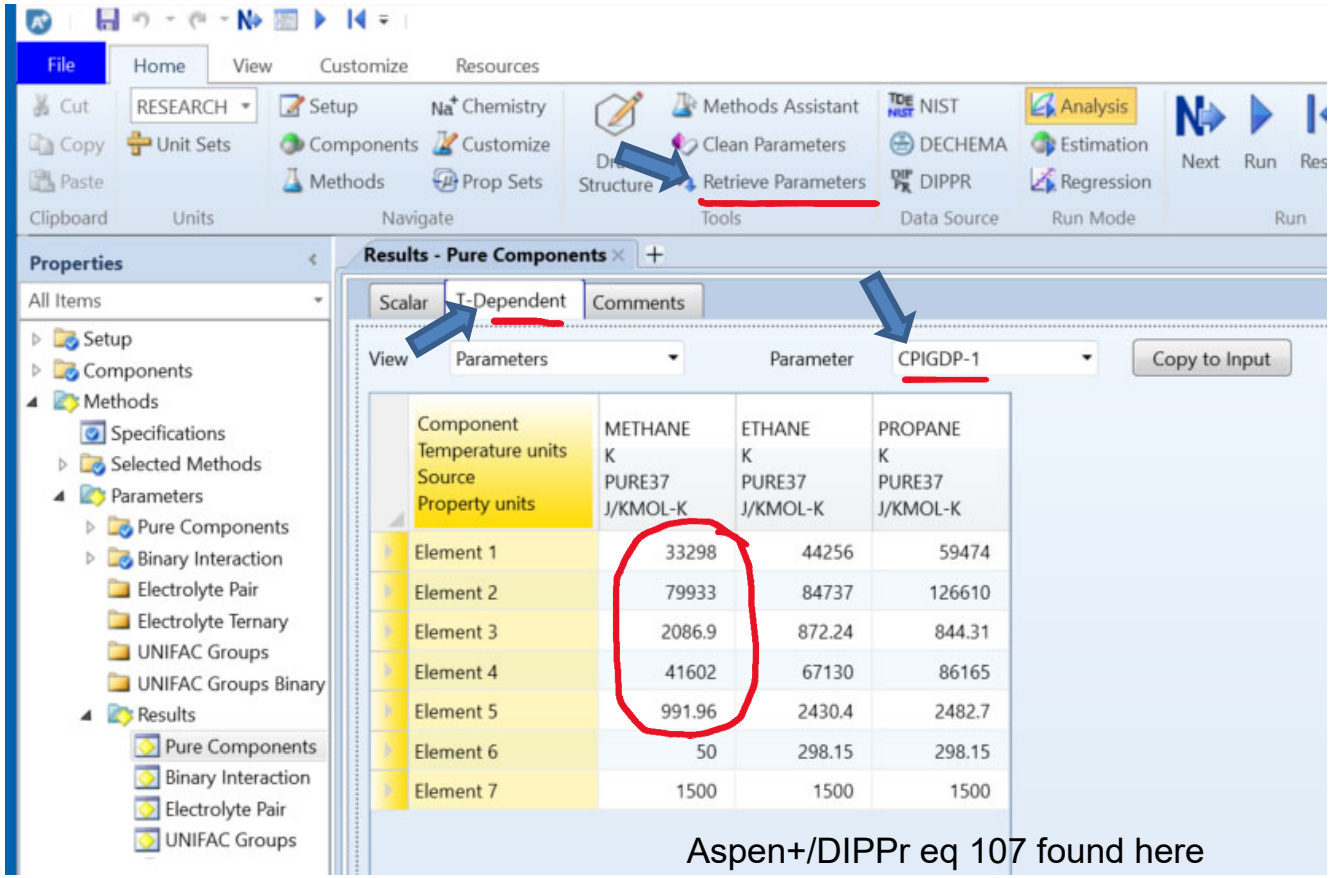

# Questions?