# 1. Theory for Liquid Heat Capacity

## I ) Polynomial equation (HC_CPLEQN)

Polynomial equation is used for Heat capacity of ideal gas.

$$C_p^L(T) = \sum_{i=0}^{3} A_i T^i \qquad (1)$$

where, $T$ is Kelvin and $C_p^L(T)$ is kJ/kg-mol.K.

## II ) Corresponding States Method for Liquid Heat Capacity (HC_CPLCSP)

The expression based on the Bondi' s method is used (Poiling et al., 2000).

$$\frac{C_p^r}{R} = \frac{C_p - C_p^0}{R} = 1.586 + \frac{0.49}{1-T_r} + w\left[4.2775 + \frac{6.3(1-T_r)^{1/3}}{T_r} + \frac{0.4355}{1-T_r}\right] \qquad (2)$$

This equation describe liquid argon behavior more accurately than Bondi' s method.

*Reference :* Poling et al., "Properties of Gases and Liquids", 5th ed. McGraw-Hill, New York, 2000

# 2. KDB Routines for Liquid Heat Capacity Calculation

KDB liquid heat capacity calculation subroutines contain one KDB correlation equation and one estimation method, which is corresponding states method based on the Bondi' s method.

| Subroutine Name | Description | Required Common Blocks |
|---|---|---|
| HC_CPLEQN | KDB correlation equation | HC_KCPL |
| HC_CPLCSP | Corresponding States Method | HC_PROP, HC_CPG |

## I ) HC_CPLEQN

1. Usage : CALL HC_CPLEQN(ICN,T,CPL,IST)
2. Arguments

ICN : Component ID number (1-50) to calculate vapor pressure (integer, input)

T : Temperature in Kelvin (real*8, input)

CPL : Liquid heat capacity in kJ/kg-mol.K (real*8, output)

IST : Status of calculation (integer, output)

= 0 : Normal termination

= 401 : Liquid heat capacity coefficient not available

= 402 : Out of range for the application

## II ) HC_CPLCSP

1. Usage : CALL HC_CPLCSP(ICN,T,CPL,IST)
2. Arguments

ICN : Component ID number (1-50) to calculate liquid heat capacity (integer, input)

T : Temperature in Kelvin (real*8, input)

CPL : Liquid heat capacity in kJ/kg-mol.K (real*8, output)

IST : Status of calculation (integer, output)

= 0 : Normal termination

= 411 : Ideal heat capacity data not available

= 412 : Critical temperature data not available

= 413 : Accentric factor data not available

= 114 : Given T exceeds critical temperature

3. Required Properties

Critical temperature in K, critical pressure in kPa, and ideal heat capacity coefficient for HC_CPGEQN