The SL model: The SL (Solid/Liquid) model is the simplest of all material models and can be used for incompressible working substances, mostly pure solids and pure liquids. When a block of copper is heated or water is pumped by a centrifugal pump, the SL model can be used for property evaluation of the working substance.

Assumptions: All state equations for the SL model are derived from the following basic assumptions:

(i) Specific volume v (and, hence, density $\rho = \frac{1}{v}$) is a constant, that is, the working substance is incompressible.

(ii) Specific heat c_v is a constant (this is actually a corollary to the first assumption).

If we consider a metal block, it expands when heated; however, the same block, when idealized by the SL model, must be considered incompressible. Table A-1 and A-2 list material properties of several common solids and liquids s. In the SL-state daemon, specific heats and specific volumes are populated as soon as a working substance is selected.

SL model equations: (Constant values of $\rho = 1/v$ and $c_p = c_v = c$ are read from tables)

$$\Delta u \equiv u_2 - u_1 = c(T_2 - T_1); \qquad c_v = c_p = c; \tag{1}$$

$$\Delta h \equiv h_2 - h_1 = \Delta(u + pv) = \Delta u + \Delta(pv) = c(T_2 - T_1) + v(p_2 - p_1) \tag{2}$$

$$\Delta s = c_p \ln\frac{T_2}{T_1} \tag{3}$$

General state equations: (Applies to any substance)

$$m = \rho V;\ \rho = \frac{1}{v};\ \mathrm{ke} = \frac{V^2}{2000};\ \mathrm{pe} = \frac{gz}{1000};\ e \equiv u + ke + pe;\ j \equiv h + ke + pe;\ h \equiv u + pv \tag{4}$$

$$E = me;\ S = ms;\ KE = m(\mathrm{ke});\ PE = m(\mathrm{pe}) \tag{5}$$

$$\dot{m} = \rho A V;\ \dot{V} = AV;\ \dot{E} = \dot{m}e;\ \dot{S} = \dot{m}s \tag{6}$$

$$Tds = du + pdv = dh - vdp;\quad c_v \equiv \left(\frac{\partial u}{\partial T}\right)_v;\ c_p \equiv \left(\frac{\partial h}{\partial T}\right)_p \tag{7}$$

Reference: Chapter 1 introduces the concept of states and properties, Chapter 3 covers various material models and state evaluation, and Chapter 11 introduces advanced concepts on property evaluation. Read more about the SL model in Sec. 3.3.