SPECIFIC HEAT

The specific heat of a substance is defined as the heat required to raise the temperature of 1 g molecule of the substance through 1 degree C (1°C)

$$C = \frac{d\theta}{dt}$$

where $d\theta$ is the amount of heat added to a system to raise its temperature from T to T + dt. The quantity of heat required to increase the temperature of a body is different under different conditions accordingly one can have various types of specific heat. For example the specific heat is at constant volume C_V. The former is always greater than the latter. ~~Acc~~

According to the first law of thermodynamics the heat added to the system is used up in two ways

i) To increase the internal energy of the system thereby raising its temperature

ii) Some work on the system to increase its volume against an external pressure

If the system expands against a constant pressure than the first law can be written as

$$d\theta = dE + pdV \quad \text{——} (1)$$

The first term on right hand side represents the change in internal energy of the system and second one represents the work done to change the volume by an amount dV at a pressure P. If heat is added to the system at constant volume the second term the equations can be written as

$$C_V = \left(\frac{d\theta}{dt}\right)_V = \left(\frac{dE}{dt}\right)_V \quad \text{——} (2)$$

~~in gases~~

Similarly one can express the specific heat at a constant pressure as —

$$c_p = \left(\frac{d\theta}{dt}\right)_p \quad \text{—— (3)}$$

In gases there is a large difference between c_p and c_v however in solids due to small change in volume c_p is always almost same as c_v particularly at low temperature. In solids most of the heat supplied is used up in increasing the internal energy. The increase in internal energy of solid may occur in two ways.

i) The atoms which ordinarily vibrate freely about their equilibrium position are set into a rigorous vibration this is many faceted by a rised in temperature.

ii) The free electrons in case of metals and semiconductors get thermaly excited to their energy state.

The first contribution arises from the atomic vibration and may be called the lattice specific heat the second contribution arises from the electronic system and is relatively small contribution. Thus in general

$$C_{solid} = C_{lat} + C_{elec} \quad \text{—— (4)}$$

Generally we write heat capacity in place of specific heat and is defined as the heat required to raise the temperature of the complete mass of a solid through 1° C. The experimental facts about heat capacity are given as

i) The heat capacity of most of solids at room temperature is closed to $3NK_B$, where N is the no. of atoms in the solid and K_B is the Boltzmann constant.

ii) For low temperature ($T \to 0K$) the heat capacity decreases sharply and follows the T^3 law for insulator and T law for metals