Thermal Expansion of Liquids

Thermal expansion of liquids

Definition. Increase in dimensions of a liquid on being heated is called thermal expansion of the liquid.
Types. Liquid has only volume. When heated, its volume increases. Increase in volume is called cubical expansion.

Real and apparent cubical expansion of a liquid

A liquid is taken in a vessel. When the liquid is heated, the vessel is also heated. The volume of vessel increases on heating. Increase in volume of the liquid is more than the increase in volume of the vessel. On observation, the increase in volume of the liquid appears to be less than the actual increase in volume.
Actual increase in volume of the liquid (taking into account expansion of the vessel), is called real cubical expansion of the liquid.
Observed increase in volume of the liquid (excluding expansion of the vessel), is called apparent cubical expansion of the liquid.
Apparent cubical expansion of liquid is less than the real cubical expansion by the amount equal to the cubical expansion of the vessel.

Coefficient of real cubical expension of a liquid

Actual increase in volume of a liquid of unit volume for one degree rise in temperature, is called coefficient of real cubical expansion of the liquid. It is represented by the symbol γ_r.

Coefficient of apparent cubical expansion of a liquid

Observed increase in volume of a liquid of unit volume for one degree rise in temperature, is called coefficient of apparent cubical expansion of the liquid. It is represented by the symbol γ_a.

Relation between γ_r and γ_a

Let a glass vessel and the liquid in it have volume V_0 at 0°C. Let γ_r and γ_a be the coefficients of real and apparent cubical expansion of the liquid and let γ_g be the

coefficient of cubical expansion of glass (vessel material).

Let the vessel and the liquid be heated to t°C.

Then,

Real cubical expansion of the liquid $= \gamma_r V_0 t$

Apparent cubical expansion of the liquid $= \gamma_a V_0 t$

Cubical expansion of the vessel $= \gamma_g V_0 t$

Since,

Real cubical expansion of the liquid

= Apparent cubical expansion of the liquid + Cubical expansion of the vessel

$$\gamma_r V_0 t = \gamma_a V_0 t = \gamma_g V_0 t$$

or $$\boxed{\gamma_r = \gamma_a + \gamma_g}$$

Viva Voce

Question.1. Define real cubical expansion of a liquid.
Answer. Actual increase in volume of a liquid (taking into account expansion of the vessel), is called real cubical expansion of the liquid.

Question.2. Define apparent cubical expansion of a liquid.
Answer. Observed increase in volume of a liquid (excluding expansion of the vessel), is called apparent cubical expansion of the liquid.

Question.3. Give relation between γ_r and γ_a.
Answer. The relation is, $\gamma_r = \gamma_a + \gamma_g$.