

To Determine Specific Heat Capacity of a Given Solid by Method of Mixtures

Aim

To determine specific heat capacity of a given solid by method of mixtures.

Apparatus

A hypsometer, calorimeter, stirrer, a lid and outer jacket, given solid in power form or in small pieces, balance, weight box, two half degree thermometer, cold water, clamp stand.

Theory

In hypsometer, the solid is heated uniformly above room temperature up to a fixed temperature and then solid is added to cold water in calorimeter.

Heat lost by solid = Heat gain by the water and calorimeter.

Diagram

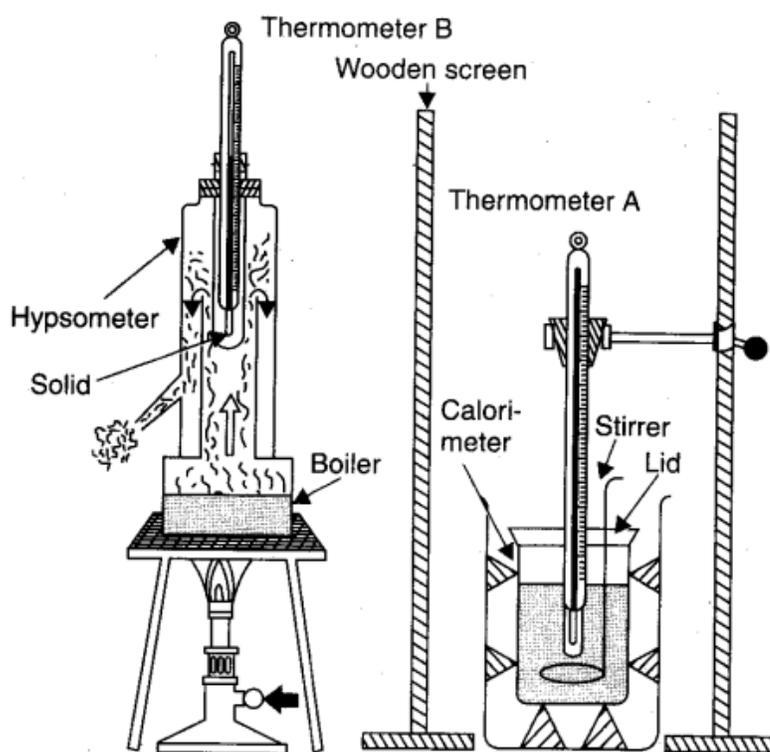


Fig. Determination of specific heat of solid by method of mixture.

Procedure

1. Put two thermometer A and B in a beaker containing water and note their reading. Take one of them, say A to be standard and find the correction to be applied to the other, say B.
2. Put thermometer B in copper tube of hypsometer containing the powder of given solid. Put sufficient water in hypsometer and place it on a burner.
3. Weigh the calorimeter with stirrer and lid over it by the physical balance. Record it.
4. Fill about half of calorimeter with water at about temperature 5 to 8°C below room temperature. Now, weigh it again and record it.
5. Heat the hypsometer about 10 minutes till the temperature of solid remains steady.
6. Note the temperature of water in the calorimeter. Now, transfer the solid from hypsometer to the calorimeter quickly. Stir the contents and record the final temperature of the mixture.
7. Remove the thermometer A from calorimeter and weigh the calorimeter with its contents and lid.

Observations

Reading of thermometer A	= $T_A = \dots\dots$ °C
Reading of thermometer B	= $T_B = \dots\dots$ °C
Correction applied in B w.r.t. A	$(T_A - T_B) = \dots\dots$ °C
Mass of calorimeter and stirrer	$m = \dots\dots$ g
Water equivalent of calorimeter	$\omega = m \times 0.095 = \dots\dots$ g
Specific heat of copper calorimeter	= 0.095 cal/g
Mass of calorimeter + stirrer + lid	= $m_1 = \dots\dots$ g
Mass of calorimeter + stirrer + lid + cold water	= $m_2 = \dots\dots$ g
Steady temperature of hot solid	= $T_S = \dots\dots$ °C
Corrected temperature of hot solid	$T = T_S - (T_A - T_B) = \dots\dots$ °C
Temperature of cold water	= $t = \dots\dots$ °C
Temperature of mixture	= $\theta = \dots\dots$ °C
Mass of calorimeter, stirrer, lid, cold water and solid	= $m_3 = \dots\dots$ g

Calculations

- Mass of cold water = $m_2 - m_1 = \dots\dots$ g
- Mass of hot solid = $m_3 - m_2 = \dots\dots$ g
- Rise of temperature of cold water and calorimeter = $\theta - t = \dots\dots$ °C
- Fall in temperature of solid = $T - \theta = \dots\dots$ °C
- Heat gain by calorimeter, cold water and stirrer = $[\omega + (m_2 - m_1) (\theta - t)] = \dots\dots$ (a)
- Heat lost by solid = $(m_3 - m_2) \times C \times (T - \theta) = \dots\dots$ (a)
- Here, C is the specific heat of solid to be calculated.

According to principle of calorimeter, heat lost = heat gained

$$(m_3 - m_2) \times C \times (T - \theta) = [w + (m_2 - m_1) (\theta - t)]$$

$$C = \frac{[w + (m_2 - m_1) (\theta - t)]}{[(m_3 - m_2) (T - \theta)]} = \dots\dots \text{cal/g}^\circ\text{C}$$

Result

Specific heat of given solid by method of mixture is.....cal g⁻¹ °C⁻¹

Precautions

1. Sufficient solid power should be taken to cover the tip of thermometer properly.
2. Sufficient water should be taken in hypsometer.
3. Solid should be dropped quickly and gently.
4. Calorimeter should be polished from outside to avoid excessive radiation losses.
5. Temperature of cold water should not be below the dew point.

Sources of error

1. Some heat is lost while transferring hot solid into calorimeter.
2. Some heat is lost in conduction, convection and radiation.
3. The bulbs of the thermometer may not be well inside the solid.

Note. To determine the specific heat of given liquid by method of mixture, instead of cold water, take the liquid whose specific heat is to be determined and proceeded as in the experiment done for determining the specific heat of solid. The specific heat of solid is already calculated.

Viva Voce

Question. 1. What is heat ?

Answer. It is the energy which produces the sensation of warmth.

Question. 2. Define specific heat of a substance.

Answer. It is-defined as the amount of heat required to raise the temperature of unit mass of substance through 1°C.

Question. 3. State the principle of calorimetry.

Answer. Whenever substances at different temperature are mixed so as to exchange the heat. Heat lost – Heat gained.

Question. 4. Why do we use calorimeter made of copper ?

Answer. Copper has very low value of specific heat. Due to this a large size in temperature takes place,
when some quantity of heat is supplied to it.

Question. 5. Is heat gained always equal to heat lost ?

Answer. No, it is only correct if there is no chemical reaction takes place between its components.