EXPERIMENT.1

DETERMINATION OF SPECIFIC HEAT OF METALS

Goal: Measuring the specific heat of metals.

Theory:

If energy is given to a matter without any work, temperature of the matter generally increases. The energy that needed to increase the temperature of matters with equal amounts changes with matter to matter. For example energy that needed to increase temperature of 1 kg of water to 1 °C is 4186 J. While energy that needed to increase temperature of 1 kg of copper to 1 °C is only 387 J. Heat capacity of a matter, C, is heat energy that needed to increase temperature of the matter to 1 °C. According to this definition, when heat unit of Q is given to an object, temperature of the object changes as ΔT. So:

$$Q=C\,\Delta T$$

Heat capacity (c) of any object is defined as heat capacity per unit volume. So if energy (Q) transfers to m massed object via heat, temperature of the object changes as ΔT. So specific heat of the object is:

$$c \equiv \frac{Q}{m\Delta T}$$

Specific heat is a measurement of heat susceptibility of given energy. If specific heat of a matter is bigger, amount of energy that can change temperature difference is bigger too. According to this definition, m is mass of matter, Q is transferred energy and ΔT is temperature difference:

$$Q=mc\,\Delta T$$

For example, heat energy that increase temperature of 0.5 kg water as 3°C is:

(0.5 kg)(4186 J/kg°C)(3°C)=6,28 x 10^3 J. When heat transfers to an object, both of Q and ΔT are positive signed. Because both of energy of system and temperature of object increase. When temperature decreases, Q and ΔT are negative and system releases energy. Specific heat changes with temperature but if temperature range isn't so wide, the difference is negligible and c is assumed as constant. For example specific heat of water changes %1 between 0-100°C at atmospheric pressure.

Heat capacity of water is the highest one among other matters. The reason of very low or high temperature of huge massed water is high heat capacitiy of water. When temperature of water decreases in winter, heat is transferred from water to air. So this cause winds that blow from waters to lands.

If a piece of iron is heated as much as 100°C in boiling water and then the iron is cooled in a water filled calorimeter, heat that released from iron is equal to heat that taken by calorimeter and water.

$$m_{Fe}c_{Fe}(100-T_2)=m_{aqua}c_{aqua}(T_2-T_1)+m_{Cu}c_{Cu}(T_2-T_1) \qquad (1)$$

m_{Fe} : Mass of iron, kg

m_{aqua} : Mass of water in calorimeter, kg

m_{Cu} : Mass of internal container(copper)of calorimeter, kg

c_{aqua} : Heat capacity of water, 4200 J/kg

c_{Cu} : Heat capacity of copper, 386 J/kg

c_{Fe} : Heat capacitiy of iron, ?

T_1 and T_2 : Initial and final temperatures, °C

Experimental Setup:

<u>Apparatus:</u>

1.) Iron

2.) Calorimeter

3.) Thermometer

4.) Stirrer

5.) Weight

EXPERIMENTAL SETUP AND MEASUREMENTS:

<u>Measurements:</u>

1.) Measure mass of iron and heat it up to 100°C with water.

2.) Weigh internal container of calorimeter and then fill 2/3 of the container by water. Weigh it again and record results to Table.1.

3.) Place calorimeter as Figure.1 and measure initial temperature of water.

4.) Put heated iron to calorimeter and stir water. Measure final temperature of water after reaching thermal balance. (Be careful about thermometer mustn't touch to iron.)

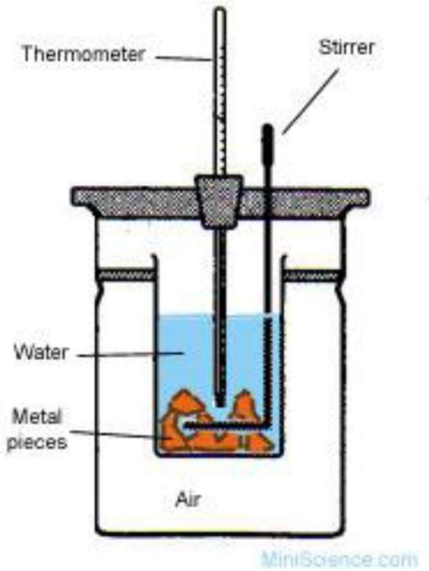

Figure.1.1 : Calorimeter

Calculations:

1.) Record your measurements and calculations to table below.

Table.1 : Measurements

Mass of Iron	m_{Fe}	kg
Mass of internal container(copper)of calorimeter	m_{Cu}	kg
Mass of internal container of calorimeter + water	$m_{Cu} + m_{aqua}$	kg
Mass of water in calorimeter	m_{aqua}	kg
Initial temperature of calorimeter	T_1	°C
Final temperature of calorimeter+iron	T_2	°C

2.) Find specific heat of iron using formula(1)

Specific heat of iron	c_{Fe}	J/kg cal/g

Error Calculation:

1.) Derive dependent error formula using formula (1) and find maximum absolute error of specific heat of iron.

2.) Show the theorical table that include real specific heats. Compare theorical and experimental value of specific heat and calculate percentage error.

3.) Write probable error sources.

Conclusions and comments:

Write your conclusions and comments about the experiment.

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