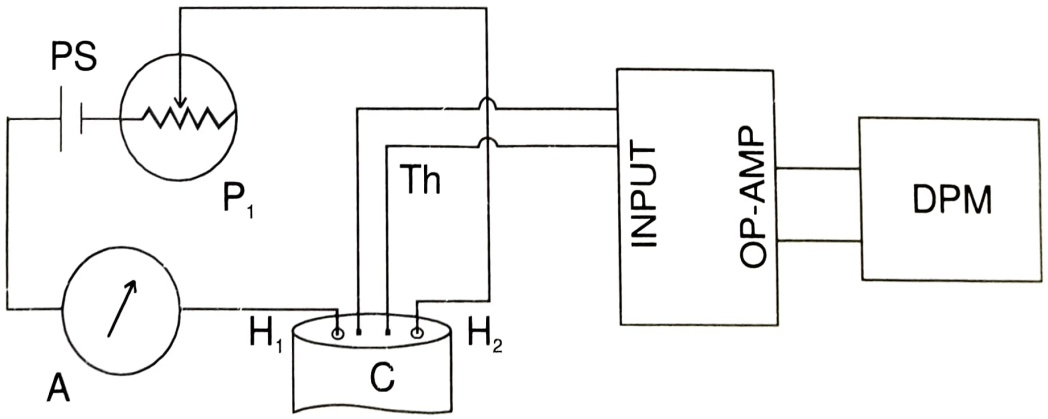
HEAT CAPACITY KIT

INTRODUCTION:

Heat capacity is one of the important thermal properties of solids. The kit is designed to determine the heat capacity of solids like metals, alloys and polymeric materials taken in the form of cylindrical rods of size (Length = 3 to 4 cm and diameter ≈ 6 mm). The experimental set up is most elegant and accurate. The important feature of the set up is that the temperature change of the specimen kept inside the silver calorimeter is detected using an iron-constant an uni-junction thermocouple. The resulting thermo-emf is amplified and displayed on a digital panel meter using suitable electronic circuitry. A built in power supply (for calorimeter heater) in series with the current meter and potentiometer with provision for connecting the calorimeter heater leads is provided in the kit. This set up will be useful for students of PG course in Physics, Chemistry, Polymer Science, Materials Science and Engineering Physics.

EXPERIMENTAL DETAILS:

The diagram of the experimental set up is given below :



The set up consists of the following parts:

(a) Amplifier with Digital display assembly and power supply (For calorie meter heater) in series with current meter (A) and potentiometer P_1 with provision for connecting calorimeter heater leads.

(b) Silver Calorimeter (C) – Fig. B: and samples (Standard sample –Silver ,Test sample – Brass, Aluminium & Copper.)

(c) 500 m A current meter (A) – provided in the Heat Capacity Kit.

(d) Stop watch 0.1 sec. accuracy.

(e) Pt-100 thermocouple.

BACKGROUND INFORMATION :

The specimen is taken in the form of a cylindrical rod (Length - 3.4 cm., diameter - 6 mm) with 1 mm dia and 3 mm deep hole at one end along the axis. The specimen is inserted into the calorimeter. Thermocouple (Uni-junction thermocouple) is inserted into the specimen hole provided to detect the temperature of the sample.

By connecting the heater leads of the silver calorimeter to the terminals marked " CALORIEMETER" provided on the front panel of the Heat Capacity Kit, adjust the current control potentiometer P_1, so that a current of approx 300 mA passed through the heater. The thermocouple output leads are connected to the terminals marked "SENSOR" provided on the front panel of the Heat Capacity Kit.

If I is the current flowing through the heater of resistance R for a time t sec. then,

$$I^2 R t = (W + m s) \cdot (T_2 - T_1)$$

Where I is the current flowing through the calorimeter heater, R is the resistance of the heater, where W is the water equivalent of calorimeter and its contents, m is the mass of the sample and S is its specific heat. $(T_2 - T_1)$ is the temperature change .

EXPERIMENTAL PROCEDURE :

1. Measure the masses of Silver (standard sample), Aluminium, Copper, Brass (Test sample)

2. Insert the thermocouple junction into the hole of the specimen kept tightly fixed into the silver calorimeter (Silver calorimeter is attached to the lid of the teflon flask). Connect thermocouple to the main unit.

3 Connect the Calorimeter heater leads to the terminals provided on the front panel of the Kit (Heater).

4 Suppose that we have to measure the heat capacity of the material at T° C (say 27.5° C). Choose Temperature T_1 as (T- 2.5° C) (25° C) and T_2 as (T + 2.5° C) (30° C).

5 Adjust the heater current control potentiometer P_1 so that a current I of 250 - 300 mA passes through the heater as can be read on the current meter. Due to the current flow in the calorimeter heater, the temperature of the specimen increases and as a result the thermo-emf of the thermocouple increases and hence the display reading. When the display reading reaches T_1, start the stop watch and note the time t for the temperature to build to T_2.

6 Using the relation

$I^2 R t = (W + m S) (T_2 - T_1)$.

Determine W employing a standard (Silver) specimen.

7 The specific heat of the test sample at temperature T can be determined using the value of W calculated above by determining the time required to heat the specimen from T_1 to T_2 when the same current I passes through the calorimeter heater.

Precautions

1. While switching the stop watch and switching off the stop watch to determine the time required to heat the sample from temperature T_1 to T_2 °C. It is desirable to see that the conditions are identical. When the panel reading is just displaced T_1 start the stop watch and stop the stop watch when the display is just T_2.

Manufacturer's Notes

Thermocouple Type: PT-100

Calorimeter Heater Resistance : _____ Ω

Mass of the Standard Sample : _____ gm (Silver)

Mass of the test sample : _____ gms. (Brass), _____ gms. (Copper), _____ gms. (Aluminium)

SPECIFIC HEATS OF DIFFERENT MATERIALS

Material	**Specific Heat** (J Kg^{-1} K^{-1})
Copper	385
Aluminium	913
Brass (70 Cu/30 Zn)	370
Iron (pure)	106
Quartz (Fused silica)	788
Glass (crown)	1400
Rubber	1600
Silver	232

PART LIST

1.	MAIN UNIT	☐
2.	SILVER CALORIEMETER WITH TEFLON FLASK	☐
3.	THERMOCOUPLE	☐
4.	STANDARD SAMPLE (Silver)	☐
5.	TEST SAMPLES (Cu, Al, Brass)	☐
6.	CONNECTING WIRES	☐
7.	STOP WATCH	☐
8.	INSTRUCTION MANUAL	☐