Order Code : 20213547.2.2

Name : Specific heat capacity apparatus

Specifications:

- Apparatus of Measuring Specific Heat Capacity, is designed with a few innovations compared with the traditional experimental methods and experimental instruments. In the aspect of experimental method, the cooling conditions of the sample are no longer only natural cooling in room temperature environment, ut also use a fan to create forced convection for cooling environment. The advantages and disadvantages of the two cooling conditions can be compared and analyzed. In the aspect of experimental device, the heating device is a PTC heating plate working at a safe voltage with temperature limiting. A temperature sensor of PT100 resistance is used to replace the traditional Copper-constantan thermocouple that needs an icy reference end to work. The sample chamber is changed from the traditional up and down vertical structure to the left and right horizontal structure. The heater movement in the sample chamber is also changed from up and down to left and right, making the experimental operation more convenient.

- This apparatus takes copper as the standard sample and measures the specific heat capacity of iron and aluminum samples at 100 °C under two different cooling environments, i.e. forced convective cooling and natural cooling, enables students to understand the relationship between the cooling rate of metal and the cooling environment, and master the experimental method of measuring specific heat capacity of metal by cooling.

- This experimental apparatus mainly consists of a main electric unit, a heater, a sample chamber, a cooling fan, a PT100 platinum resistance, and so on. Using this apparatus, the following experiments can be performed:

1. Learn to measure temperature using PT100 platinum resistance;
2. Under forced convective cooling, measure specific heat capacity of iron and aluminum samples at 100 °C;
3. Under natural cooling, measure specific heat capacity of iron and aluminum samples at 100 °C.

Note: Specifications are subject to change, Photos shown above are Indicative, Actual Product can Vary.

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Description	Specifications
PTC heater	working voltage 30 VAC stable temperature > 200 °C temperature limiting 260 °C
Digital Ohm meter	0 ~ 199.99 Ω, resolution 0.01 Ω
Metal sample	copper, iron and aluminum, each one, length 65 mm, diameter 8 mm

Parts

Description	Qty
Electric unit	1
Sample chamber	1
Sample	3
Connection wires	2
Stop watch	1
Power cord	1
Instruction manual	1

Sample mass: Copper $M_{Cu} = 18.34g$, Iron $M_{Fe} = 18.07g$, Aluminum $M_{Al} = 6.50g$

Use Copper as the standard sample: $C_1 = C_{Cu} = 0.39J/(g\cdot℃)$

1. Under forced convective cooling, measure the specific heat capacities of samples iron and aluminum at 100 °C

Table 1 The spent cooling time from 105 °C to 95 °C for 3 metal samples

	$\Delta t / s$					Average
	1	2	3	4	5	$\overline{\Delta t} / s$
Copper	16.97	17.22	17.25	17.16	17.25	17.17
Iron	20.40	20.54	20.38	20.22	21.13	20.53
Aluminum	12.84	13.38	13.56	13.47	13.94	13.44

Calculated specific heat capacities are follows:

Iron sample $C_2 = C_1 \frac{M_1(\Delta t)_2}{M_2(\Delta t)_1} = 0.39 \times \frac{18.34 \times 20.53}{18.07 \times 17.17} = 0.47J/(g\cdot℃)$

Aluminum sample $C_3 = C_1 \frac{M_1(\Delta t)_3}{M_3(\Delta t)_1} = 0.39 \times \frac{18.34 \times 13.44}{6.50 \times 17.17} = 0.86J/(g\cdot℃)$

2. Under natural cooling, measure the specific heat capacities of samples iron and aluminum at 100 °C

Table 2 The spent cooling time from 105 °C to 95 °C for 3 metal samples

	$\Delta t / s$					Average
	1	2	3	4	5	$\overline{\Delta t} / s$
Copper	29.72	30.81	31.53	32.16	32.84	31.41
Iron	38.34	39.44	39.82	40.41	41.12	39.83
Aluminum	22.25	23.19	23.75	23.94	24.10	23.45

Calculated specific heat capacities are follows:

Iron sample: $C_2 = C_1 \frac{M_1(\Delta t)_2}{M_2(\Delta t)_1} = 0.39 \times \frac{18.34 \times 39.83}{31.41 \times 18.07} = 0.50J/(g\cdot℃)$

Aluminum sample: $C_3 = C_1 \frac{M_1(\Delta t)_3}{M_3(\Delta t)_1} = 0.39 \times \frac{18.34 \times 23.45}{6.50 \times 31.41} = 0.81J/(g\cdot℃)$

Conclusion: method of forced convective cooling can achieve relatively better measurement results as they are closer to recognized values for iron and aluminum samples.

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