Practical 10 Specific heat capacity of a liquid

Purpose

The aim of this experiment is to measure the specific heat capacity of a liquid using an electrical method.

Safety

Do not heat the contents of the calorimeter above 50 °C.

You will need:

- A copper or aluminium calorimeter with a volume of between 250 and 400 ml
- Insulating jacket with a hole for the thermometer or sensor
- Electrical immersion heater
- Voltmeter
- Ammeter
- Low-voltage power supply (0–12 V)
- Thermometer (0–50 °C)
- Stop clock

(A temperature sensor and data logger can be used instead of the thermometer and stop clock.)

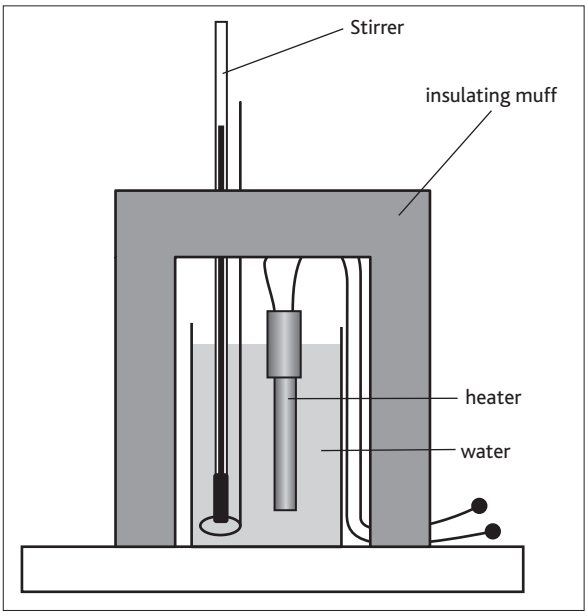

Figure 1: Calorimeter setup for measuring the specific heat capacity of a liquid

Experimental instructions

Set up the apparatus as shown in the diagram. Measure the mass of the calorimeter (m_C) and fill it with a known mass of water (m_W). There must be enough water to cover the immersion heater when it is put in the calorimeter. Place the muff over the calorimeter.

Switch on the heater. Set the voltage (V) to a convenient value and record this with the value of the current (I). Measure the initial water temperature (θ) using a thermometer and start the stop clock (or use a temperature sensor and data logger). Record the temperature at one-minute intervals, stirring just before the thermometer is read. Switch off the heater when the temperature reaches 50 °C.

(You may need to adjust the value of V during the experiment so that the power input remains constant.)

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Analysis and conclusions

Plot a graph of temperature against time and choose a section of the graph where the temperature is rising steadily. In this area find the temperature rise $\Delta\theta$ in a time Δt.

Calculate the electrical energy supplied to the heater ($VI\Delta t$).

Assume that there are no heat losses during the experiment.

Calculate the specific heat capacity of water (c_W) from the equation:

$$VI\Delta t = m_C c_C \Delta\theta + m_W c_W \Delta\theta$$

where c_C is the specific heat capacity of the material of the calorimeter. (The value of c_C can be found from a data book.)

Repeat the experiment with other liquids.

Record any sources of error which you consider will affect your result.

Predict the effect on your answer of significant heat loss.