Make Your Own – Simple Immersion Heater (two versions)

1. Nichrome wire heater

This small and cheap piece of equipment is easy to make and store and perfect for carrying out investigations into the specific heat capacity of water.

Equipment Required:

~60cm of 28swg Nichrome wire

(https://www.brecklandscientific.co.uk/ELW-550-028-p/elw-550-028.htm)

Electrical terminal connecting block (5A)

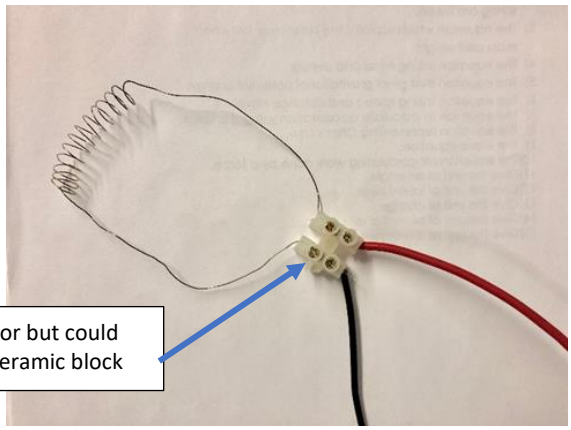
(http://www.wickes.co.uk/Wickes-Terminal-Connector-Block-Strip---5A/p/710110)

2 x 4mm leads (with socket ends)

A pen or pencil

Small screwdriver

Wire cutters



Instructions

Cut a 60cm length of the nichrome wire (does not need to be exact – err on the side of a bit too long if doing it quickly). Measure 8cm in from one end, then wrap 14 times around a pen or pencil to form 14 coils. This should then leave around 8cm of straight wire at either end of the coil. Break off 2 of the electrical connectors from the block. These connect through the middle of each. Unscrew the small screw in one side and put in one end of the nichrome wire. Connect it in a loop to the other connector (see photo). Screw in tightly. To the other side of the connector block you need to attach 4mm wires. Either use wire that has not had plugs put on yet or remove the plugs from one end of two wires. Strip around 1cm or the plastic insulation off the ends leaving bare copper wire. Fix this into the connector block in the same way as the nichrome wire as shown in the photo.

Technical Specifications

Using 12V D.C. from a lab power pack, you can expect a current of around 2A in the coil. The heat generated will raise the temperature of 100cm^3 water by around 12^{0}C in 5 minutes.

Safety

The bare nichrome wire gets very hot and touching it when connected should be avoided. When handling, touch the plastic connector block or insulated 4mm leads. When on, the wire is hot enough to melt some plastic so it is recommended to use pyrex glassware to contain liquids.

Suggested use:

Measure 100cm^3 of water into a beaker. Connect the coil to a 12v D.C. power supply with an ammeter in series. Measure the temperature of the water. Place the coil in the water and switch on. Note down the reading of current on the ammeter. Time for 5 minutes. Switch off, stir and measure the temperature of the water again and calculate the temperature difference from the start.

Use the formula:

Energy (J) = Potential Difference (V) x Current (A) x Time (s)

To calculate the electrical energy supplied by the coil to the water.

Then use the formula:

Energy (J) = Mass (kg) x Specific Heat Capacity (J / Kg ^{0}C) x Temperature Difference (^{0}C)

Rearrange to calculate the specific heat capacity of water. Remember: Energy – is the amount calculated as being supplied electrically by the coil. Mass – 1cm^3 of water = 0.001kg. Temperature difference – your value from your experiment.

The accepted value is 4186 J /kg ^{0}C. Compare your calculated value to this. What might cause have caused the difference? Could you repeat your experiment with any modifications to get a closer value?

2. Using an mes lamp as heater in a boiling tube

12/6V mes lamp in holder, shrouded in a plastic tube and leads soldered to

Test-tube(boiling tube) with cloth round tube secured with elastic band

Materials required:

For the housing

Glass tubing, approx. 7mm External Diameter, 120mm in length. Cut from a long length but needs to have sharp edges removed. It might be possible to buy in some rigid plastic tubing of the same diameter which could be used to reduce the risk of breakages.

Very flexible plastic tubing, the tubing that I used is softer than PVC tubing, you need 2 different diameters which are a tight fit on the 7mm Glass tube. I used 9mm External diameter, and 9 mm External diameter. As the walls are just over 1mm thick, it means that the 9mm creates a seal on the 7mm glass tube, and the 11m creates a seal on the 9mm plastic tube. Only short lengths around 20mm long are required of each tube, you may find this tubing available in your Biology department. Silcone rubber tubing might be good.

For the heater

Bulb holder – these may be made from some very basic mes bulb holders that you may have around the department which may be taken from their mounts, the tags can then be bent with pliers so they are in line with the bulb holder.

Leads – make these from Extra flexible wire as this is easiest to 'squash' to pass through the narrow tube. Making these around 50 cm long that is the best length to connect to a Power Supply. Connections may be soldered to the mes bulb holder, just stripped back around 25mm then twisted together and wrapped a small piece of insulating tape around the connection.

Bulbs – 12v, 3W, 11 x24mm mes bulbs. Or 6V mes lamps

Insulation

Reflecting and Insulating Radiator foil, shiny aluminium with polystyrene backing.