Comparing the thermal conductivities of different materials

Demonstration

This experiment uses a commercially available apparatus to compare the thermal conductivity of different metals.

Apparatus and materials

Ingenhousz's apparatus, or similar

Paraffin wax

Health & Safety and Technical notes

Read our standard health & safety guidance

The apparatus has a number of rods, each made of a different metal. Accompanying information will identify them.

The rods must be coated with wax. This can be done by one of the following methods:

i Take the rods out of the water box and lay them in a chilled tin tray containing molten paraffin-wax. Remove quickly, hold vertically to allow the excess wax to drain off, and push them back into the water box.

ii Keep the rods in the water box. Paint each rod with a paint brush dipped in very hot molten wax. This produces an uneven, thick coating of wax, which must then be thinned by blowing a Bunsen flame up and down the rod. (This is a poor method, only successful in very skilful hands.)

A simple and easy-to-use set of conductivity bars is now available from Timstar [2]. Four bars made of different metals are mounted on the same plastic support. Each bar has a liquid crystal strip showing temperature changes along the bar.

Timstar Laboratory Suppliers, Marshfield Bank, Crewe, Cheshire. CW2 8UY
Tel: 01270 250459 Email: sales@timstar.co.uk

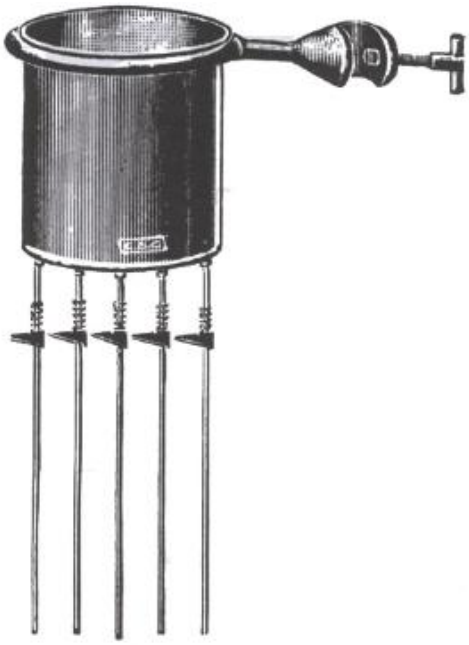
Procedure

---

a Fill the water bath with hot water. Note how far along the rods the wax has melted when the apparatus

reaches a steady state.

Ingenhousz's apparatus



Edser's apparatus

Different designs are available. Generally they use a bath of hot water to heat the rods.

Teaching notes

1 Note that the speed at which a particular temperature (such as the melting point of wax) travels along a bar when one end is heated is essentially the speed of the 'temperature waves'. This involves specific heat capacity and density as well as conductivity. Thus a rod of lead makes a quick start in the race although it is a poor conductor, but the wax-melting will not have travelled far when a steady state is attained.

2 The experiment involves heat losses from the surface of the rod. If for a steady state, the distance from the heated end to the melting point of the wax is twice as great for rod A as for rod B, then rod A has only half the temperature gradient but twice the surface area for heat losses. So rod A must have four times the conductivity of rod B.

3 The versions of this apparatus currently available are of the static warm water type. The preferred form has steam passing continuously through the apparatus. This is left to attain a steady state. Slider rings indicate the progress of the melting wax.

This experiment was safety-checked in January 2007

Related guidance

Conduction, convection and radiation [3]

Weblinks

Timstar [2]

Source URL: http://www.nuffieldfoundation.org/practical-physics/comparing-thermal-conductivities-different-materials

Links:
[1] http://www.nuffieldfoundation.org/node/1634/
[2] http://www.timstar.co.uk/
[3] http://www.nuffieldfoundation.org/node/1856