Experiment: Thermal Conductivity Apparatus – Ice Melt

Purpose

1. To understand the theory of heat conduction
2. To measure the thermal conductivity *K* of different materials, and compare it to the theoretical value.

Theory

There are three methods of heat transfer: heat conduction, convection, radiation. The main use of this experiment is "heat transfer", which refers to "heat passes from a high temperature location to a low temperature location, that is, the direct contact between the substances, but there is no exchange of material.

Thermal equilibrium is when the temperature of a system or organism is equal to the temperature of its surroundings. This means things at the same temperature are the same temperature.

When a system reaches thermal equilibrium, it means the pressure, temperature, volume, and other physical properties will not change over time, but the particles still remain active.

A piece of ice is placed in the plate and gives heat ΔQ by the heat generated from the steam pot. So we know that *the contact area A* of the ice and material plate, *the* *thickness t*, and *the temperature difference ΔT.* Record the amount of water from the melting ice to calculate *the thermal conductivity k.*

thermal conductivity：

[W/(m • K)]

In the equation:

k：Thermal conductivity

ΔQ： Total heat energy

Δt：Time

h：Thickness

A：Area

ΔT：Temperature difference

Every material has different coefficient of thermal conductivity, for example, the thermal conductivity of the glass is high, the cooling rate is fast. Conversely, the coefficient of thermal conductivity of the wood is low, so is its cooling rate. By the equation, we know that the conduction of the heat is proportional to the thickness of the material, but the contact area is inversely proportional to the temperature and time.

Instrument

NO	Accessory	Quantity
1	Ice Melting Base	1
2	Steam Cup	1
3	Fixer	2
4	Measurable Object	3
5	Icing Container	3
6	Beaker	2
7	Steam Heating Pot	1
8	Tube	1

Thermal Conductivity Apparatus Set

Procedure

1. Use the icing container to make ice before the experiment.

2. Put the right amount of water into the steam heating pot, and then tighten the lid fixer. Connect one end of the tube to the pot lid and the other end to the bottom of the base. Then place a beaker below the experimental base to get the water.

3. Measure and record the thickness h of the object.

4. Tighten the measurable object on the steam cup, and then turn the power on to generate steam into the cup. (the valve on the side of the cup can be used for adjustment)

5. The V-shaped front end must be connected to the slide tightly in order to make all water flow into the beaker. (Note: the measurable object must be placed in the right position of the slide to avoid leaks, and then tighten the fixer knob.)

6. Measure the diameter of the ice, and then put the ice on the top of the object.

7. Make one end of the object 100℃, and the other end 0℃ using iced water. Keep the temperature difference ΔT at 100 ℃.

8. Contact the ice with the object for a few minutes, the ice will begin to melt. Do not read the data before melting, because the temperature may be lower than 0 ° C at this time.

9. Measure the melting time Δt (about 5 or 10 minutes, depends on ice size), the amount of water, and the diameter of the ice before and after melting (calculate the average diameter to obtain the cross-sectional area A).

10. Calculate the heat energy measured in terms of calories (the heat of fusion of ice is 79.5cal / g,)

11. Calculate the k value of the object.

12. Change the measurable object to repeat the above steps in order to find the k value.

Experimental Record

Experimental Record Form 1						
Measurable object	**h**	**A**	**ΔT**	**Δt**	**ΔQ**	**K**
	average thermal conductivity K：					

Experimental Record Form 2						
Measurable object	**h**	**A**	**ΔT**	**Δt**	**ΔQ**	**K**
	average thermal conductivity K：					

Experimental Record Form 3						
Measurable object	**h**	**A**	**ΔT**	**Δt**	**ΔQ**	**K**
	average thermal conductivity K：					

Questions and Discussions

1. Describe the theory of this experiment.

2. Analyze the values of K.

3. Can we calculate the heat energy by the amount of condensate water?

4. If the object is non-metallic, is this method appropriate? Why?

5. What causes the error?

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