

An investigation into the properties of insulators.

Aim

To show that good insulators have trapped pockets of air.

Insulators

The four insulators we are going to use are Bubble Wrap, Cotton Wool, Cardboard and Newspaper. We are also going to test the amount of heat lost without any form of insulator so that we can compare the results.

Equipment

The equipment required for this experiment is:

- Boiling tubes
- Boiling water
- Thermometer
- Stop Watch
- Four chosen insulators
- Stand (to clamp the boiling tubes on)

Preliminary Work

We could not decide between us, which type of container to use – boiling tubes or metal beakers. We tested both out to determine which gave the fairest results; and we decided that the boiling tube was the better of the two. We thought this because metal is a good conductor of heat, and if we used a metal beaker it would work against the insulators.

Prediction

I predict that cotton wool will be the best insulator (and the poorest conductor) because it has trapped pockets of air. I think that trapped pockets of air are very important in insulators because the air within them are trapped and so cannot move, therefore convection currents cannot occur; which makes the still air a good insulator. Air is a good insulator because the particles are far apart so heat cannot transfer through the particles as fast or as easy as it could in a metal.

If you are insulating something, and the air space is too large, the air will not insulate because convection currents are able to flow. Convection currents

are the circulating paths of fluids caused by the application of heat, which means they travel through air spaces if they are large enough to create a current. Cotton wool should not have this problem because it is made up of very thin layers with small air pockets, therefore very small spaces within. I do not think that bubble wrap will be a very good insulator because the air pockets are extremely large and will make it easy for heat transfer to take place. Also, I do not think that newspaper will be a very good insulator because it is very thin with no air pockets, therefore the basic necessities for insulation to occur are missing. And finally, I think cardboard will be a very good insulator because it has several layers, however after weighing up the advantages of each insulator I reckon cotton wool is the best.

Diagram

Method

For this experiment we clamped a boiling tube in a stand, and filled it with 40 ml of boiling water (or as near to boiling as we could make it) with a measuring cylinder and a thermometer (to check how hot we had made it.) Each experiment lasted ten minutes and we took the temperature at the start and the finish so that we could compare results and see the amount of heat lost. Each experiment used a different type of insulator (and each insulator was tested three times). To ensure it was a fair test we took the following steps:

- 40 ml of boiling water was used in every experiment
- We allowed ten minutes for the span of each experiment

- The same amount of insulator was used in every experiment

Results

Insulator	Start temp	Finish temp one	Finish temp Two	Finish temp three	Finish temp four
Bubble Wrap	86	55	52	51	53
Cardboard	73	55	57	55	56
Newspaper	71	50	54	52	52
Cotton Wool	74	50	55	56	53
No insulator	65	40	40	38	39

Calculations

Bubble Wrap:

Start temperature – average final temperature

= Amount of temperature lost

$$86-56$$

$$=33$$

Cardboard:

Start temperature – average final temperature

=Amount of temperature lost

$$73-56$$

$$=17$$

Newspaper

Start temperature – average final temperature

=Amount of temperature lost

$$71-52$$

$$=19$$

Cotton Wool

Start temperature – average final temperature

=Amount of temperature lost

74-53

=21

No Insulator

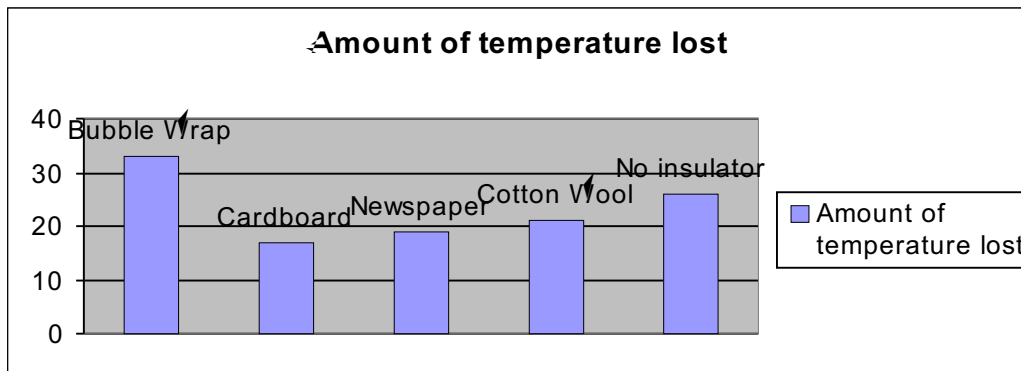
Start temperature – average final temperature

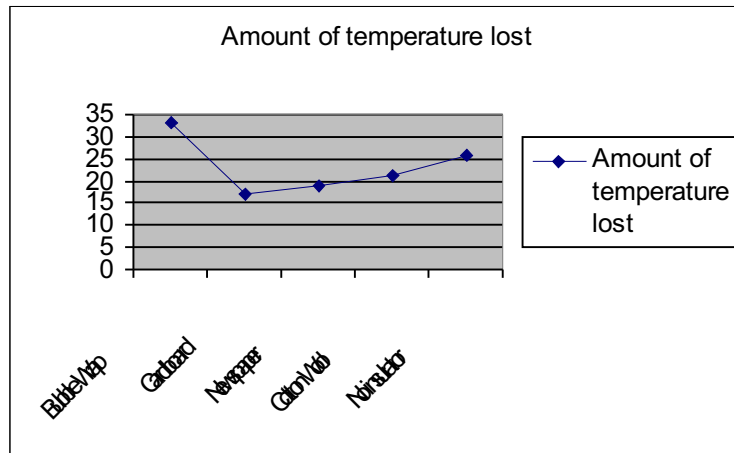
=Amount of temperature lost

65-39

=26

Graphs





Conclusion

In conclusion, we can see by looking at the results that cardboard is the best insulator. This means that my initial prediction was not correct, because cotton wool was only the third best insulator out of those we tried. I also discovered that wrapping a boiling tube in bubble wrap actually makes the amount of temperature loss increase, which either means the experiment went wrong or bubble wrap has some absorption qualities that increase the rate of heat energy transfer.

Evaluation

I think that the experiment was a success, and we had no major problems. We have clear, concise results that gave us the answer to our question – whether the best insulators contain pockets of air. To develop our ideas and our results, I would like to do an experiment on bubble wrap to find out why we came to the conclusion that we did, and whether our results were accurate or not.

Abbie Taylor