

Science coursework

Aim

To find out which makes the best insulator.

Materials to be tested

Bubble wrap

Wool

Carpet underlay

Polystyrene

Curtain material

Scientific knowledge

Conduction

Conduction transferred between solids through heat, thermal energy is passed through particles. Metal is an excellent conductor of heat as the particles in the metal are very close together. Solids conduct heat by vibration of one particle being passed on to the next when they bump together and the process continues. It is the most important type of heat transfer in solids.

Convection

Thermal energy is transferred through particles in liquids and gases, the particles do not have fixed positions they carry energy wherever they flow. As the heat is trapped and cannot escape it circulates. Air is heated and it rises when it cools it descends

Radiation

In radiation, which is known as infra-red as well, this is given off by hot objects and is absorbed by black surfaces but reflected by shiny or white surfaces. Radiation travels through waves and space. Hot objects radiate more heat than cold objects.

Insulator

An insulator is a material that will not allow heat to pass through it by conduction and it is a non-metal. Air is an excellent insulator because the molecules are too spread out to be able to transfer heat through conduction.

Bubble wrap stops heat escaping as it has trapped small pockets that have trapped air inside them and air is a poor conductor of heat so conduction is prevented. There is some loss of heat with radiation as there is no colour.

Wool has tiny pockets of air in between the fibres and air is an excellent insulator of heat so conduction is stopped, again air is trapped unable to escape so heat loss is reduced by convection. It is not changed through radiation, as it is neither black or white so it can't absorb or reflect heat.

Carpet underlay stops heat escaping as it has trapped air in its pockets and air is a poor conductor of so conduction is stopped. And convection is reduced because the air is trapped and cannot go anywhere so it circulates.

Polystyrene stops heat escaping as it has trapped air in its pockets and air is a poor conductor of heat so conduction is reduced. Convection is stopped because the air can't escape so it circulates.

Curtain material stops conduction as it has small pockets of air and air is a bad conductor of heat. The air is trapped and cannot escape so convection is stopped. Its white on the inside so radiation reflects the heat back in but on the outside it is a different colour so no heat is reflected or absorbed.

Prediction

My prediction for the best insulator is polystyrene because it reduces heat by conduction, convection and radiation. In conduction there is trapped air and air is a poor conductor of heat so conduction is reduced. With the air trapped inside and unable to escape so it has to circulate so there is a reduction of convection. The outer colour of the polystyrene is white so is the inside, it reflects heat from the inside back in but it also reflects heat out from the outside.

Plan

Equipment list

1. Aluminium can
2. Water
3. Water measurer
4. Kettle
5. Elastic band
6. Card board box
7. Thermometer
8. Stopwatch

- Wrap the material around the can
- Put an elastic band around the can
- Heat water with a kettle until boiling temperature
- Pour the water in the can using the measuring cylinder, fill it until 220 ml and then start the clock from 0

Control

The control is to compare two sets of results, and find out what the differences are between the two. This then will be used to find out the average

Fair testing

The variables that are kept the same are

The water should always be at the same level and the same amount of water should be used

The water should be at the same temperature

It should be recorded every one minute for the same fifteen minutes.

Variables that are changed

The room temperature changes gradually

Materials overlapping

Results

1	Material							
	Minutes	Carpet	Polystyrene	Wool	Curtain	Bubble wrap	No wrap	
	0	88	89	89	90	89	92	
	1	84	84	86	87	87	88	
	2	83	83	85	86	85	86	T
	3	82	82	85	85	84	85	E
	4	81	81	85	84	83	85	M
	5	80	80	83	83	83	83	P
T	6	79	79	82	82	82	82	E
I	7	78	78	81	81	81	81	R
M	8	77	77	80	80	79	79	A
E	9	77	77	79	78	79	79	T
	10	76	76	78	76	79	79	U
	11	75	75	77	75	78	78	R
	12	75	75	76	74	77	77	E
	13	74	74	75	72	77	77	
	14	73	73	75	71	75	75	
	15	73	73	74	70	75	75	
Temperature								

In the first set of results I measured the temperature every one minute for fifteen minutes starting from 0.

Averages

Number	Material	Results 1	Results 2	Averages
1.	Carpet	15	25	20
2.	Polystyrene	16	15	15.5
3.	Wool	15	18	16.5
4.	Curtain	16	20	18
6.	Bubble wrap	14	16	15
7.	No wrap	15	17	16
Temperature				

Conclusion

My results (averages) clearly state that Bubble wrap was the best insulator of heat. This was not my prediction as I predicted that the polystyrene would have been the best material but according to my results it was the second best insulator and it was bubble wrap that was the best. I have come to this conclusion through my averages as it states that bubble wrap has the lowest average temperature (15) therefore it is the best insulator of heat.

The most inefficient material was the carpet; this material has the highest average temperature (20) so it is the worst insulator of heat. I predicted the polystyrene so my prediction was wrong.

Evaluation

My evaluation is that I could have done a couple of things that would have improved my results, these include: I could have made the material smaller so it would not overlap. If I had stirred the water every minute and so on for 15 minutes, the parts that heat has not reached would have spread making it so that the temperature reached all of the water and inside the can. The result would mean that there would be an increase in conduction making it more efficient. If I secured the lid on tighter as there was a gap while I was doing the experiments no heat would have been lost through convection