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Science Heat Loss Investigation

Da don Ranjit dhillon'z coursework,

Introduction

In this investigation I will investigate heat loss and heat transfer in different materials and I will also investigate which materials are the best insulators. A material that prevents this heat loss is called an insulator and this helps to keep the object that is being insulated warmer for, longer. Heat is generally transferred in three different methods: -

- Conduction
- Convection
- Radiation

Conduction is energy transferred from the hotter part of a solid to the colder part of conduction. It is transferred by the particles in the material the particles in the hot part are vibrating more. These vibrations are passed on to the cooler particles next to them, so the energy spreads through the material until all particles have the same energy. Metals are good conductors, whereas most non-metals are poor conductors and poor conductors are used as insulators.

Convection is the transfer of energy by the movement of a liquid or gas. When a liquid becomes warm it expands and becomes less dense. The warmer fluid floats above the cooler fluid, which sinks. This creates a flow, which is called convection current.

Radiation is when bodies emit radiation. Basically the hotter the body, the more energy it radiates. Dark, dull surfaces emit more radiation than light, shiny surfaces. They also absorb radiation well. Light, shiny surfaces do not absorb radiation well – they are good reflectors. Radiation can pass through space – that is how the warmth of the sun reaches the Earth.

Also heat can be transferred by evaporation and this may be relevant in my investigation as I am dealing with water and the heating of water. Also evaporation is when the particles near the surface of a liquid and become a vapour. The particles that escape are those with higher-than-average energy – otherwise they would not have enough energy to escape. Because the liquid loses its higher energy particles, the liquid that is left has less energy, so it becomes cooler.
I will test two types of insulation to see which is the best at preventing heat loss I will use black card, and tin foil to insulate the beaker filled with water. I will also do this twice one in a small beaker and once in a larger beaker. I will investigate also if I use more water will this affect the heat loss. If I use more water will this hold insulate the water more? So overall I will have four sets of results.

Factors of the experiment

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In this experiment there are many different factors that could affect my experiment and the results I achieve, the factors are:

The amount of water used in each experiment - If I use a large of amount of water this will mean that the water will cool down slower and therefore stay warmer for longer. So the more water I use the longer the water will stay warm, so if I use a small amount of water it will cool down quick.
Type of Insulation I will use - This will change the amount of heat loss significantly. Different types of material insulate differently depending on how efficiently the material prevents heat loss. For example, if I use a good insulator it will stay warmer than a poor insulator that doesn't insulate effectively. If you include insulation around the beaker it will stay warmer for longer. Also the amount of times you wrap the insulation material around the beaker is another factor. The more times I wrap the material around the beaker the longer it will stay warm, and therefore lose less heat.
Covering the top of the container - Another factor will be if I cover the top of the beaker and therefore stop heat escaping through the top of the beaker this will stop convection and evaporation from taking place successfully as the heat can't escape from the top.

Making sure this test is fair

I will keep the amount of water the same for each test so I will have two tests measuring the rate of heat loss of 150 ml of water, and 100ml of water each using either black paper or tin foil for insulation.
I will also use the same starting temperature for each test. I will make 78 degrees the starting temperature for the 100ml beaker, and 76 degrees for the 150ml beaker and this will enable me to evaluate the heat loss rate accurately.
I will also use the same amount of insulation on each of the beakers. I will do this by making sure that the insulation only goes round exactly once.
I will also use a stopwatch so I can be accurate see when I need to record another temperature reading.

Safety Precautions

I will need to use safety precautions in this experiment as I am dealing with hot water which can cause harm if misused. I will:

- Wear Safety goggles to protect my eyes
- Be careful when pouring the water out of the kettle
- Also I will use a cloth to handle the measuring cylinder, as it will be considerably hot.

Prediction

I think that as the experiment goes on the rate of heat loss will slowly decrease so there will not be as big difference during the first few readings then toward the end.

Out of the two materials I chose to investigate I think that the tin foil will be the better insulator. We already know that shiny surfaces do not absorb radiation well reflecting heat back into the beaker, therefore will make the water warmer for longer.

I think that the black paper will a poor insulator and will not keep the heat in the beaker because the colour black absorbs heat and transfers it away so I think black card will not be a good insulator.

Also I think that the more amount of water I use in this experiment the more it will be insulated, and therefore stay warmer for longer. As we know already this as the outside of the water will cool down and the inside will stay warm.

Apparatus

- Thermometer
- 150 ml beaker
- 100 ml beaker
- Silver foil
- Black paper
- Kettle
- Sellotape
- Scissors
- Safety goggles
- Stop clock
- 250ml measuring Cylinder
- Black paper
- Tin foil
- Cloth

Diagram

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Method

- I will first of all put on my safety goggles
- I will then set up the apparatus in the correct way
- I will then need to cut out the insulators by using the scissors and sellotape
- Cover the two beakers and make sure that I cover it only once
- I will fill up the kettle and then wait for it to boil
- Once boiled I will pour the water into a measuring cylinder
- I will then measure out the correct amount of water I will need
- I will then pour the water into the beaker and place the thermometer into the beaker
- I will make sure that the starting temperature is at the correct temperature
- I will activate the stopwatch and take down the temperature every 30 seconds 15 minutes
- I will then do this experiment again 3 more times so I will have four sets of results.

Conclusion

As you can see from the graph that I have produced and my results table, they show that the rate of heat loss decreases when insulated by different materials. They results I had are very close together but we can see which insulator was the better. We can see clearly that the tin foil insulated the water better and this confirmed my prediction. Looking at my results I can see that the temperature decreased more with the black paper, as it was a poor insulator. By placing the tin foil around the beaker this helped to keep heat in and for it to stay warmer for longer. I stated in my prediction that from my own knowledge that any material, which is black, will be a poor insulator as it transfers heat away rather than keep it in. The tin foil as it has a shiny surface is a good insulator, I predicted that because from my own knowledge light, shiny surfaces do not absorb radiation well and also they are good reflectors.

Also I extended this investigation further by investigating whether the volume of water would affect the rate of heat loss and from my results and graph we can see clearly that if we compare both results the one with a greater volume of water decreases less. For example, the 150 ml beaker and 100 ml beaker the 150ml beaker didn't lose as much heat as the 100ml beaker. I predicted this in my prediction that the more water I use, the warmer the beaker will stay. And we can see from my results that this was very true.

Therefore from this investigation we can conclude that

- Wrapping a liquid container with a type of insulation material will affect the rate of heat loss, and help it stay warmer for longer
- Different materials insulate differently, some are more efficient than others. For example tin foil was a better insulator than black paper.
- Using a greater volume of water will affect the rate of heat loss. The more amount of water I use the warmer the water after I heat it, than a lesser volume of water this will decrease more rapidly.

Evaluation

I think that my results were reasonable as you can see that the different factors affected the rate of heat loss. Though the results are quite close together we can still which insulator is the best, and which factors affected the rate of heat loss. I think that the investigation went good as I kept the test fair and achieved my aim of getting good results and these results proved my prediction.

Also I received a few anomalous results there could have been many reasons for this. I could have read the temperature at a wrong time or the room temperature suddenly changed. I could have improved my experiment by doing it in controlled conditions and I was doing the experiment near a window, and this could have affected the results as it could have made it warmer or cooler.

The method I chose to use was successful and worked well within the investigation it was stable and fair. I would not change the method if I repeated the investigation as it worked well with the experiment.

Also to improve my investigation I could have done many things. I could have repeated the experiment again and took down the average results and this will make the experiment more accurate as one set of my results could have been affected. Also there would have been different temperatures within the beaker thought they would have only been slight differences. The temperature would be different with the water nearer to the glass compared to the water directly in the middle. So it would have helped if I stirred the water so I could get the general temperature.

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