Insulation experiment essay sample

Environment, Water

Why will insulators affect how long a test tube of hot water stays hot?

Background Information

I know that there are many different ways of insulating this test tube, shiny foil can be used because it's a poor emitter of radiation and it will reflect escaping heat by reflecting, because this method is used in flasks to keep hot drinks warm. Though it is a good conductor so will lose heat through to surfaces its touching but it shouldn't matter because it will be touching air and glass which both are really poor conductors. Bubble wrap, foaming and cotton wool can be used as an insulator because it will trap heat in air pockets and air is a poor conductor of heat, hence it will be a good insulator. I shall not use any black objects for insulation because black will radiate the heat greatly. I have found information from the internet, that the polystyrene will be the best in insulator. I will have to bung up the end of the test tube as well because heat will be lost by convection currents. By keeping the test tubes well insulator the water molecules should be zooming around in the water at the same speed for a longer time with all that trapped heat energy.

Prediction

I predict that polystyrene will be the best insulator against all the others. I think though it will result in the end being really close though and maybe another insulator will be better. The reason is polystyrene has a lot of trapped air in it, which will trap all that heat, plus it's a poor conductor and doesn't radiate heat through empty space. Though bubble wrap has lots of trapped air in the bubbles which makes it a good insulator. But my mind is still set on polystyrene to be the better insulator simply because it's got

loads of tiny air holes in it and it’s denser, so if any heat is tries to conduct through the polystyrene its go to go through a lot more air and polystyrene.

Key factors

In my investigation the things I can change, which are the dependent variables is the volume of water used because this will depend on how fast the water will heat up and lose heat. I can change what I heat up the water with maybe a Bunsen burner or a kettle. I’ll be using four different insulators, so I could choose what insulators I’m going to use, I could pick two good insulators and two really bad insulators so I can see how effective insulators are and see the difference in the qualities of each insulator in more depth. I could also change how much of the materials I will use, but they will be the same amount for each to make it fair. I will also need to control the starting temperature of the water, even though it will be hard to get the exact temperature. Lastly I can change the amount of time I heat the water up for and how long I leave into “ cool”.

Preliminary work

A small experiment has already been carried out. I heat up some water in a beaker using a Bunsen burner, heating the water up to boiling point which is 100’C. This was carried out to see how long the water cooled down without using any insulators. The water molecules slowed down really fast after heat energy was taken away. The temperature dropped rapidly down 30’C and to around about 70’C then had a constant and steady decline in temperature as it cooled. From this preliminary work, I know that I will need to keep as much

heat energy in the water so it only drops fractionally over a longer period of time.

Plan and Diagram

The equipment I’m going to use is 2 boiling tubes, 2 beakers, water, a tripod, wire gauze, Bunsen burner, thermometer, ruler, stop clock and polystyrene. I will use 10cm2 of polystyrene foaming. I will use 40ml of water in the each boiling tube. I will take measurements for the temperature at the start and end of the test. The measurements for the temperature will degrees Celsius (‘ C). For the volume of water, I’m going to measure it in millilitres (ml), I will measure how much material I use in centimetres squared (cm2). Lastly the time will be measured in minutes. I’m going to time each boiling tube for 10 minutes after boiling point has been reached.

To keep it a fair test, we will need to put 40ml of water into each boiling tube and make sure they are all the same starting temperature 100’C (boiling point) then turn of the Bunsen burner and let there cooling down times the same and each boiling tube is well insulated properly. These are the independent variables. The dependent variables will be the different materials and how much you use. These will be able to be manipulated but still keeping the test fair. Also if the independent variables are changed then the dependent variables outcome will make the experiment unfair.

To make my results accurate I will keep a good eye on the time and make sure the temperature should be taken when needed. Plus all results will be immediately recorded as soon as collected, so no results are left out.

For safety all equipment will be used for it’s use only and nothing else, also no running in test area or lab, all long hair tied back, goggles on always, boiling tube faced away from any students near by.

To make my results reliable I’ll write down my results on to ready to use result tables as soon as information is recorded. All the tables will have relevant headings (temperature, time and material) and then put onto graphs of best suit and make sure that everything has been checked and looked at so any anomalies.

My neat results will be recorded on graphs and big clear tables which will have the corresponding units as well for each measurement. This is to make data easy to read and understand.

Method

Firstly equipment was got out and primed for use for the experiment. Equipment used was a thermometer, Polystyrene foaming, 2 beakers, 2 boiling tubes, measuring cylinder, and stop clock.

First practical part of the experiment which was done was heating the water with the Bunsen burner which took a few minutes. Both boiling tubes had 40ml of hot water in them with the thermometers which the start temperature was 100’C for all 3 experiments for both boiling tubes. Plus I filled the second beaker with polystyrene foaming, which would hold the boiling tube number 2. I filled the second beaker to the brim with polystyrene foaming.

The boiling tubes were then timed for 26 minutes; the temperature was taken every 2 minutes. Then made all the readings were correct and then we packed away the equipment after 26 minutes.

This experiment was taken another 2 times to get a wider range of results which would help on the accuracy of the averages which will be plotted on a line of best fit graph.

Insulation Experiment Results

Material Nothing ” ” Polystyrene ” “

frequency 1 2 3 1 2 3

Start temperature 100’C 100’C 100’C 100’C 100’C 100’C

2mins 62’C 67’C 63’C 64’C 66’c 70’C

4mins 56’C 64’C 58’C 61’C 63’C 67’C

6mins 54’C 60’C 55’C 59’C 60’C 62’C

8mins 51’C 56’C 52’C 57’C 58’C 62’C

10mins 49’C 53’C 50’C 54’C 56’C 58’C

12mins 46’C 50’C 47’C 52’C 54’C 57’C

14mins 44’C 48’C 45’C 50’C 52’C 54’C

16mins 42’C 45’C 43’C 49’C 50’C 52’C

18mins 40’C 43’C 41’C 47’C 49’C 50’C

20mins 39’C 42’C 40’C 45’C 48’C 48’C

22mins 37’C 40’C 39’C 44’C 46’C 47’C

24mins 36’C 39’C 37’C 42’C 45’C 46’C

26mins 34’C 38’C 34’C 40’C 44’C 45’C

Nothing Polystyrene

Average (‘ C)

0mins 100 100

2mins 64 66

4mins 59 64

6mins 56 59

8mins 53 56

10mins 50 56

12mins 48 54

14mins 46 52

16mins 43 50

18mins 41 48

20mins 40 47

22mins 39 46

24mins 38 44

26mins 36 43

Insulation Conclusion

My results turned out mainly what I had predicted that the insulated one will be hotter for longer than the un-insulated one. The experiment was taken out 3 times. This overall did help us get more accurate results but if we had only done this experiment twice it would have been hard to get a clear picture of what generally happens.

The experiments were clear and easy predictable results. I did expect this to happen, I think we had a sufficient time and weren't in such a rush that we got dodgy in reliably suited results. I think that there was great accuracy and judgement when pouring the water into the boiling tubes; hence we got no odd and strange anomalous, but we don't know because we did not do any other experiments to find this out.

All the experiments turned out the same for each the insulated one and the non-insulated one. So the experiment must have been accurately taken out 3 times. My results show that the insulated boiling tube temperature was staying up above the normal boiling tube temperature for every time the experiment was taken except for the last experiment. The insulated tube had dropped slightly lower than the normal tube after 2mins. But this changed

back around after another 2mins. But the polystyrene foaming was only around the out side of the boiling tube and the glass is a poor conducted, so that’s why the results were not very far apart from each other. Overall the polystyrene foaming did trap heat in the air pockets, meaning that the water did lose heat slower than the un-insulated one did.

This answers my question “ why will insulators affect how long a boiling tube of hot water keep hot.”

Because I have found out from my results that insulators do trap in heat adequately but not sufficiently to keep the heat a lot longer. I feel that all the areas would need to be sealed up e. g. the lid because more heat would be lost by convection currents than the glass sides conducting it outwards through the beaker.

Insulation Evaluation.

I think mainly my results were accurate on all experiments. They were very accurate because it worked with a lot of accuracy of timing and measuring. I didn’t have any inaccurate results from my experiments, because there was enough time and easy pace to get it all done. This meant data collecting and presenting was a lot easier because there were no anomalies. Are results were taken accurately because we measured and heated the water the same for every experiment. Also we took each experiment for 26minuteseach time and put took in readings as quick as possible. I don’t feel that we could have made the experiments with more accuracy than what was done.

The experiment could have not been improved, but there should have been more tests taken, making it our results more reliable. Also this experiment could have been made to see if insulators would work with other liquids. E. g. coffee

The experiment could have been extended by having the 5 different insulators for a lot bigger, so we would of seen a wider variety of insulators and maybe that there could have been a better on than polystyrene foaming. It would have made it more interesting. The practical work made looking at the problems more simplified and easier to understand on what the insulation was doing to keep the heat in.

The best part of the experiment for me was that all the results were collected and that they were accurate and reliable enough to give us a better picture of insulation.

I don’t think I would improve the experiment because it was simple and easier enough to do in a short amount of time. But I reckon we have had enough time so we enough time to get reliable and accurate results.