

Abstract

What did we do?

We conducted an investigation which involved us in trying to find out if polystyrene keeps temperatures constant by putting containers of hot water in polystyrene boxes or leaving them as they were. We measured the temperature of the water and found out that the hot water in the polystyrene boxes kept the most constant.

Why did we do this?

We thought that energy bills such as heating bills and gas bills are becoming more expensive. If we could think of a way other than gas heating and fire places to keep our homes warm, we could save money, valuable resources and energy.

How did we do this?

We had 4 take away tubs filled with boiling water, we put two of the take away tubs in a polystyrene box, after 10 minutes we measured the temperatures of the water with 4 thermometers. (1 thermometer per takeaway tub) We continued to measure the temperature of the water for the next 30 minutes.

What did we find out?

We found out that the take away tubs that were in the polystyrene boxes kept the most constant temperature. At the time when we conducted the experiment, we hadn't done much research. We thought that because the take away tubs in the polystyrene boxes were in an enclosed space the air inside the box kept warm from the heat source (the boiling water).

Conclusion

Polystyrene is obviously a very good insulator as there was a big difference in the temperatures of the take away tubs-the tubs in a polystyrene box had the most constant temperature as for the take away tubs without a polystyrene boxes' temperatures dropped dramatically.

Introduction

Background Research Findings - Why it is of interest, what is already known and what have others done?

Polystyrene is a hard stiff synthetic resin, produced by the polymerization of styrene. It is widely used in the food-service industry as disposable trays, containers, eating utensils, foamed cups, plates, and bowls.

Polystyrene is also copolymerized, or blended with other polymers eg: polyethylene, polypropylene, polyacrylonitrile, polyisobutylene and many other polymers to polystyrene to give hardness and stability to the plastic.

- In 1839, polystyrene was invented but only in 1954 it was made useful. Styrofoam was the trademark for polystyrene insulation
- EPS or expanded polystyrene is made from a rigid cellular plastic with an expansion agent in it.
- . EPS is made from oil and the raw material for EPS is produced from some small polystyrene beads containing a blowing agent, or pentane, which when is exposed to steam, expand to form a light "pre-foam" of required density. This pre-foam is then processed by further steam treatment until the beads melt together, either in a mold to give that material a specific shape and size or as large blocks for cutting up
- EPS is one of the most widely used polymers in the world
- EPS dramatically reduces the energy used in a common household by 30% when a house is insulated with Styrofoam ,as it keeps the house cool in summer and warm in winter
EPS has no impact on the environment when it is being manufactured as only 0.2 of the man-made gasses is made up of EPS production

Information gathered from experts who have background knowledge (Dr Tracey-Ann Palmer (PhD))

Polystyrene is thought to keep temperatures constant, as it is what's called a Thermal insulator. Thermal insulators are a type of material eg: polystyrene, plastic: which stops heat flow to the outside or lower temperature and traps hot air from the hotter temperature. However conductors eg: metal, glass: let heat through from the outside or lower temperature into the warmer temperature. Conductors can be double layered eg: metal on the outside and glass on the inside to create thermoses to keep things hot. This is because the air in between the two surfaces gets hot and the outside temperature gets reflected allowing the air between the two surfaces remain warm.

Aim / Purpose

It is widely thought that polystyrene is a reliable insulating material. The aim of our experiment was to investigate the effect of polystyrene in preventing or slowing down heat loss in water compared to an uninsulated control sample of warm water. We examined the effectiveness of the insulation over a specific time to find out if warm water that is kept inside polystyrene boxes stays warm for longer than water that is not kept inside polystyrene boxes.

Hypothesis / Prediction

If we change the container in which we place 4 plastic tubs containing warm water, by placing two tubs in two different polystyrene boxes, for example: *by putting 2 take away tubs with boiling water in a polystyrene box with a lid and leaving 2 take away tubs as they are. Then measuring the water temperature using a thermometer*, **THEN we think / PREDICT** that the take away tubs in polystyrene boxes will keep the water the most constant temperature because polystyrene is used as take away containers and **some** people insulate their houses with it.

Variables

Independent Variable

The Independent Variable which is what we **changed** in in this experiment is whether the take away tubs with boiling water are in a polystyrene box with a lid or not.

Dependent Variable

The dependent variable which was what we **measured** in this experiment was the temperatures of the water because our experiment is about finding out if polystyrene keeps temperatures constant.

Controlled Variables

The controlled variables were all factors that we **kept the same**. These include: the size of our polystyrene boxes, the amount of water we put in the takeaway tubs, the type of takeaway tubs we used, the heat of the boiling water (58°), the thermometers that we were to measure the heat of the water and the time that the temperature of the water was measured.

Materials & Methods / Procedure

Put 2 polystyrene boxes on a cleared desk
Fill up a kettle and put it on a boil
Pour boiling water into a jug
Measure water temperature with a thermometer
If the temperature of the water is not 58° add more cold or hot water accordingly
Pour 200mls of 58° water in each of the four beakers
Pour the water in the beakers in to each of the four take away tubs
Put 2 of the take away in a polystyrene box
Quickly put the lid on the polystyrene boxes and start your stopwatch
After 10 minutes take the temperatures of the water in the take away tubs using a thermometer
Repeat to take temperatures 5 times

Risk Assessment

As scientists we had to think of all the potential risks of conducting an experiment
As a result of not using equipment correctly all these things could happen:

- Beakers and thermometers are made of glass. If someone dropped a beaker or a thermometer another person could go to clean up the glass and get it stuck in their hand. If not treated immediately open cuts can lead to serious infection
- Boiling water could spill and severely burn someone
- Steam from boiling water severely could burn someone
- Someone could accidentally touch the kettle and burn themselves
- Someone could be silly and spill hot water and burn someone else

Table of Results

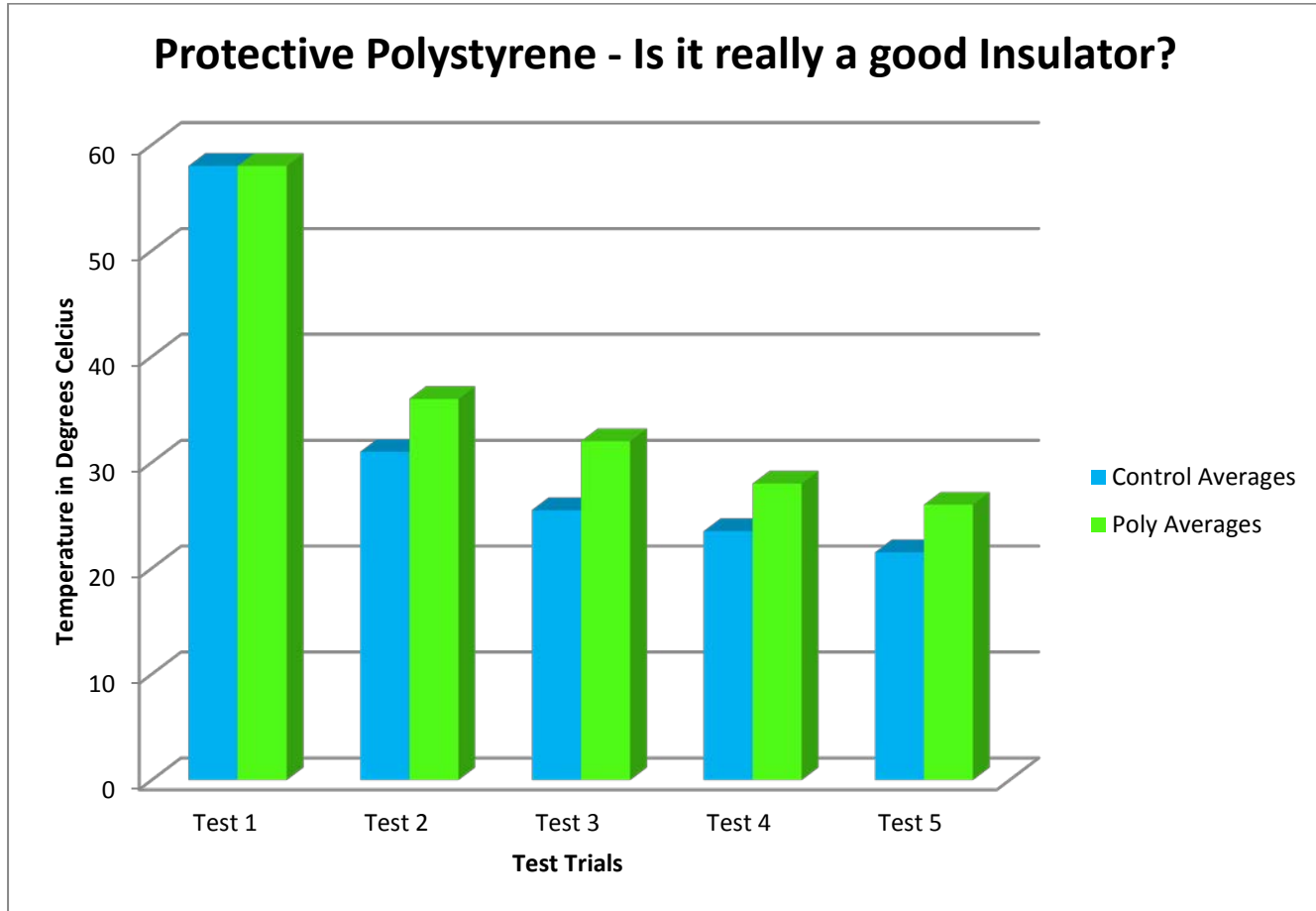
Table of Results – ‘Protective Polystyrene’

	Date:19 th May Test 1	Date:19 th May Test 2	Date:19 th May Test 3	Date:19 th May Test 4	Date:19 th May Test 5
Control 1	58°	32°	23°	23°	22°
Control 2	58°	30°	28°	24°	21°
Control Averages 16/07	58°	31°	25.5°	23.5°	21.5°
Poly 1	58°	36°	32°	27°	26°
Poly 2	58°	36°	32°	29°	26°
Poly Averages 16/7	58°	36°	32°	28°	26°

Table of Results - Explanation

In the table of results, we can see that the average temperature of the control tubs decreased from 58 degrees to 21.5 degrees. In the polystyrene tubs (Poly 1 & 2), we can see that the average temperature dropped or decreased from 58 degrees celcius to 26 degrees. This tells us that the temperature of the liquid in the control tubs decreased more quickly than the liquid in the polystyrene tubs. Therefore, the polystyrene tubs helped to keep the temperature more constant, slowing down the loss of temperature of the liquids.

Graph



Graph Explanation

In the Graph we can see in Test 2 that the temperatures in the controls have gone down from 58° to less than 35°. We can see by the green columns, that the temperature is dropping at a constant rate, but that the polystyrene temperatures (green columns) are always higher than the temperature of the control. In the final average temperatures, the poly temperature is 26° whereas in the control it is 21.5°. This shows that the polystyrene tubs helped to keep the temperature of the water from dropping and they provided some form of insulation to slow down the rate of decrease in the temperature of the water.

Discussion

Describe any trends / patterns

- The control average temperatures were always lower than the polystyrene average temperatures
- The temperature of the water dropped the most at the beginning of all the tests, whereas nearing the end of the tests the temperature didn't decrease as much

Can you explain the trends?

- The control average temperatures were always lower than the polystyrene average temperatures because the take away tubs in the polystyrene boxes were in an enclosed space and polystyrene is a type of material called an insulator. When something is in an inclosed space all the hot air gets trapped inside the object and it drains out slowly. With a material with the properties of an insulaltor the draining out of the hot air takes place very gradually or slowly.
- Temperatures of the water dropped the least towards the end of the test because more warm air got trapped in the polystyrene boxes and stabilised the water temperature. As for the control boxes,the same thing happened. As the control boxes temperatures were 21 °.
- How could you improve the study?

We think we could improve this study by situating our experiment in a different location as it was right next to a door, which could have contributed to the more rapid loss of temperature in the exposed tubs.

Discussion continued...

- Fairness, bias, accuracy, replication

As hard as we tried we could not complete our test completely accurately for the following reasons:

- We poured the water into each take away tub about 40 seconds apart. This could have affected our results because when water is in a small amount it loses heat more rapidly.
- We left the thermometers in the take away tubs for slightly different times. This could have affected our results by some tubs having a slightly different temperature to what it was supposed to be.
- Any ideas for future work
- We could test the insulating properties of polystyrene by comparing it to more insulating materials eg: cardboard, plastic. This would give us a clearer idea on how good the insulator polystyrene really is. We would conduct the investigation exactly the same as our original investigation except we would add in the other materials (cardboard,plastic).

Conclusion

Do your results support or disprove your hypothesis?

Our results supported our hypothesis because we thought that the take away tubs in the polystyrene boxes would have the most constant temperature. This happened in our experiment as the two tubs that were not kept inside the polystyrene boxes had the greatest loss of temperature whereas the two tubs inside the polystyrene tubs maintained a more constant and higher temperature for longer.

Useful Applications

How is this information learnt in this investigation useful to us and society?

People can save money and energy by insulating their house with polystyrene or Styrofoam. This would help reduce energy bills dramatically in both the summer and the winter. People can also keep their food that either needs to be hot or cold in a polystyrene box. Polystyrene is both cheap and works well so it could also be either recycled or disposed of with little loss of expense.

References

<http://www.britannica.com/science/polystyrene>

<http://www.polystyrenepackaging.co.za/educationalinformation.htm>

Acknowledgements

1) Teacher

We would like to thank Mrs Venish for giving ideas about our experiment, giving us time to conduct our tests and for helping us edit our work

2) Other students

We would like to thank Alex M and Amelia H conduct our experiment and organise the equipment.

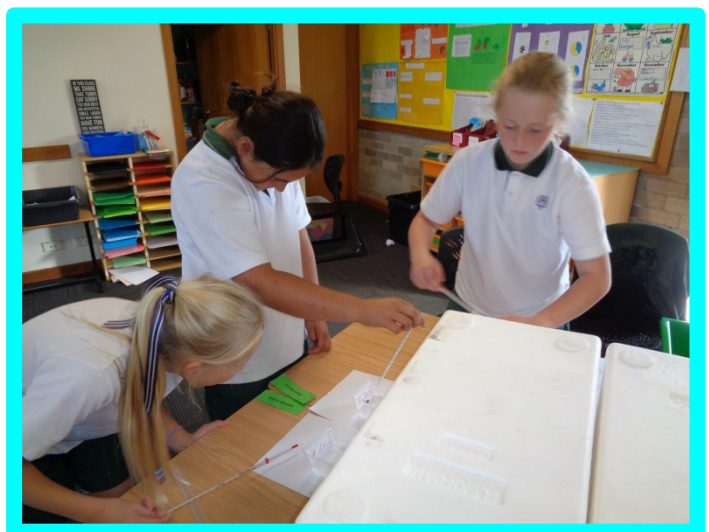
3) Outside experts

Dr Palmer helped us with some ideas for research

Scientific Log / Journal

Date: 28/4/2015

Journal: We started our investigation by thinking about real problems that needed to be solved which could be used in our science investigations. As a class, we brainstormed a variety of ideas for problems to investigate. Some of us came up with the idea that, energy bills are getting such as electricity bills and gas bills are becoming



more expensive. Having a result on people not being able to afford these bills.

We posed investigation questions and our question was: does polystyrene really keep temperatures constant?

19 May 2015

Next we had to think of our group roles so everything went smoothly .we had a vote for who should be what role .it ended up as:

Director	Speaker
Maya	Emma

21 may 2015

Group planning: Our teacher explained to us some of the things we need to think about whilst doing our experiment, here are some of them;

Aim/purpose: to investigate if polystyrene keeps temperatures constant.

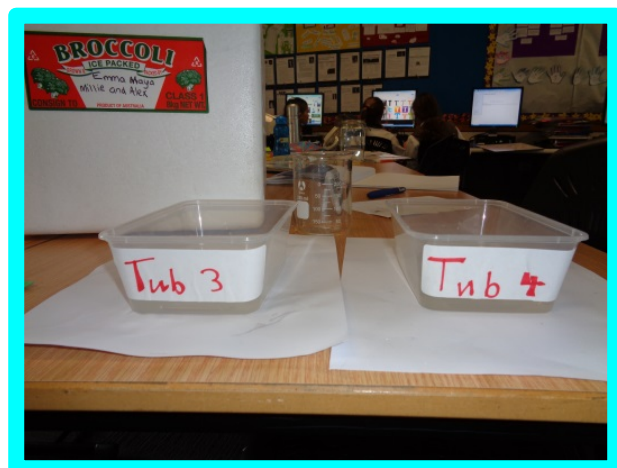
How do we plan to carry out the investigation? We will have x2 polystyrene boxes and x4 take away tubs filled with hot water. We will put x2 take away tubs inside the polystyrene boxes. We will measure the temperatures of the take away tubs with thermometers.

Hypothesis: If we change the surrounding that the take away tubs are in (the independent variable) by having 2 take away tubs in polystyrene boxes, then we think that the tubs in the polystyrene boxes will keep the water the warmest because polystyrene take away containers are used and people insulate their houses with polystyrene.

Background research 1 June 2015

We now started to conduct our background research on polystyrene. We were trying to find out wat polystyrene is , how it is made and why the food industry uses polystyrene so much

5 June 2015



Planning: Next we completed a “Cows Moo Softly” scaffold chart to consider the variables of fair testing. The **C** in “cows” stands for what will we **change**? We thought that we could change if the x2 of the take away tubs are in a polystyrene box or not. The **M** in “moo” stands for what will we **measure**? Obviously we would measure the temperature of the hot water in the take away tubs. The **S** in “softly” stands for what will we keep the **same**? This is what we thought we would keep the same: the temperature of the water, the thermometers, the time that temperatures are measured, the quantity of water that was put in the take away tubs, the size of the take away tubs and the type of tubs.

After this we had to list our materials, we would need:

- 4 plastic take away tubs to put boiling water
- 2 polystyrene boxes to put take away tubs in
- 1 kettle to boil the water
- Water supply: in our case a tap
- 4 thermometers to measure boiling water
- 1 recording sheet to write results
- 4 beakers to measure the boiling water

9 June 2015

We were almost ready to conduct our investigation but we had to write up a procedure first. Our procedure had to include every single step of the experiment and it had to be sequenced in a logical order.

Our procedure:

- 1) Put x2 polystyrene boxes on a big cleared table or bench
- 2) Position x4 take away tubs on the same table or bench
- 3) Fill a kettle up with water
- 4) Put the kettle on boil
- 5) Measure the temperature of the water with thermometer
- 6) Add more cold or hot water to make the water temperature 58°
- 7) Pour 200mls of water into a glass beaker repeat x3 times

- 8) Tip the beaker of water in each of the take away tubs
- 9) Put x2 of the takeaway tubs in the polystyrene boxes
- 10) Put a the lid on the polystyrene boxes
- 11) Wait 10 minutes and measure the temperature of the water with a thermometer
- 12) Repeat 3 more times

Experiment results: 12 of June 2015

Our experiment went successfully! When we drew our conclusions they were that: the polystyrene was effective keeping temperatures constant. But the take away tubs without a polystyrene box failed to keep a constant temperature as the heat dropped dramatically.



1 July 2015

We conducted another experiment and found the same results –the take away tubs in the polystyrene boxes had the most constant temperature. We had enough data to start a document in which we could record everything we learnt .

3 July 2015

We decided to expand on our background research and start a document with all our reaserch in it.

3 August 2015

Dr Tracey Palmer who recently completed her PhD made a visit to our school and gave us valuable background information

18 August 2015

From the 3rd of July to the 18 of August we worked on our final document until it was finished.