Contents

Introduction

What makes a coffee special to you?

> *"It is the most amazing caffeinated beverage in the world and it has everything in it I need to get me through the day."*
>
> Benjamin Gibson – Year 12, HSC Student

> *"The flavour. It is sort of refreshing and a warm luxury on a cold winter's day. I look forward to having it every day."*
>
> Krystina Jones – oldest of four younger sisters

> *"It has the marvellous ability to get you up and going again. It makes life that much easier. I don't know where I would be without it."*
>
> Jenelle Seaman – High School, maths teacher

This is just what a few people had to say on how much they need coffee in their lives. It gives us a kick to get through a night of studying or heat infusion on a cold day, but how do take away cups keep the coffee inside them warm?

Coffee Shop

I was out with my Mum for a shopping trip earlier this year and we decided to stop for a coffee in a food court. There was different types of places there that sold coffee and I wanted to go to my favourite café and Mum wanted to go to a different place. We both ordered coffee at the same time and received them at the same time but as we sat down we got to talking about what we had bought, and where we were going next. When we pick up our coffees to start drinking them, Mum's was much hotter than mine was. I wondered why this was.


People enjoying their Coffee

I thought it might have something to do with how the coffees were made. If there was more milk in one or if one was made with slightly cooler water etc. But then I wondered if the cups the coffee was in had anything to do with the difference in temperature. I asked my Mum if she knew why the temperature difference was so dramatic and when she said that she guessed it was how they were made but didn't really know. I had an idea.

In class the day before, our science teacher had told us that we would have to do a science project for our school marks but we could also enter a project into the Young Scientist Competition. My teacher said that it would be a good idea for us to start looking for ideas that we could use. When I found this question with the cups, I thought that I could test a whole lot of different cups and see if there was a difference in how long their contents stayed hot.

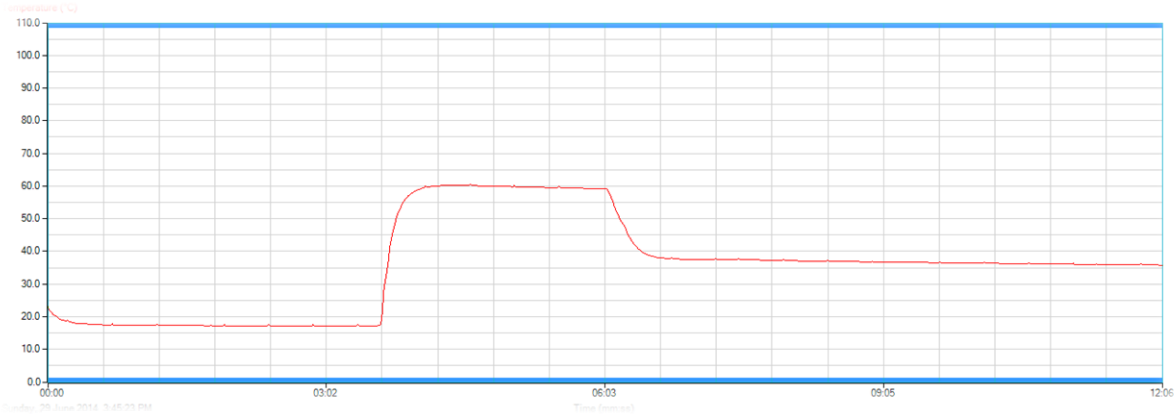
I Decided to Use Water

I took this idea back to my science teacher and asked him if it was a good idea, he said it was, and he gave me some ideas on how I could go about this experiment and some things I would need to do to get the right results. I decided that I would test hot and cold *water* in the cups instead of coffee because it was easier, more easily accessible and cheaper to get than coffee is.

Data Logger

I decided to try and set up a system where I could measure how much heat is lost by the coffee, either from temperature of from the cup absorbing it. Then I found an experiment that used calorimeters to test the difference in temperatures.

To find the heat a cup absorbs I had a particular cup with an amount of cold water in it, measure the temperature of that water. Then I also had a control cup with the same amount of boiling (hot) water in it and I measured the temperature of that water and what the decrease in temperature was of that water over a period of time. Then, I combined the hot and the cold water in the cup I tested and see how much heat is lost from the water. After this I asked my maths teacher if she would help me work out a calculation that I can use for all of my cups. To measure the temperature of the water I used a data logger which, every 30 seconds, automatically records the temperature of the water. With this information it makes a graph and I printed out all of the recorded times as well as the graphs.



Cup 1 Graph

With these I worked out the calculation of the calorimeter constant. This is a measurement of how much heat the calorimeter (coffee cup) has absorbed. The first one I tried worked very well which was a good start to my experiment.

I also created a website where my experiment, pictures and results of my investigation can be found. I made this so that anyone can see, have a say and share their experiences, both good and bad, about their coffee trips and the cups involved.

Sidengo.com/coffeecup

Aim

My aim is to test a range of take away cups from popular cafés, and see which of these cups keeps the coffee inside them the hottest for the longest amount of time. I want to see which outlet a person should go if they want to have the hottest coffee.

Background Research

I can still remember being told in primary school Science classes that energy cannot be created or destroyed, it just changes form. And I have always wondered since then where does the energy go? Why do my hands get hot when I rub them together, but my coffee gets cold when I leave it too long? Why is my cup of coffee not boiling hot when I add the boiling water to a cold mug with a small amount of cold milk?

I discovered the word "Calorimetry". Calorimetry is the science of measuring a quantity of heat, which is expressed in joules, J. A calorimeter is the instrument used to measure the amount of heat. The most commonly used calorimeter in laboratories today is the humble Styrofoam cup! To measure the amount of heat, all you need is a thermometer (plus a few other things)!

If two objects at different temperatures are brought together, there will be a transfer of energy between them until both objects are at a thermal equilibrium. This means that both objects will have the same temperature. Energy would have moved from the object with the higher energy, to the object with the lowest energy. The change in temperature of each object is related to the objects **heat capacity**.

The heat capacity of an object is the amount of heat required to raise the temperature of the object by one degree Celsius. For example, metal spoons have a low heat capacity because they can conduct heat and heat up easily, while wooden spoons would have a high heat capacity because they are insulators and do not readily heat up.

In the perfect world if the same amount of water at two different temperatures were mixed, the resulting temperature should be the average of the two temperatures. For example, if 75 mL of hot water at 80 ^{o}C was added to 75 mL of cold water at 20 ^{o}C in a perfect cup, the result should be 150 mL of warm water at 50 ^{o}C. However, this does not happen. The resulting temperature is always less than 50 degrees C. Why? The two liquids being mixed together are the same, so they must both have the same heat capacity … so where did the extra energy go? This got me thinking that if this obviously happens with a Styrofoam calorimeter, then it must also happen with takeaway coffee cups that are purchased by the millions everyday around the world.

I found out that I could measure the heat capacity of takeaway coffee cups by measuring the change in temperature when I mixed a fixed amount of hot and cold water inside the cup. Water has a specific heat capacity of 4.18 J/g/^{o}C which is a constant. So if I know the mass (or volume) of the water as well as the change in temperature, I will know how much heat has been lost or gained by the equation

$$Q = m \times C \times \text{change in } T$$

where Q is heat, m is mass and T is the temperature.

Some of the heat may have leaked out into the surroundings, or warmed up the thermometer, but most of it would have been absorbed by the calorimeter coffee cup, which is called the Calorimeter Constant or the Heat Capacity of the Coffee Cup. The thermal properties of the calorimeter should be reasonably constant. This means the Calorimeter Constant equals …

Calorimeter Constant = (heat lost – heat gained)/change in temperature of water in the cup

Sample Calculation:

As an example of a calorimeter constant calculation, let us assume that the final temperature of the system mentioned before was 40 ^{o}C . The calculations would be as follows.

Heat Lost = 75 x 4.18 x (80 – 40) i.e. decrease in temperature

= 12540 J

Heat gained = 75 x 4.18 x (40-20) i.e. increase in temperature

= 6270 J

Calorimeter Constant = (12540 – 6270) ÷ (40-20)

= 313.5 J/^{o}C

I have assumed the mass and the volume of the water is the same, as I needed to measure the water mass/volume quickly, otherwise the temperature would have changed too much. This is a valid assumption as the density of water is approximately 1.00 g/mL. Further, I have used tap water, as that was the most readily available and I do not think that this will make any significant difference.

Q. How to calibrate a Coffee Cup (calorimeter)?

Question from my website.

A. By Measuring Heat Loss.

Calorimetry is the measurement of changes in heat. A calorimeter is an insulated vessel used in the measurement of heat changes; while minimising the heat exchange between the contents and the surroundings.

The Heat capacity (calorimeter constant) of a calorimeter is equal to the heat absorbed each time it is used. It is the amount of heat required to raise the temperature of a substance by one degree.

The larger the Calorimeter Constant of the coffee cup the more energy is needed to raise the temperature of the contents. More energy is absorbed by the coffee cup, ensuring the contents will have less energy.

Hypothesis

I think that the results from this experiment will show that the thicker and denser cups are the ones that will be the best insulators. The cups made from foam with the thickest walls are the ones I presume will have the lowest Calorimeter Constant.

Risk Assessment

This is a relatively risk free experiment. The only risks that I encountered are as follows.

- I used hot water to do testing, so I made sure that at all times I was using a heat proof container to take the hot water from the saucepan and, also, to pour into the measuring cylinders.
- I used a hot stove or a kettle, so I made sure to only have the water on a low boil so that the surfaces were not as hot.
- In my experiment, I used a long temperature probe that stuck out the top of the cup. I was very careful to always have the probe facing away from me and not to knock it over.
- I was using some expensive equipment during experimentation. The data logger and my computer are going to sit right next to where I am pouring and mixing water. I kept the area dry with paper towels and I did all of the pouring on a tray to minimise any spillage.

Variables

Independent Variables

- The different types of cups tested

Dependent Variables

- The calorimeter constant of each of the cups

Controlled Variables

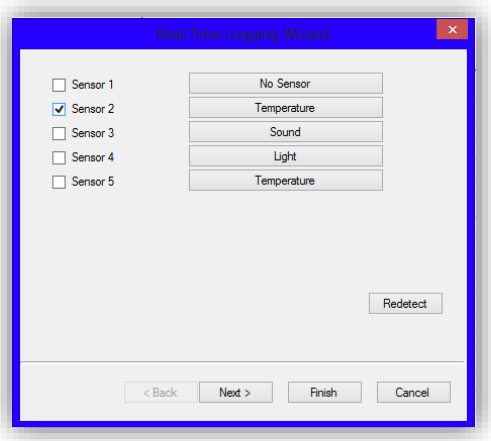
- I kept the measuring cylinders for the hot and cold water the same for every experiment
- I did not change the control cup for measuring the temperature of just the hot water
- I used the same data logger for all experiments
- I used the same probe in every experiment
- I kept the room temperature relatively the same by doing the experiment in an air conditioned room
- I kept the amount of water I used the same for each set of experiments, i.e. 100 mL for smaller cups and 180 mL for larger cups

Method

Data Logger software

Before Recording Data

1. Install the data logger's software onto a computer.
2. Change settings on the data logger so that it can read to 100°C or above.
3. Plug in the data logger to the computer and set up the computer to record the information into a graph.



Only measure temperature

4. Change the settings so that only temperature is being measured, through one probe.

Recording Data

5. Place a saucepan on the stove with water in it, set it to boil.
6. Set up a work space, label the cups '1, 2, 3…' etc. and put the cups that are being tested in a row.
7. On a board or tray, have two 100mL measuring cylinders, where the amount of water will be measured. Label one measuring cylinder, 'hot' and the other 'cold' so that the water will be measured by the same measuring cylinders each time.

Boiling water on the stove

8. Then have the cup that will be measured first (Cup 1), and a control cup (the same cup used each time to measure the temperature of the hot water), in the middle of the tray.

Measuring Water

9. Fill the cup that is being tested with 100mL of cold water and cover with lid.
10. Place the probe from the data logger into the hole in the lid of the cup, and leave to rest.
11. While the probe is resting, label the results sheet with the cup number, the date and the amount of water that is being tested.
12. During this time, measure out 100mL of hot water and pour it into the control cup, ready for the experiment. Place the lid on the control cup.
13. Press the start button and watch the graph on the computer. The probe is measuring the temperature of the cold water.
14. Every thirty seconds write down the temperature that is displayed on the screen.
15. When it gets to 3 minutes: quickly pull out the probe, wipe it dry with some paper towel and place the probe into the control cup with the hot water.
16. Watch the screen and again record the temperature every thirty seconds, on the results sheet.
17. When it gets to 6 minutes: swiftly pull out the probe, remove lids, and pour the hot water into the subject cup with the cold water, put the lid back on, reinsert the probe and then give the cup a swirl to mix the water.

Combining hot and cold water

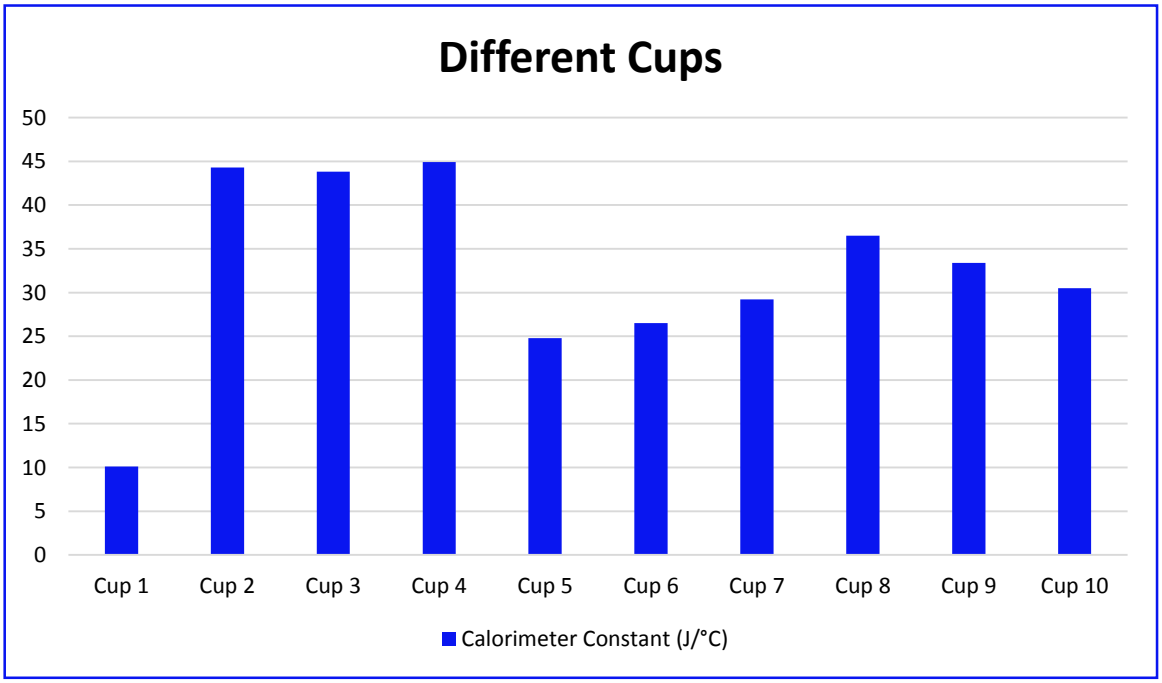
18. Record the results for the next 6 minutes on the results sheet.
19. When the time gets to 12 minutes, stop the recording and save the graph.
20. For the rest of the cups repeat steps 10 – 20.

Results

In total I tested over 40 cups, this was done over a period of a month. I have found out some things that were very interesting. As soon as I had collected the data from my experiments I printed them out and did calculations straight onto paper. All of my results, readings, graphs and evaluations can be found in my 2 appendix folders. The first one holds all my results for the 10 random cups, Styrofoam cups and the McDonalds cups. In the second folder are all my results for Gloria Jeans, Muffin Break, Donut King, The Coffee Club, Michel's Patisserie and The Little Rock Café cups.

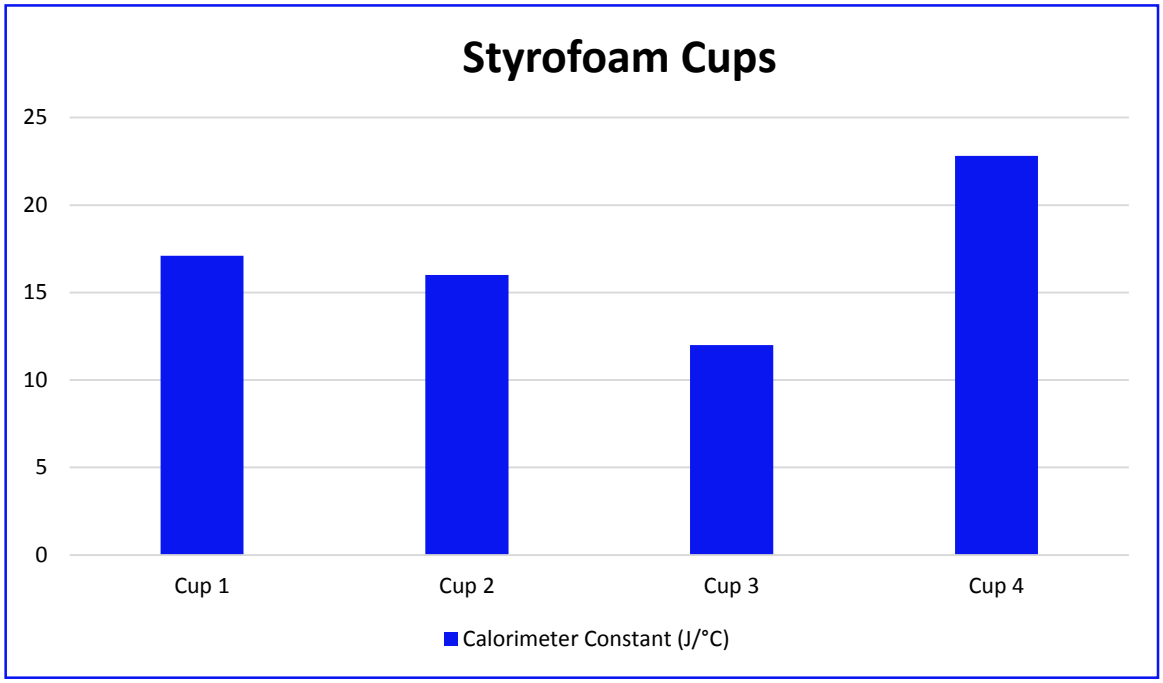
For each of these experiments I have found:

Different Cups	Calorimeter Constant (J/°C)
Cup 1	10.1
Cup 2	44.3
Cup 3	43.8
Cup 4	44.9
Cup 5	24.8
Cup 6	26.5
Cup 7	29.2
Cup 8	36.5
Cup 9	33.4
Cup 10	30.5



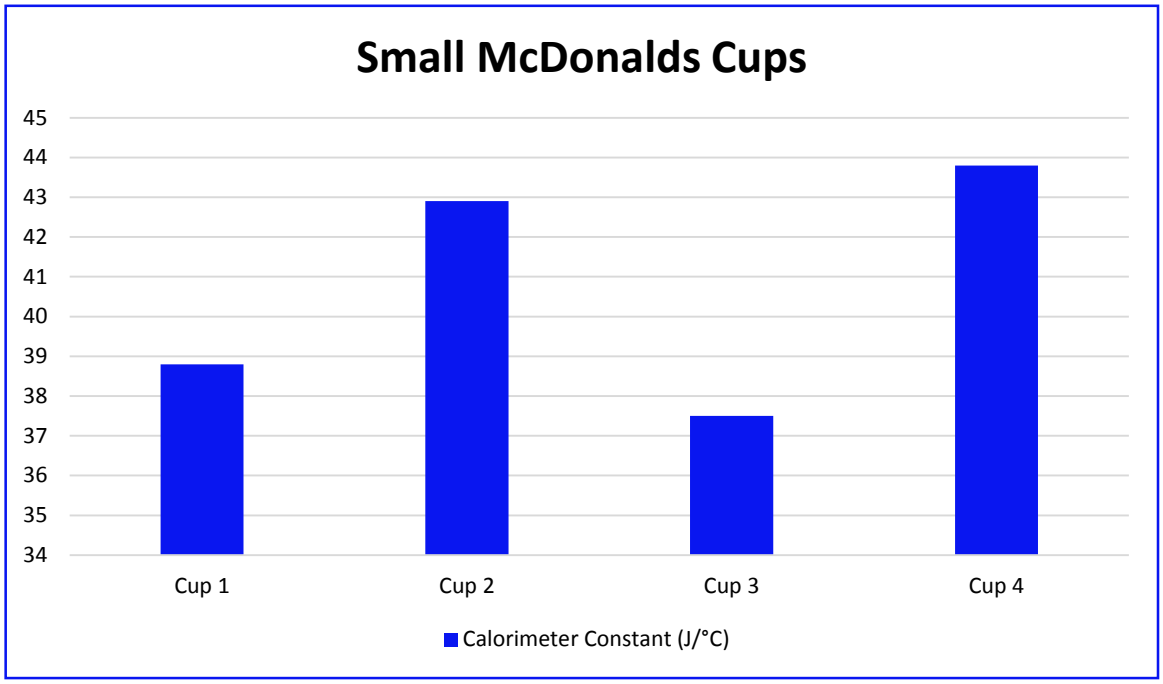
This table shows all of the readings we gathered form the 10 different cups. In this table the best reading is that of Cup 1. This could be for a number of reasons but there could also be some errors or things that happened during this test that did not happen during the others. This was the first test and so I was still trying to get all of the components of the experiment working at the same time and I did not repeat this result. This could possibly be the reason this one stands out from the rest, it is definitely an outlier, and is therefore not a valid result.

Styrofoam Cups	Calorimeter Constant (J/°C)
Cup 1	17.1
Cup 2	16.0
Cup 3	12.0
Cup 4	22.8
Average	17.0



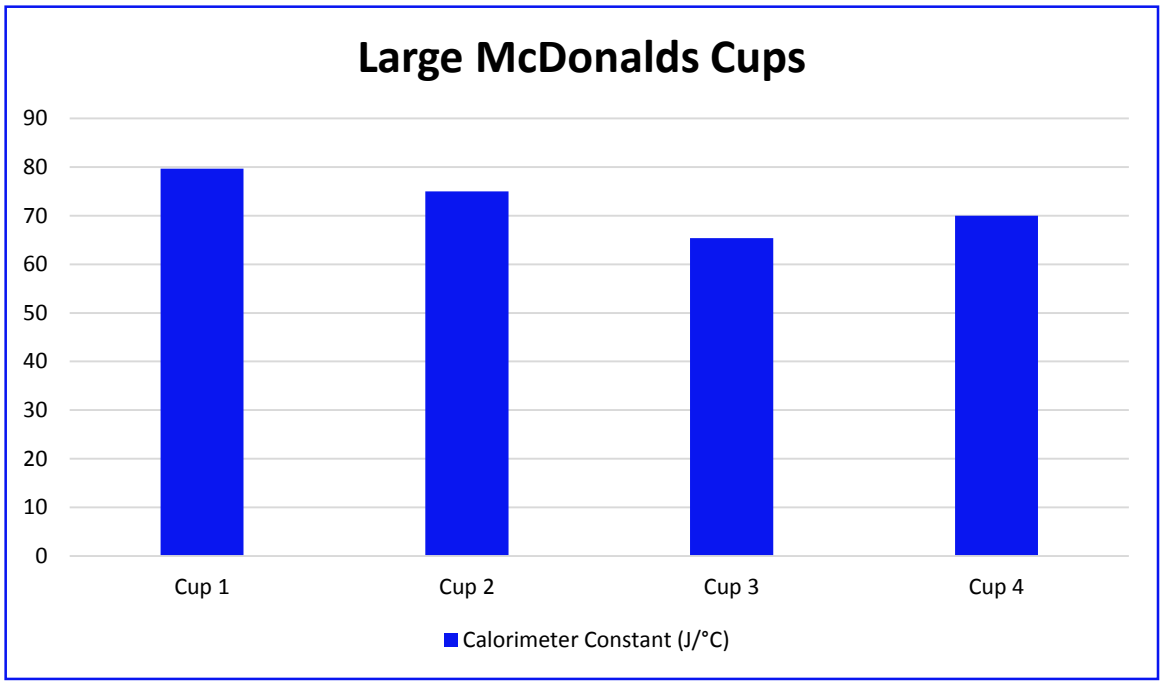
This is a very good scoring set of cups. They all have a very low calorimeter constant therefore they keep coffee very hot. These scores are all well under 35 J/°C and are therefore in the lowest range of cups. They keep getting progressively lower until the last cup that unexpectedly jumps up a bit. However this spike is nowhere near the height of some of the other cups.

Small McDonalds Cups	Calorimeter Constant (J/°C)
Cup 1	38.8
Cup 2	42.9
Cup 3	37.5
Cup 4	43.8
Average	40.8



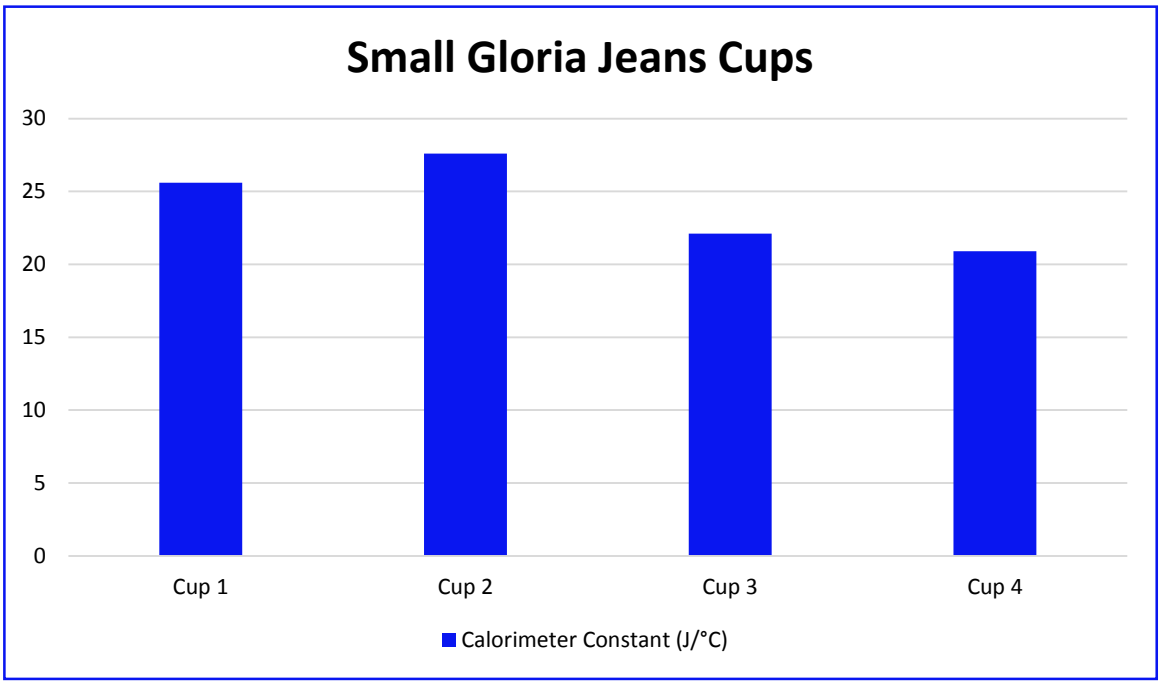
These are not the best results. They range from the high 30's to the low 40's. Overall these cups do not keep the coffee in them very warm. The first and third cups tested were the better ones, while the second and fourth were definitely the worst. The average of the cups was also in the low 40's which was a very low result.

Large McDonalds Cups	Calorimeter Constant (J/°C)
Cup 1	79.7
Cup 2	75.0
Cup 3	65.4
Cup 4	70.0
Average	72.5



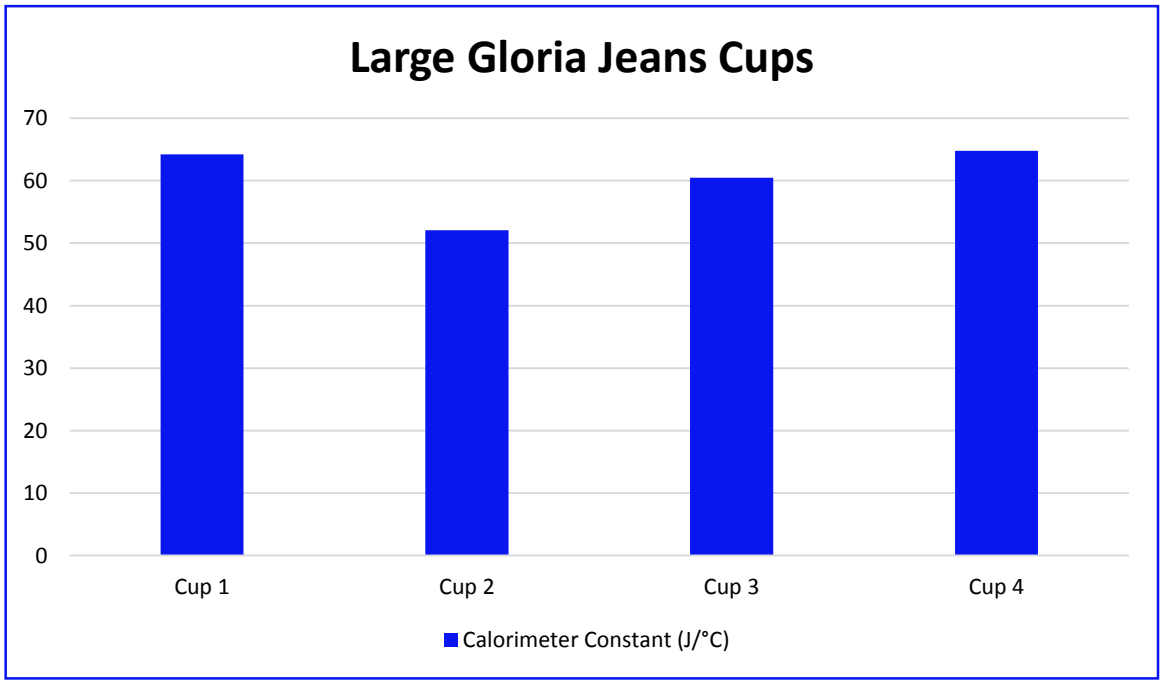
All of these results are very similar, they are all in the high 60's or low 70's. These results are also really bad. These are exceptionally high figures and I have not seen them in any of the other results yet. This is interesting because these cups are large and the reason they are doing so badly may be because of this. There are also other reasons but the McDonalds cups in general have not been very good.

Small Gloria Jeans Cups	Calorimeter Constant (J/°C)
Cup 1	25.6
Cup 2	27.6
Cup 3	22.1
Cup 4	20.9
Average	24.1



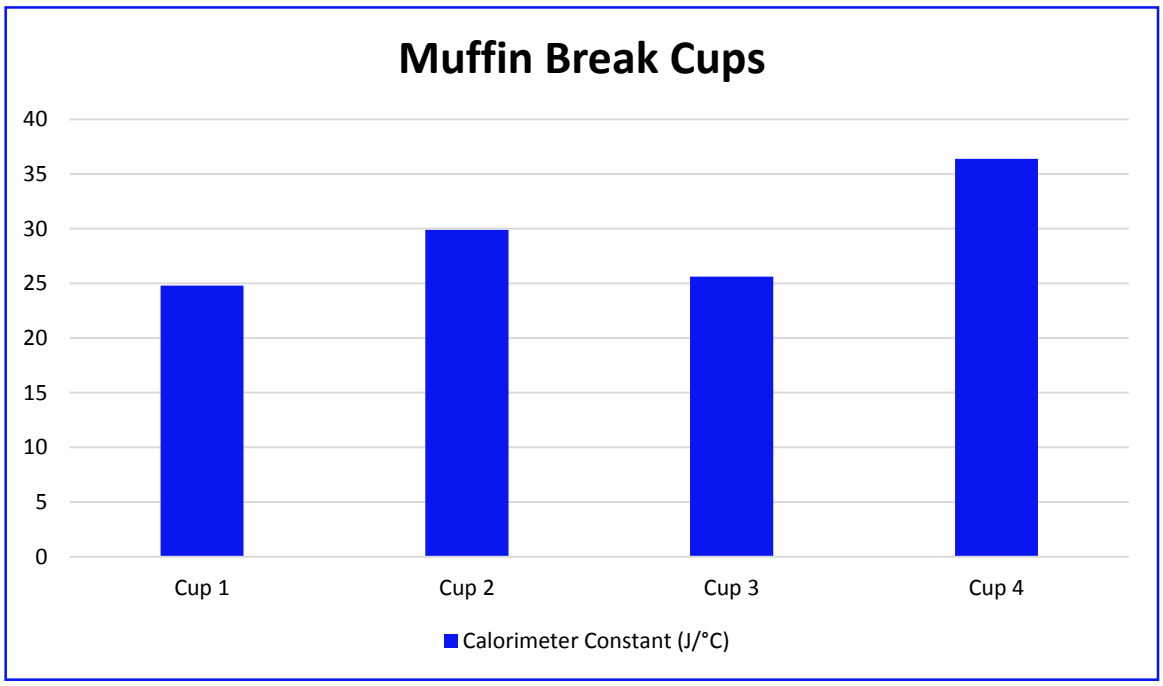
These cups have a reasonable result. They are all in the 20's which is a good score for any cup. This is an average score so these cups neither are good at keeping coffee hot nor are they particularly bad, they are very average. They are all generally descending a except for the second cup that is just a bit higher than the other three cups are.

Large Gloria Jeans Cups	Calorimeter Constant (J/°C)
Cup 1	64.2
Cup 2	52.1
Cup 3	60.5
Cup 4	64.8
Average	60.4



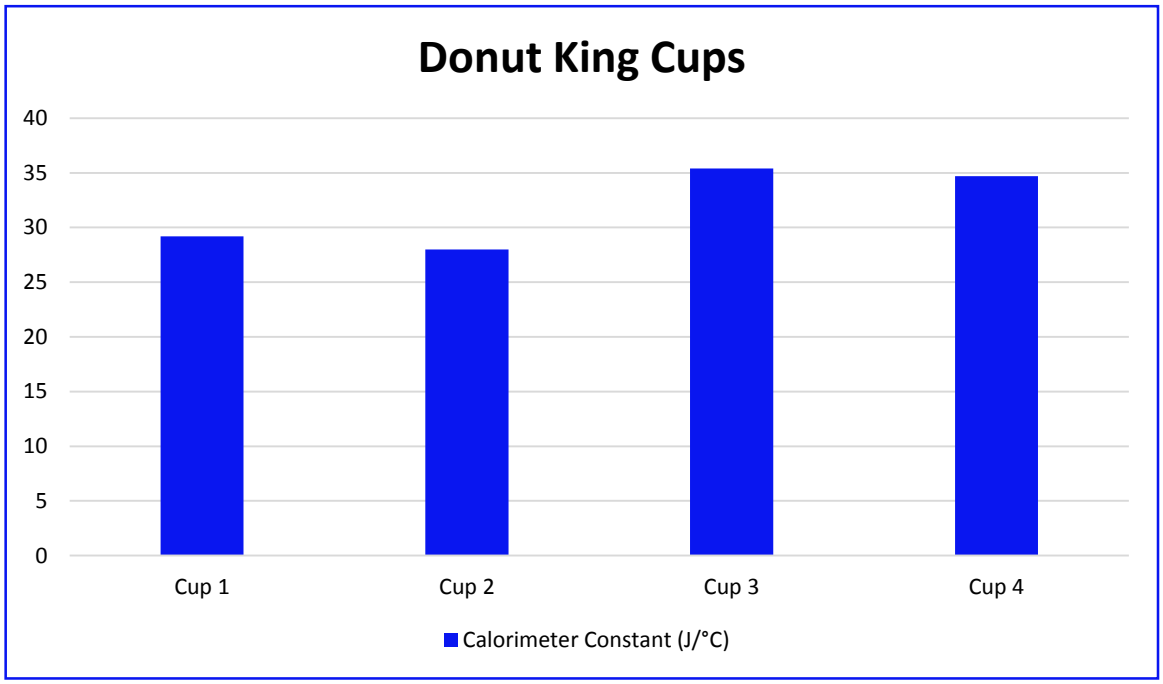
These are not the best results, they are higher results therefore are less able to keep the coffee hot. They are not the worst cups I have tested but they are also not the best. The first cup is rather high but the second cup drops and then the third and fourth cups rise again until the fourth cup is back at basically the same pace of the first cup.

Muffin Break Cups	Calorimeter Constant (J/°C)
Cup 1	24.8
Cup 2	29.9
Cup 3	25.6
Cup 4	36.4
Average	29.2



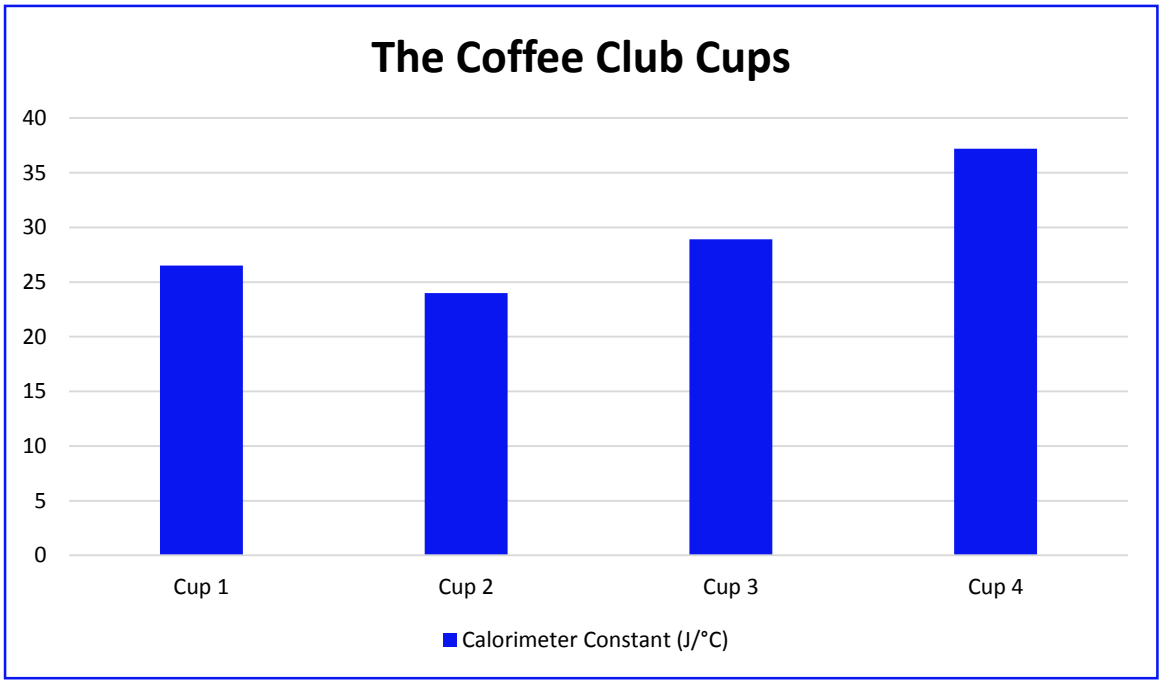
The range of these cups is varied. The first cup is a low score, then the second cup rises up, then the third cup drops again and finally the last cup is the highest of all of them. The results are not very spread out and all come within the 20's and 30's. This shows that all of this company's cups generally have the same score or range of scores.

Donut King Cups	Calorimeter Constant (J/°C)
Cup 1	29.2
Cup 2	28.0
Cup 3	35.4
Cup 4	34.7
Average	31.8



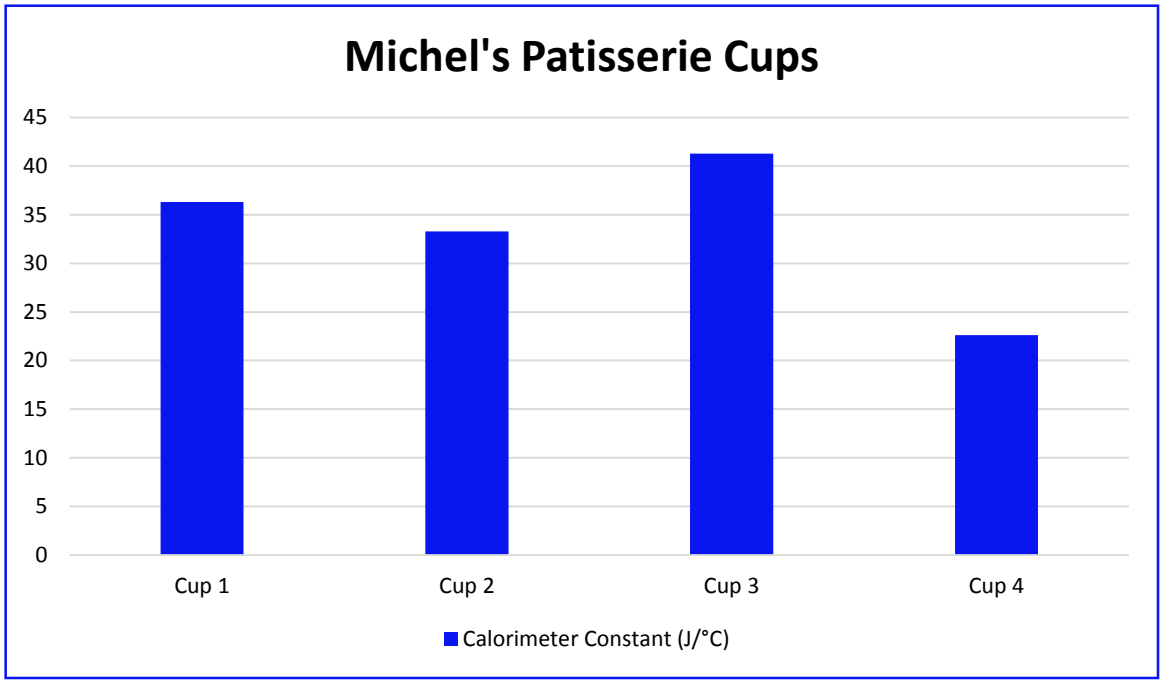
This set of data is similar at both ends. Cups 1 and 2 are both about the same score while cups 3 and 4 are also both about the same score. This is also a more spread out graph than the other ones were. This has data ranging from 28 to 35 J/°C and this increase is between two cups: Cup 2 and Cup 3.

The Coffee Club Cups	Calorimeter Constant (J/°C)
Cup 1	26.5
Cup 2	24.0
Cup 3	28.9
Cup 4	37.2
Average	29.2



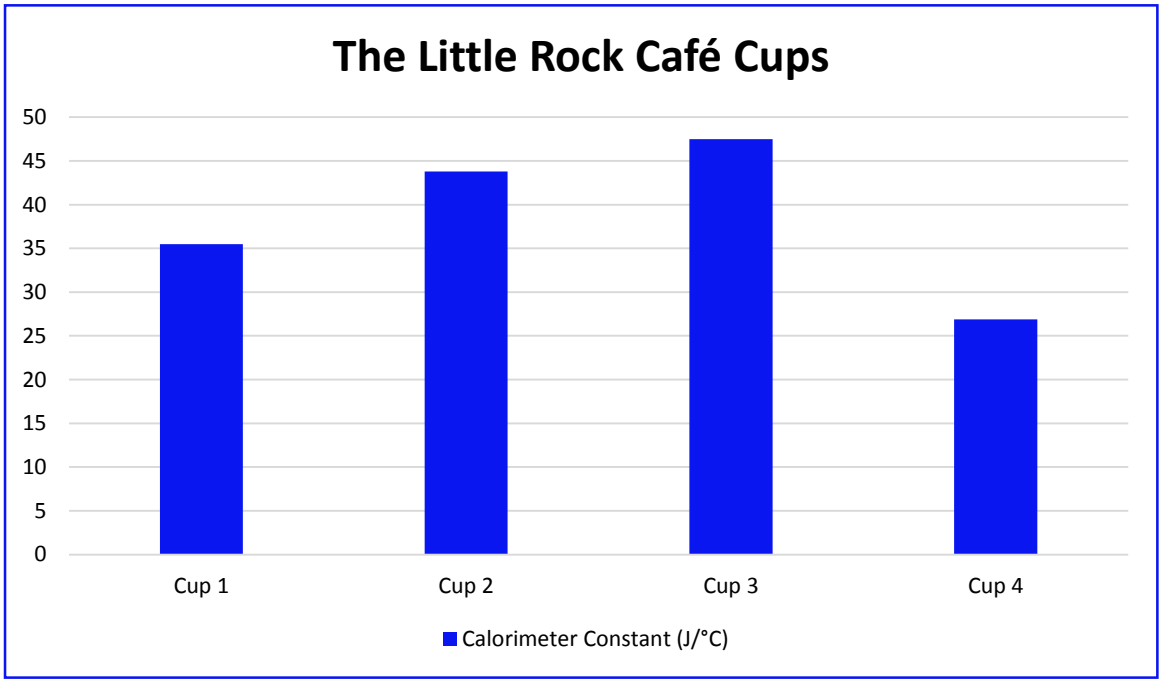
This data is very close together. There is no data anywhere else than in the 20's. This indicates that all of these cups are consistent and have the same capabilities of keeping the coffee hot. It is good to have uniformity in a particular company. The first cup starts with an average reading and then the second one drops a bit, the third one rises and then finally the fourth one is the highest reading in this set of data. In the last experiment the lid of the cup may have been not put on properly so that could account for the spike in the data.

Michel's Patisserie Cups	Calorimeter Constant (J/°C)
Cup 1	36.3
Cup 2	33.3
Cup 3	41.3
Cup 4	22.6
Average	33.4



Most of the data in this graph is in the 40's and 30's. However there is one reading that is very different from all of the rest: Cup 4 is down in the 20's. This does not show uniformity within a company and is a bit strange. This outlier could be a result of many things, because there is a number of variables.

The Little Rock Café Cups	Calorimeter Constant (J/°C)
Cup 1	35.5
Cup 2	43.8
Cup 3	47.5
Cup 4	26.9
Average	38.4



In this set of data the first three cups are steadily rising and then the fourth one drops really dramatically. This is, again, an example of an outlier in this graph. Most of the data is in the high 30's to high 40's but the fourth cup is down in the 20's. This is another example of when a company does not have consistency in their cups. This could also be an error in the experiment.

Small McDonalds Cup 1 Calculation

Heat Lost = 100 x 4.18 x (72.5 – 45.4) i.e. decrease in temperature

= 12 581.8 J

Heat gained = 100 x 4.18 x (45.4-20.6) i.e. increase in temperature

= 10 408.2 J

Calorimeter Constant = (12 581.8 –10 408.2) ÷ (45.5-20.6)

= 33.8 J/°C

Final Results

The last thing I did was to draw together all of my data and to organise it into a table. With this table I was then able to use standard deviation to see the spread of the cups.

I found that some cups were more spread out than others. For example Michel's Patisserie has a much broader range of data than the Styrofoam cups do.

This could have happened for a number of reasons, but the most likely is that in the cups that have a bigger standard deviation, there was probably an outlier in the group who altered the outcome of the calculation a good deal.

In this table I have separated the large cups from all of the small cups because they are really a totally different experiment altogether and so should not be included with the data from the small cups.

Rating	Coffee Cup	Calorimeter Constant (Small)	(Large)
1.	Styrofoam	17.0 ± 2.2	-
2.	Small Gloria Jeans	24.1 ± 2.7	60.4 ± 5.4
3.	Muffin Break	29.2 ± 4.6	-
4.	The Coffee Club	29.2 ± 5.0	-
5.	Donut King	31.8 ± 3.3	-
6.	Michel's Patisserie	33.4 ± 6.8	-
7.	The Little Rock Café	38.4 ± 7.9	-
8.	Small McDonalds	40.8 ± 2.7	72.5 ± 5.4

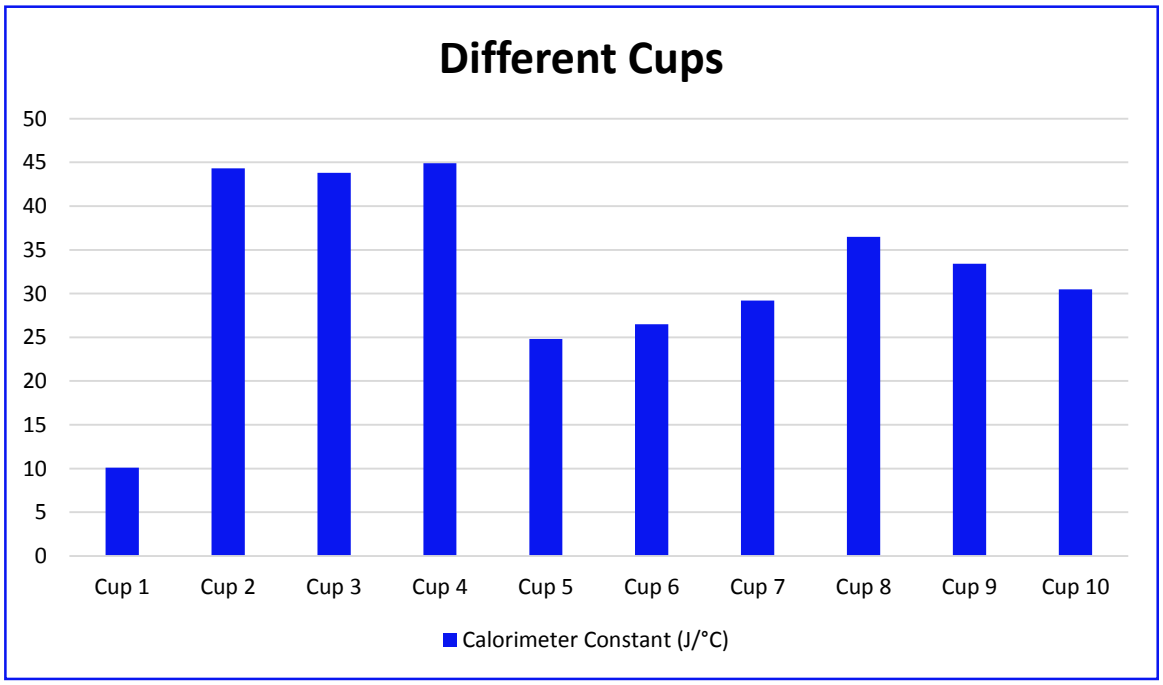
Discussion

Different Cups

The purpose of getting so many cups too test at first was to see what was out there. How many different types of cups could there be? Many! There are variegated ones; there is a choice of single, double or tripled walled; there are corrugated ones; smooth ones; ones with grips; ones that are biodegradable! Who would have thought that there was such a choice when choosing disposable cups! And they all have different thing that make them up.

I chose to test 10 random cups from little coffee shops and cafés so I could get an idea of what the calorimeter constant for general cups is. This was a challenge at some shops to actually get the cups. Most places I went they were very happy to give me a cup or 4 (for the company cups), but at some places I went they said I had to pay for them! They asked sometimes for over a dollar just for the cups. Each time someone asked me to pay I did but I made sure I go a receipt as a record. These can be found with the cups data in the 2 appendices folders.

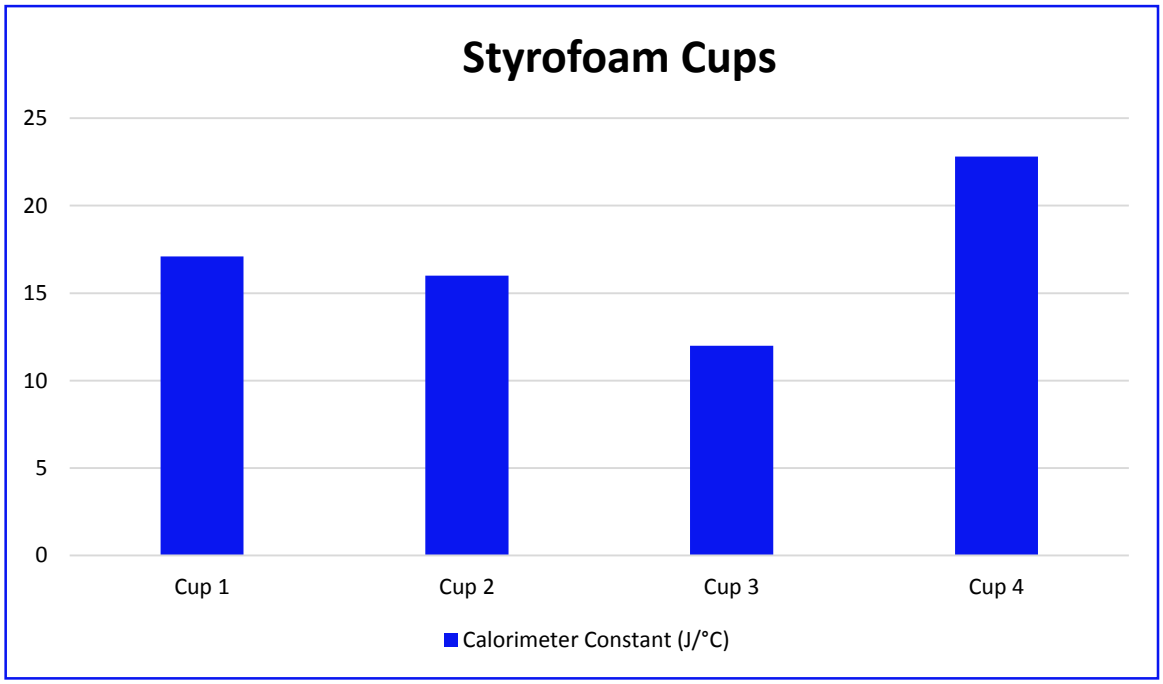
When I actually started experimenting with these 10 different cups I found that not only were there many different numbers and there were many different results but there also could have been many reasons for these dramatic differences.



As can be observed in the graph above many of the cups had numbers less than 35, however, there are a few cups that are way above what the majority are. The reason that this has happened is because some of these cups are better insulated than others are so they get a better reading than the other ones do. This is a good spread of data that I can now work with to base my findings of the company cups on.

Styrofoam Cups

These cups were unsurpassed. They all had really low readings and were the only ones that were all consistently low. Styrofoam has been used for a long time to carry hot drinks in and there is a good reason for that. These were by far the best cup to keep coffee hot. So why don't companies and franchise stores use them? The answer is because they are no biodegradable. All the stores nowadays are into promoting recycling and environment friendly products. Styrofoam is one of those materials that does not breakdown. This is the reason the shops do no sell hot drinks in Styrofoam.



The graph above shows just how low the Styrofoam cups results were. They were all in the well below 25 J/°C. This is exceptionally good. In this graph though it also shows that the last cup rose unexpectedly. This could be due to an error in experimentation or it could be that this cup is just not as good as holding heat as the others are.

Small McDonalds Cups

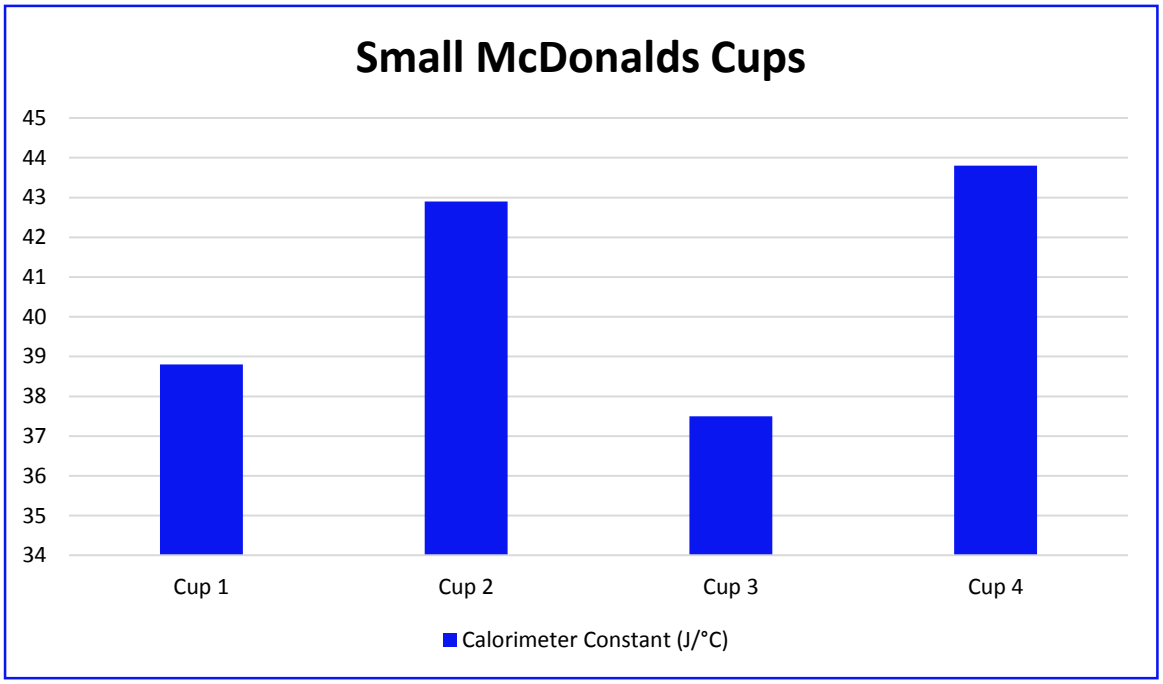
These cups did not do very well at all. Their results were very high and were not at all as good as would be expected from such a big company like *McDonalds*. These are so far at the bottom of the table of all the cups. When I tested these cups I wondered what it would be like to test a large cup from *McDonalds* and see if that did any better or worse. The amount of the liquid inside the cup may make a difference. In the next experiment I will explain about the large cup.

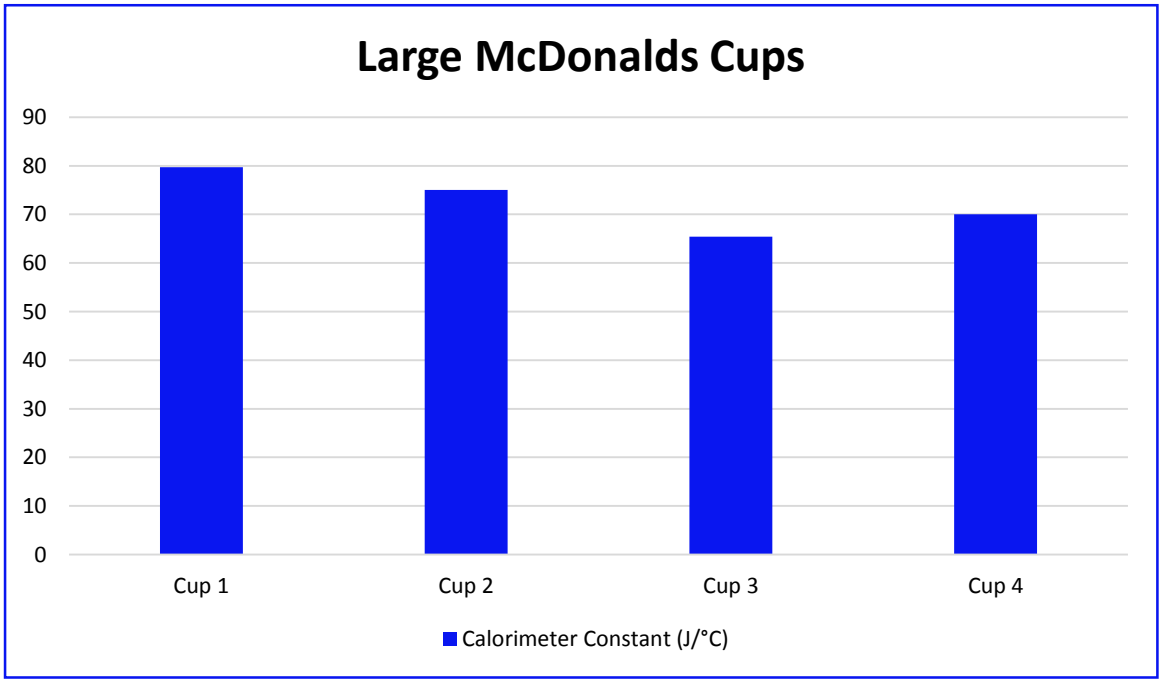
This means that when I find out my results I can go to *McDonalds* and tell them that their cups are not the best ones on the market. I also found an article that was a court case against

McDonalds because someone had burnt themselves when a coffee go spilt and they took *McDonalds* to court. This is another indication that *McDonald's* cups are not good cups.

Large McDonalds Cups

I tested these cups just because I wanted to find out if the larger size of the cup would affect the result it gave. When I was testing the smaller cup I wondered if the size would make a difference, so I tried it. I tested 4 large *McDonald's* cups as well as the small ones.



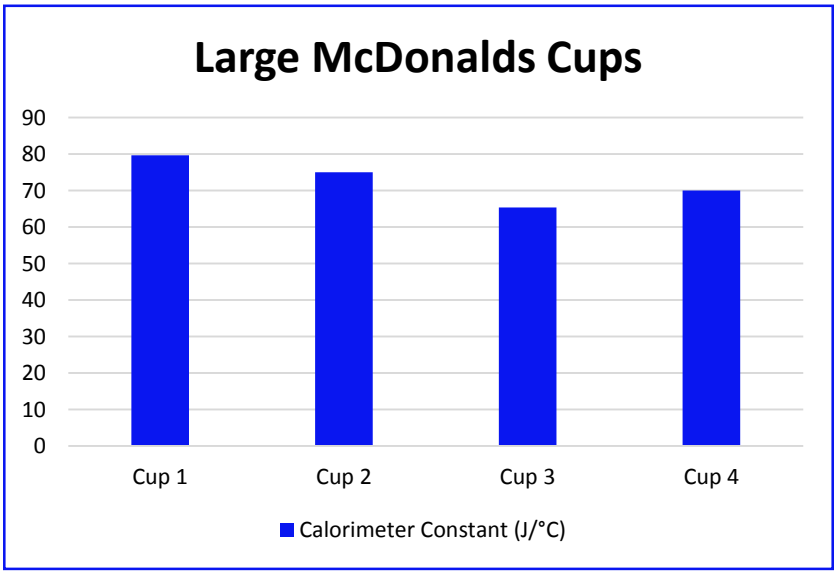


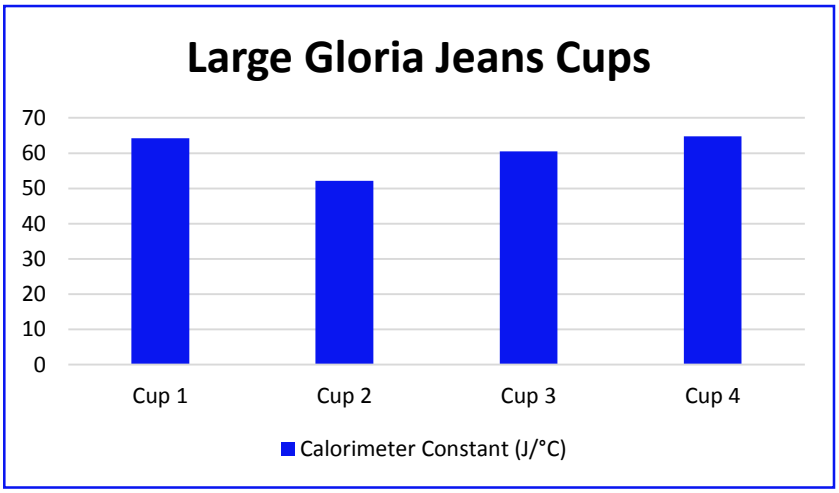
When I compared the two graphs, previous, there is a definite difference between both of the graphs. The larger cup has a much higher rating which means that they are not good at keeping the coffee hot. This may be due to the fact that there is a much larger surface area with the bigger cups. This means that more of the heat is taken up by the calorimeter (cup) because it is larger than the smaller cups. This is the reason that I thought the results were so different.

I did not want to just have one company's cups because their cups could just be bad ones. So took the set of cups that had the best result at the time (*Gloria Jeans*) and I got large cups in this company and tested them.

Large Gloria Jeans Cups

I initially tested these cups because I had only tested large *McDonalds* ones and I wanted to see if the results I got for the large *McDonalds* cups were representative of all large cups. I then found the cups that had the best results (*Gloria Jeans*), and I got 4 of the large type from an outlet. I then tested them to see if they would be better, the same or worse than the *McDonalds* ones.





As these graphs show the *McDonalds* cups are a lot worse than the *Gloria Jeans* cups are. This means that *McDonald's* cups in general are not very good insulators. It also shows that I was right to do some more experiments using different company's cups because, the *McDonalds* cups were not a representation of what all company's large cups are like.

You would be much better off buying a *Gloria Jeans* coffee to a *McDonald's* coffee if you want the hottest coffee you can get.

Reasons for Similarities between Cups

As the previous pictures show, the reason that so many of the cups have a similar calorimeter constant is because they are all basically made out of the same things. They all have a double wall where one is the main insulator and cup and the other one is a layer to keep the cup easy to hold as well as have a company's logo on it.

There is no real reason why the McDonalds cups are so different from the other cups. One reason could be that in 1994, there was a court case where McDonalds was being sued after a woman had gotten badly burned from a McDonald's coffee. McDonalds lost this court battle and had to pay thousands of dollars in compensation. This might very well be the reason that McDonald's cups have such a low score. They could be deliberately trying to make their coffees not so hot, so they do not get a court case against them again.

Further Research

In the near future I would like to continue with my research. I would like to find out why each cup has different calorimeter constants, and with this information I would like to design and make my own coffee cup.

This cup would be a compilation of: my future investigation into what makes up the best take-away cups and a way to make a cup that was healthy for our environment – one that could be recycled.

If I did this experiment again I would like to not use so much paper work and just use the computers records, this would mean less confusion. I would also like to try out coffee mugs, travel mugs and the glass cups that hot drinks are served in at cafés.

I would also like to continue to investigate the calorimeter constants of the large cups. The two that I did in this experiment had a great difference to the small cups so I would like to investigate that avenue yet.

Scientific Significance

The significance of my project is that many coffee and café outlets and businesses will be able to have an idea of which cups will be better for them to sell to their customers. The will be able to give all of their consumers the best product that they can. This project also identifies the worst cups in the industry and in my further research I will be able to identify why these cups have performed the worst.

When I undertake my further investigation, I am going to investigate why one cup performs better than another and I will be able to construct my own cup using these findings. I will then be able to go to companies that have not done very well in **this** investigation, and tell them that they do not have the best product and show them my example of the best insulated cup.

Conclusion

In conclusion, I have found the best cup for keeping coffee hot is the Styrofoam cup. This is what I had originally predicted in my hypothesis. The only reason why shops and cafés do not sell these cups is because they are non-biodegradable. This is a major drawback because in our society we generate so much waste that it is important to look after our environment with recyclable rubbish.

Another thing that was very interesting was that McDonalds did very poorly in this investigation. This is a major international corporation where thousands of people go to by coffees every day and they are not getting the best product.

This is the table from best cup to worst cup:

Rating	Coffee Cup	Calorimeter Constant (Small)	(Large)
1.	Styrofoam	17.0 ± 2.2	-
2.	Small Gloria Jeans	24.1 ± 2.7	60.4 ± 5.4
3.	Muffin Break	29.2 ± 4.6	-
4.	The Coffee Club	29.2 ± 5.0	-
5.	Donut King	31.8 ± 3.3	-
6.	Michel's Patisserie	33.4 ± 6.8	-
7.	The Little Rock Café	38.4 ± 7.9	-
8.	Small McDonalds	40.8 ± 2.7	72.5 ± 5.4

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The Stella Liebeck v. McDonald's Restaurants, P.T.S.,Inc. and McDonald's International, Inc. August 18, 1994

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My family	Who had to put up with all of the coffee cups around my house for about a month. It's hard to see them and know there is no coffee in them to drink!
My schools Chemistry teacher	She mentored me through this investigation. She helped me come up with using the idea of calorimeters in my project. She also let me borrow equipment form the school laboratory. She also helped me with getting started with my experimentation.
My Science teacher	He let me have class time to work on writing up and doing my report work during our science lessons.
My IT teacher	He helped me set up a web page where I could design a website for my project.