An Investigation on the Yield of an Aspirin Tablet as it gets heated up compared to Salicylic Acid

Aim

The aim of this investigation was to assess the yield of an aspirin tablet by measuring its mass as it gets heated up in a non reactive solution (baby oil) compared to salicylic acid under the same conditions.

Introduction

I was interested in studying the yield of aspirin because I wanted to research something that had a real life application and that drew me to looking at medicinal chemistry because it has an impact on my life and it is a topic that interests me. From there I began to look at how external factors impact the effectiveness of medicine and that lead me to look at how effective medicine is under different amounts of heat. Originally I was planning to look at the thermal stability of aspirin compared to salicylic acid. However, I decided to change from it because scientists who measure thermal stability use a machine that is able to measure all the different data points needed to calculate thermal stability simultaneously. My school doesn't have the machine and I was worried that attempting to collect all of this data by hand would lead to inaccurate set of data. I also realized that the temperatures I needed to get the aspirin and the salicylic acid to was not feasible and dangerous for a high school student to perform.

I decided to look at the mass to determine the yield of aspirin because I thought simply if some of the aspirin is lost by heating the tablet up then it has to have an effect on how well the aspirin works because some of the aspirin is gone. I also thought that it was best to put the aspirin in a solution that it could be heated up in, but it wouldn't react with I came to the conclusion that putting the aspirin and the salicylic acid in baby oil would work the best because the alkanes from the baby oil and the benzoic acid from the asprin and the salicylic acid would react the least of the possible options.

After researching more about what I planned to do for my experiment I looked at potential issues or problems that my experiment could run into. I came to the conclusion that there were no huge issues with my experiment in terms of ethics or the environment. The only safety issue is that I heated up the salicylic acid and the aspirin and there was a possibility that something could've went wrong. I didn't encounter any problems with the salicylic acid or the aspirin, but there was a possibility. I put both the aspirin tablet and the salycic acid in baby oil to limit outside interference and there is a possibility that it could catch on fire. Medspa says that the flash point or the point at which their baby oil begins to catch on fire is 345 degrees celsius (653 degrees fahrenheit)[1]. I did reach the boiling point of aspirin and the salycic acid, but I did not go over them so I wasn't concerned about their flash point. Had I been looking at the thermal stability I would have been more concerned with the flashpoint of the materials involved, but for this experiment I

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Background

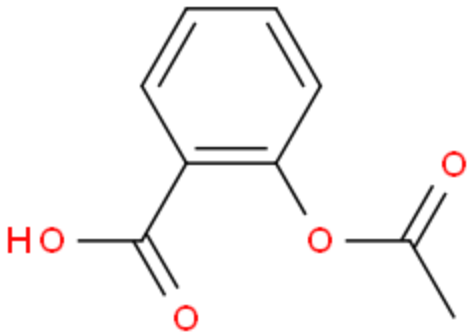
This investigation mainly focuses on the topic of yield and it does involve some kinetic energy which I will explain below.

Yield

Kinect Energy

Although the investigation is assessing the yield of aspirin and salicylic acid as it heats up the actual reaction of the aspirin and the salicylic acid does involve kinetic energy and specifically activation energy. When something is heated up the velocity of the molecules increase the frequency is collisions between molecules

General Information about Aspirin and Salicylic Acid



Aspirin or acetylsalicylic acid has a chemical formula of $C_9H_8O_4$ and its melting point is roughly 140 degrees celsius and it has a flash point of 250 degrees celsius.

When

Salicylic Acid has a chemical formula of $C_7H_6O_3$

Methodology

The most common way to assess the yield of something in terms of its mass is to find the theoretical yield (in this case the mass of the aspirin tablet or salicylic acid before it is placed in the baby oil and heated up), the actual yield (the mass of the aspirin tablet or the salicylic acid when it is heated up) and then take the actual yield divide that by the theoretical yield and then multiply by 100 and that gives the percent yield. This is represented by the equation below.

Percent yield=(actual yield/ theoretical yield) x 100

Since the mass is being measured at different temperatures I can compare the percent yield of the aspirin and salicylic acid at different temperatures and truly see how much the heat impact its yield.

Materials:

- Three 380 mg aspirin tablets
- 1140 mg of salicylic acid
- two 250 ml erlenmeyer flask
- 600 ml of baby oil
- Two thermometers that can reach at least 150 degrees celsius
- A hot plate

Procedure

1. Gather the following materials: three 380 mg aspirin tablets, 1140 mg of salicylic acid, two 250 ml erlenmeyer flasks, and 600 ml of baby oil
2. pour 100 ml of baby oil into each erlenmeyer flask and add one aspirin tablet into one flask and 380 mg of salicylic acid into the other
3. Weigh the flask with the baby oil and either the aspirin and the salicylic acid inside
4. Put the flask on a hot plate starting at 50 degrees Celsius and record data and observations
5. Every 25 degrees celcius take the flask off the hot plate and record the mass
6. Repeat this until the temperature reaches 150 degrees Celsius
7. Weigh the flask and its contents again
8. Repeat so there are three trials for both the aspirin and the salicylic acid

Data

Mass of Salicylic Acid

Trial	Mass before (In mg)	Mass at 50 degrees celsius	Mass at 75 degrees celsius	Mass at 100 degrees celsius	Mass at 125 degrees celsius	Mass at 150 degrees celsius
Trial 1	380.0	366.4	342.3	305.8	271.6	258.2
Trial 2	380.0	367.1	344.2	308.2	270.2	258.7
Trial 3	380.0	365.8	339.6	301.0	269.4	256.3

Percent Yield of Salicylic Acid

Trial	Percent yield before	Percent yield at 5o degrees celsius	Percent yield at 75 degrees celsius	Percent yield at 100 degrees celsius	Percent yield at 125 degrees celsius	Percent yield at 150 degrees celsius
Trial 1	100%	96.42%	90.08%	80.47%	71.47%	67.95%
Trial 2	100%	96.61%	90.58%	81.11%	71.11%	68.08%
Trial 3	100%	96.26%	89.37%	79.21%	70.89%	67.45%

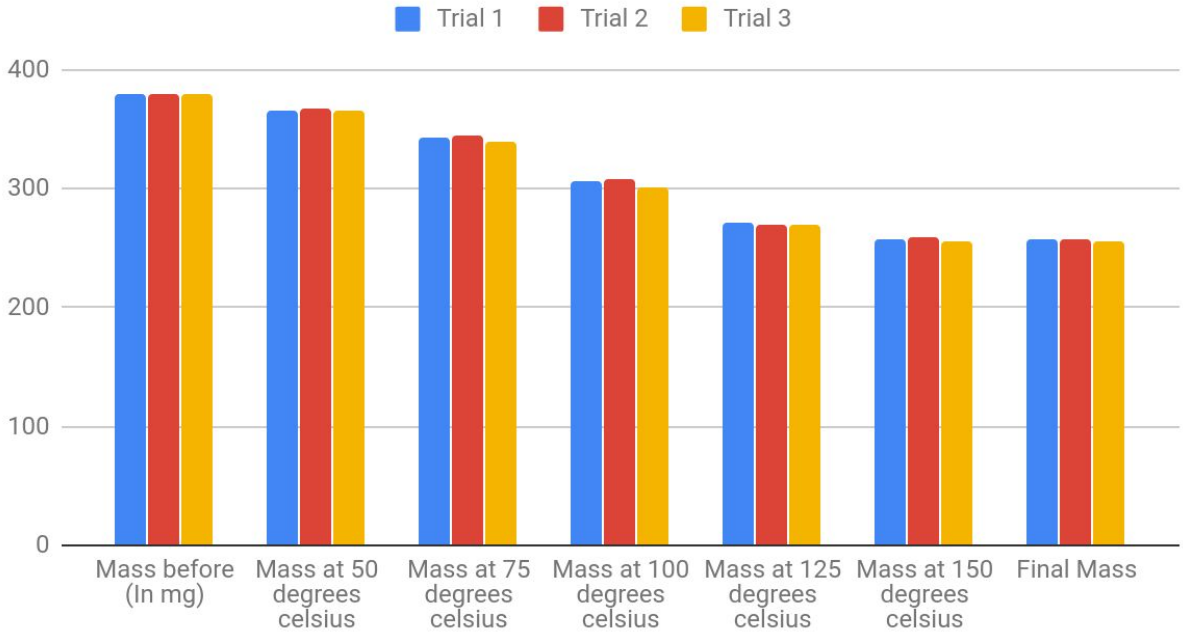
Mass of Aspirin Tablets

Trial	Mass before (in mg)	Mass at 50 degrees celsius	Mass at 75 degrees celsius	Mass at 100 degrees celsius	Mass at 125 degrees celsius	Mass at 150 degrees celsius
Trial 1	379.9	371.1	349.4	313.8	281.6	264.7
Trial 2	380.0	368.2	345.1	309.8	276.6	261.5
Trial 3	380.0	372.8	350.2	314.7	282.3	266.7

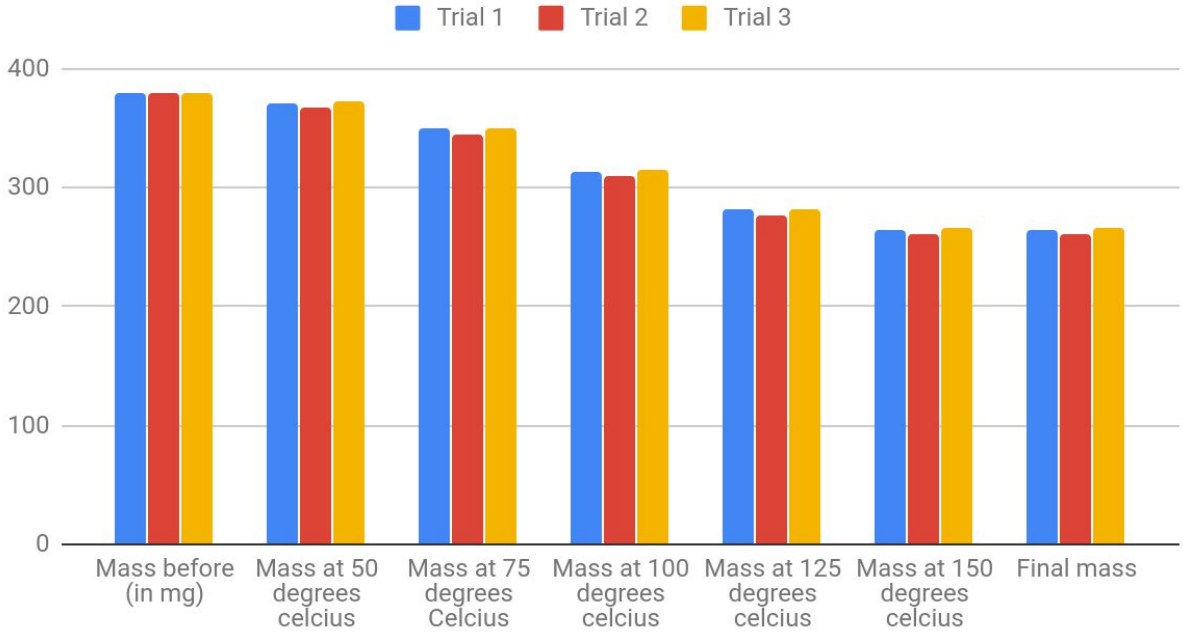
Percent Yield of Aspirin Tablets

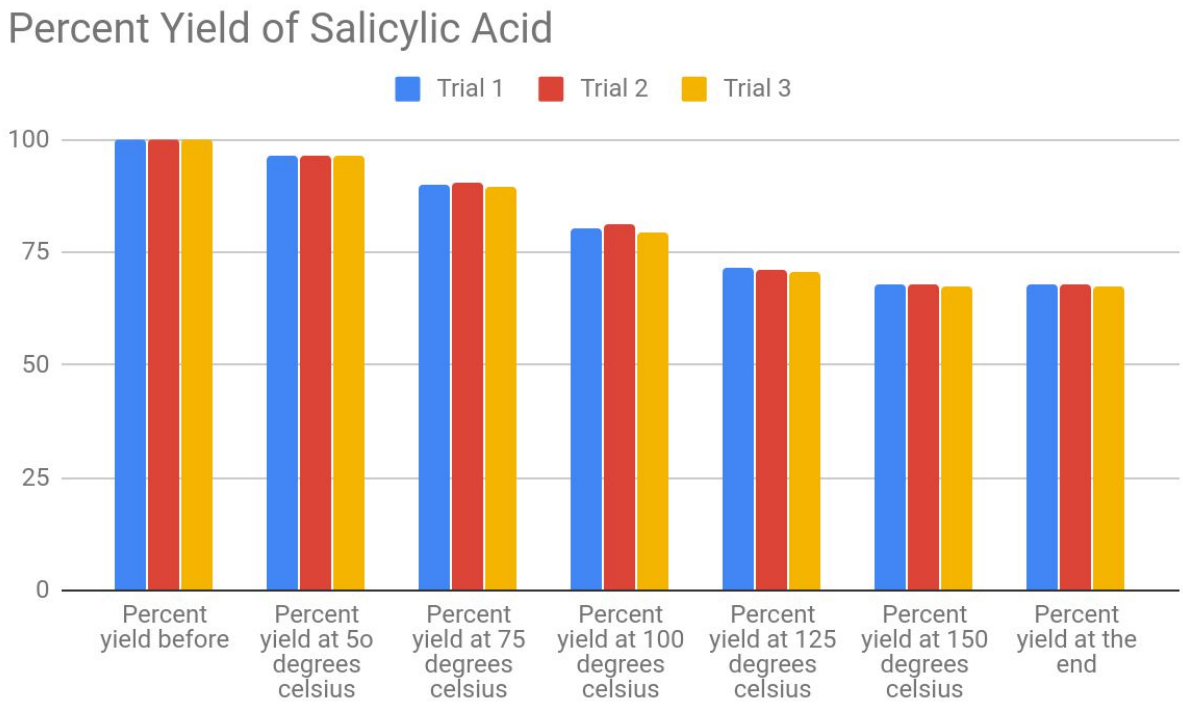
Trial	Percent yield before	Percent yield at 50 degrees fahrenheit	Percent yield at 75 degrees fahrenheit	Percent yield at 100 degrees fahrenheit	Percent yield at 125 degrees fahrenheit	Percent yield at 150 degrees fahrenheit
Trial 1	100%	97.68%	91.97%	82.58%	74.12%	69.68%
Trial 2	100%	96.89%	90.81%	81.53%	72.79%	68.81%
Trial 3	100%	98.11%	92.16%	82.82%	74.29%	70.18%

Mass of Salicylic Acid

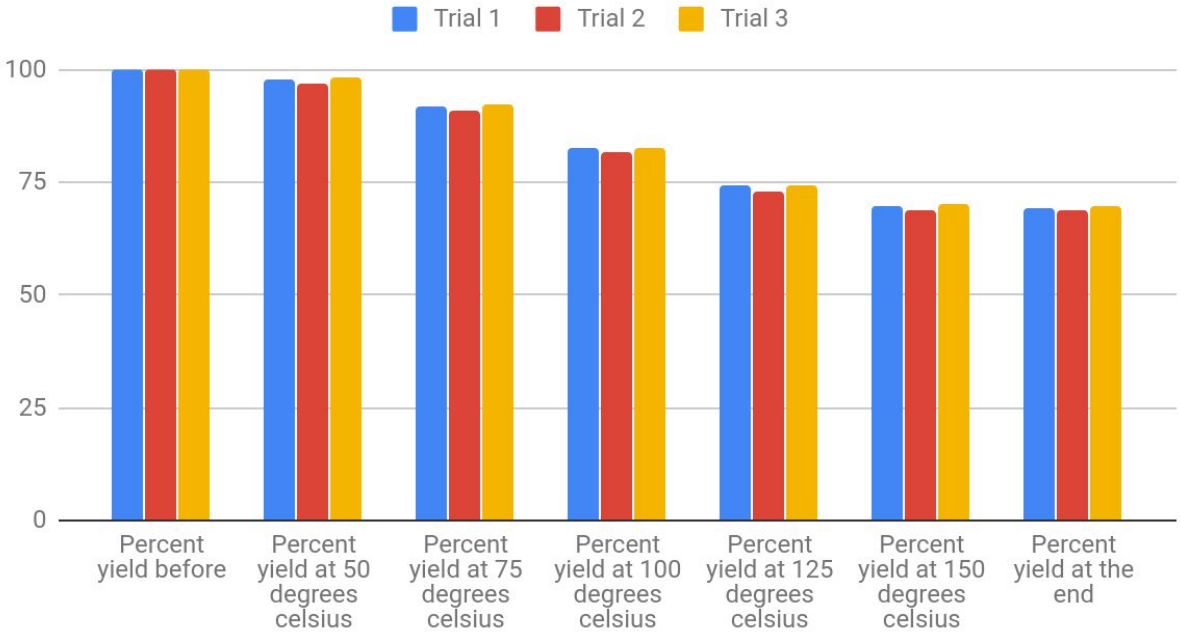


Mass of Aspirin Tablets

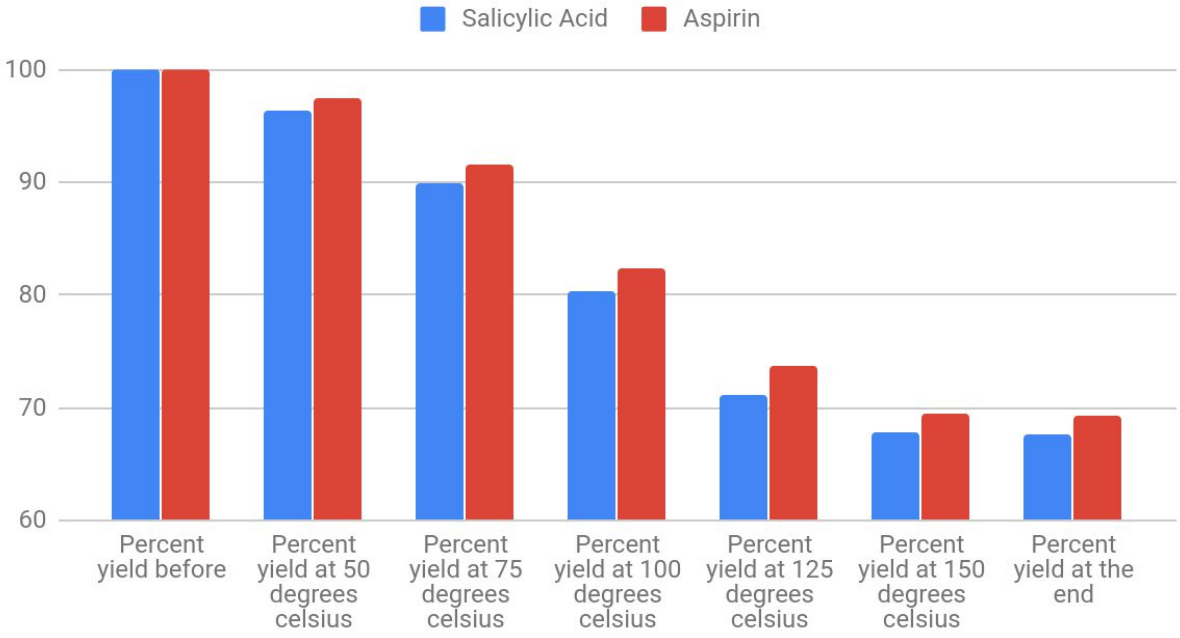



Percent Yield of Salicylic Acid
Trial 1
Trial 2
Trial 3
100
75
50
25
0
Percent yield before
Percent yield at 5o degrees celsius
Percent yield at 75 degrees celsius
Percent yield at 100 degrees celsius
Percent yield at 125 degrees celsius
Percent yield at 150 degrees celsius
Percent yield at the end

Percent Yield of Aspirin Tablets



Percent Yield of Salicylic Acid Compared to Aspirin



Data Uncertainty

To account for uncertainty in my data set I decided to account for the following.

Since I rounded to the nearest tenth for my mass measurements I read that scientists add a ±.2% to each piece of data. Because I took 21 different mass measurements I created the following equation to calculate my percent error.

Percent error= 21x.2

Percent error= 4.2%

Conclusion

The aim of this experiment was to find the yield of an aspirin tablet in terms of mass as it's heated up compared to salicylic acid. Based on the results of this experiment this aim has been meet and I was able to determine the yields of both aspirin and salicylic acid in terms of mass.

I was able to calculated the average percent yield of both the aspirin and the salic acid which is

69.34% yield for aspirin and 67.67% for salicylic acid.

Based on what I have read that value seems to line up with the idea of it losing 20-40% of its yield. Reflecting back on the methodology of the experiment I'm somewhat surprised with the accuracy of the data because I had initially fear when I was looking at thermal stability that recording everything by hand would make the results inaccurate. One thing I would change next time is to use two hot plates simultaneously because I only used one hot plate and it took a while for it to heat up each time so it would definitely be more efficient to use multiple.

I think that this result is very interesting and I would be interested to extended this experiment to over commonly used medicine to see if heat has similar effects on the yield. I would also like to even test the opposite and see if cooling medicine affects the yield in a similar way or if it doesn't have as much of an impact. The results of those experiments would be

interesting to compare with my experiment just to see how heat or cooling affects the yield of different types of medicine and if this is something that people need to be careful of.

Bibliography

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