

Science Scholar Program Investigation

By Charles Whitter

Introduction

Recent studies from the UK show a change of saltiness in the ocean due to climate change¹. Salinity levels are important because they could affect the rate that ice melts in the oceans, the water cycle and the sea currents due to the density of salt water. For this reason, I wanted to figure out how salt affects ice melting.

Given that we put salt onto icy roads to melt ice, I thought the ice would melt quicker in the salt water because salt water has a lower freezing point meaning the ice will melt at a higher temperature.

Resources :



3x glasses of equal size

1x measuring jug

12x ice cubes

1x table spoon

3x tea spoons

1x table spoon of salt

1x table spoon of sugar

3x labels

1x stopwatch

1x notebook (for results)

Method

1. Measure out 200 mls into each cup using the measuring jug
2. Label Each cup of water as either control; sugar or salt
3. Add 1 tablespoon of sugar to the cup you labelled sugar and add 1 tablespoon of salt to the glass you labelled salt and leave the control glass with only water
4. Add 1 ice cube to each cup



5. Once all of the cups have an ice cube in it start the stop watch and check back every 30 seconds to check how much the ice has melted
6. While checking on the ice create 3 columns in your notebook 1 column for each glass and when you check back on the ice and the ice is still there put a tick in the column that corresponds to the glass but if the ice melted do the same but put a cross this will clearly show which ice cube melted first.
7. Repeat the experiment again and record results to fact check
8. Repeat one more but stir each glass 1st every 3 minutes then then repeat the experiment but stir it every minute.



Results

Experiment 1 (selected time results)

<u>Time (mins)</u>	<u>Glass 1 (fresh)</u>	<u>Glass 2 (salt)</u>	<u>Glass 3 (sugar)</u>
<u>0</u>	✓	✓	✓
<u>5</u>	✓	✓	✓
<u>10</u>	✓	✓	✓
<u>13</u>	✗	✓	✓
<u>15</u>	✗	✓	✓
<u>20</u>	✗	✗	✓
<u>25.5</u>	✗	✗	✗

Experiment 2 (repeat of experiment 1)

<u>Time (mins)</u>	<u>Glass 1 (fresh)</u>	<u>Glass 2 (salt)</u>	<u>Glass 3 (sugar)</u>
<u>0</u>	✓	✓	✓
<u>5</u>	✓	✓	✓
<u>10</u>	✓	✓	✓
<u>15</u>	✗	✓	✓
<u>20</u>	✗	✓	✓
<u>25</u>	✗	✓	✓
<u>39</u>	✗	✗	✓
<u>40</u>	✗	✗	✗

Experiment 3 (stirring every 3 mins)

<u>Time (mins)</u>	<u>Glass 1 (fresh)</u>	<u>Glass 2 (salt)</u>	<u>Glass 3 (sugar)</u>
<u>0</u>	✓	✓	✓
<u>5</u>	✓	✓	✓
<u>10</u>	✓	✓	✓
<u>13</u>	✓	✗	✓
<u>14.5</u>	✗	✗	✓
<u>18</u>	✗	✓	✓
<u>39</u>	✗	✗	✓
<u>40</u>	✗	✗	✗

Experiment 4 (stir every minute)

<u>Time (mins)</u>	<u>Glass 1 (fresh)</u>	<u>Glass 2 (salt)</u>	<u>Glass 3 (sugar)</u>
<u>0</u>	✓	✓	✓
<u>5</u>	✓	✓	✓
<u>8</u>	✓	✗	✓
<u>10</u>	✓	✗	<u>X</u>
<u>11.5</u>	✗	✗	<u>X</u>

Experiment 1 and 2

I was very surprised that the fresh water beat out the salt and the sugar. This was even more noticeable in experiment 2, This could be because in experiment 2 the salt had more time to dissolve into water. The glass with sugar in it was included in the experiment to see if any other substances added to water would affect the ice melting time.

It seems the higher the salinity of the water the slower the ice melts however saltwater is denser than fresh water so could it be that the salt water is lying at the bottom of the cup while the colder fresh water (from the melted ice is from the top)

The melting ice will be colder than the fresh water so will sink to the bottom of glass 1 and be replaced by warmer water moving up to the top meaning the water is constantly moving. This is in contrast to glass two and three where there is less water movement because of the density of the salt and sugar solutions. The lack of circulation results in an equilibrium at the interface of the ice and water so the ice melts more slowly.

Experiment 3 and 4

To test this theory that the movement of the water would cause ice to melt quicker we stirred each glass first every 3 mins and then again for every 1 minute. The results show that by the creation of a water current the salt did melt the ice faster and with enough current the sugar can have the same effect.

Conclusion

In conclusion if the salt in seas continue to rise it will affect the water current because of the density and will eventually affect the water cycle and thus the weather. The experiment series does support the theory that salt water melts ice more quickly. It does this by reducing the energy required for the ice to melt as salt water has a lower freezing point. This might also have an impact on ice caps melting.

References:

1. P. A. Stott, R. T. Sutton & D. M. Smith, "Detection and attribution of Atlantic salinity changes", *Geophysical Research Letters*, Vol. 35, L21702 (2008).