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June 5, 2015

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THE RATES OF SOLUBILITY OF SODIUM CARBONATE IN WATER UNDER DIFFERENT TEMPERATURES

EXPERINMENT AIM

To measure the mass of sodium carbonate dissolve in water under different temperatures during the certain time.

LAB MATERIALS

- 1 Water bath
- 2 thermometers (from -10-120 oc)
- 2 glass stirring rods
- 2 stop watches
- 2 test tube racks
- 4 large boiling test tubes
- Two small beakers (25ml)
- I spoon/ spatula

- 800 milliliters of distilled/deionized water
- 100 grams of sodium carbonate
- Pipette(0.0-25.0ml)
- 1 plastic beakers(100 ml)
- An electrical scale(accurate to 0.001g)

LAB PROCEDURE

1. Put a test tube in to a plastic beaker, and then weigh them, record the data down.
2. Heat up the water bath to 40^{o}c, put a thermometer in water bath in order to get the right temperature.
3. Pour 25 ml water into the test tube by using pipette; put it into water bath when water bath's temperature reaches 40^{o}c.
4. Put a thermometer inside the test tube, and then wait for it to heat up, until it reaches 40^{o}c
5. When it reaches40^{o}c, turn on a timer. Gradually put a spatula of sodium carbonate into test tube while stirring it. Keep stirring the solution at the same rate.
6. Until the solution becomes clear again and there is no powder at the bottom, add another spatula of solute. Remember to keep stirring the solution during the process.
7. After 5 minutes past put the test tube in plastic beaker reweigh it. Record it down.
8. Repeat the step 1-6 to obtain the results about the mass of Sodium Carbonate dissolve in water at 40^{o}c, 50^{o}c, 60^{o}c, 70^{o}c, 80^{o}c in 5 minutes.
9. Repeat the step 1-7 twice, to obtain 3 sets of data under each temperature.

DATA COLLECTION

	First time		Second time		Third time	
Temperature (^{o}c)	Mass in total(g)	Mass of the test tube and plastic beaker(g)	Mass in total(g)	Mass of the test tube and plastic beaker(g)	Mass in total(g)	Mass of the test tube and plastic beaker(g)
40	85.0176	58.1719	89.5607	59.1487	89.7738	60.6054
50	89.2277	60.0513	89.4655	60.3373	91.9920	61.3461
60	90.8601	60.0732	92.0036	61.3461	90.3561	59.0381
70	92.7451	60.7513	91.8501	60.2539	93.9760	60.3508
80	93.7985	60.2907	94.4643	60.7513	94.9573	59.8267

UNCERTAINTY OF APPARATUS:

Pipette: ±0.05ml
Electronic scale: ±0.001g

DATE PROCESSING

The density of water=1000kg/m3=1.000g/cm3
Reference from Wikipedia: http://en.wikipedia.org/wiki/Properties_of_water
The volume of water is 25.0±0.05 ml = 25.0±0.05 cm3
Percentage uncertainty of the volume of water is 0.2%
The mass of water= 25.0cm3 x 1.000g/cm3=25.0g
The uncertainty of the mass of water=25.0g x 0.2%=0.05g
The mass of water=25.0±0.05g
The mass of solute dissolve in water = the mass in total- the mass of the plastic beaker and the test tube- the mass of water.
The average mass of sodium carbonate dissolved in water (25ml) under different temperatures.

ERROR ANALYSIS

	First time	Second time	Third time	
Temperature (^{o}c)	Mass of solute dissolved in water(g))±0.052g	Mass of solute dissolved in water(g))±0.052g	Mass of solute dissolved in water(g))±0.052g	Mass in average (g) ±0.052g
40	1.9	3.4	4.2	3.8
50	4.2	4.1	5.7	4.7
60	5.8	5.7	6.3	5.9
70	7.0	6.6	8.6	7.4
80	8.5	8.7	10.1	9.1

DATA PRESENTING

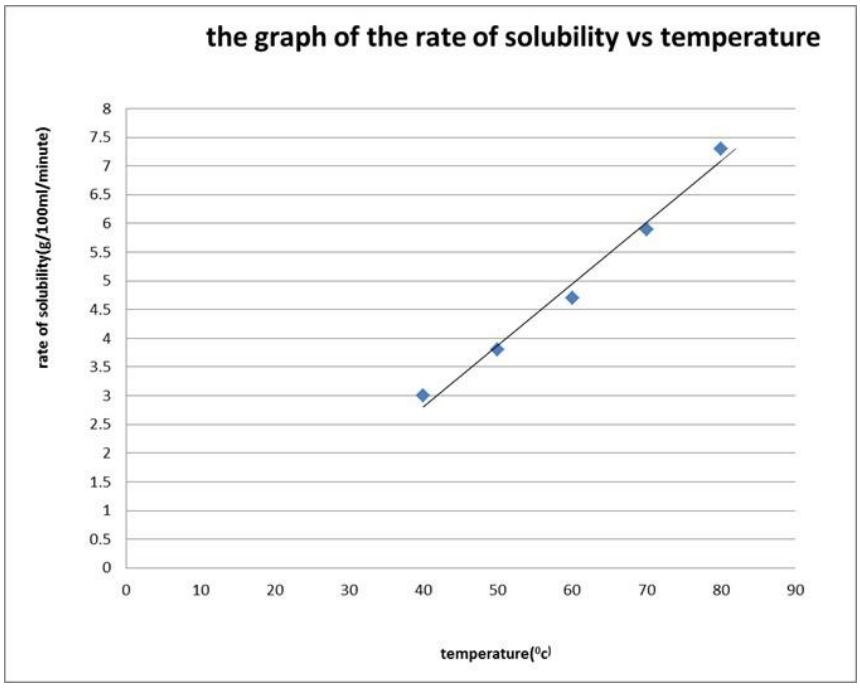

Figure 1: Literature values of solubility of Sodium carbonate

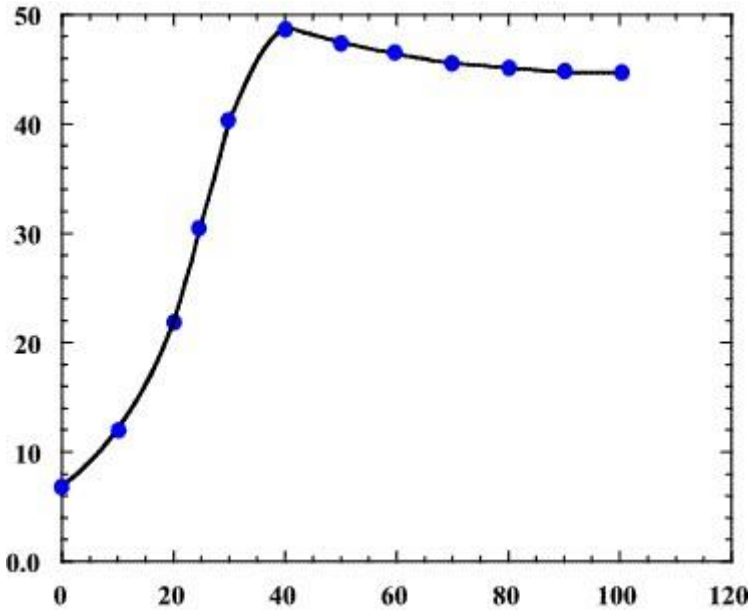

Figure 2: Solubility of sodium carbonate in gram per 100g H_2O versus temperature (°C)

CONCLUSION

The experiment show us that the temperature of solvents increases makes the rate of solubility of solvent increases with a constant rate of changes.From the graph, the best fitted line is a steep straight line growing up from left to the right. According to the algebra theory, there is a linear relationship between independent values (temperatures of solvents) and dependent values (the mass of the solutes dissolve in a solvent within 5 minutes). And the constant rate is positive due to the shape. That means, the mass of Sodium Carbonate dissolve in water will change with a positive constant rate as temperature of the water changes.

From the literature values, we can know that the solubility of Sodium Carbonate is 48.81g/100ml at 40oc, 47.49g/100ml at 50oc, 46.41g/100ml at 60oc, 45.56g/100ml at 70oc , 45.14 g/100ml at 80oc.The result I got for the mass of sodium carbonate dissolve in water with 5 minutes is 15g/100ml at 400c, 19 g/100ml at 50oc, 24g/100ml at 60oc ,30g/100ml at 70oc, 36 g/100ml at 80oc.So we can know that the solutions were not saturated during the experiment. So the maximum solubility would not affect the result I got. The literature values show a decreased trend of solubility from 40oc to 80oc. From the errors analysis, the percentages errors I got are range from 2.9% to 8.9%, the error I got from each result is different. When converted the percentage into numbers, the values can be 14.05-15.95/100ml at 400c, 17.3-20.7g/100ml at 50oc, 23.30-24.70g/100ml at 60oc, 28.3-31.7g/100ml at 70oc, 34.7-37.3g/100ml at 80oc. Even comparing literature results to experimental results with the ranges of errors, the trend of solubility against temperatures is different from the mass of sodium carbonate dissolve in water within 5 minutes. This proves that the solubility of sodium carbonate in 5 minutes under various temperatures, but cannot represent the actual trend of solubility of sodium carbonate.

From the errors analysis, the error I got from each result is different. The difference between maximum percentage errors to minimum percentage error is 6.0%. this means the errors we made through the experiment are not only about the measuring errors or calculation errors. There are some other errors occur through the experiment, such as inconstant rate of stirring. The errors also can be also caused by loss of water (evaporation during experiment), impure substance etc, there are also some variables which we can not control, for example, the air pressure(the experiments costs us 2 class periods. So we had to do it on different day, so the air pressures can be very different.), the bigger air pressure is, the greater the rate of solubility is.

Sincerely,

Ding Xijia

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College Student