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Section 01

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Gravimetric Determination of Chloride and Sulfate

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Abstract:

The values calculated for Cl- were 17000mg/L, 480mmol/L, and 5.04% mass. The average values for Sulfate was 1666.67mg/L, 17.34mmol/L, and .4% mass.

Introduction:

The purpose of this experiment is to find out the concentrations of Cl- and SO42- using gravimetric methods of analysis. Small aliquots of Millipore seawater is taken out and put into a beaker mixed with solutions that are able to create precipitates with Cl- or SO42- respectively. Once the precipitate forms, the amount of Cl- and SO42- can be quantitatively found.

Results and Discussion:

Table I: Raw Collected Data

Part II	
Weight of 50mL Beaker	31.1762g
Weight of 50ml Beaker + 1.5mL seawater	33.2187g
Filter Weight	.0853g
Filter weight after oven	.1882g
Part III and IV	
Seawater I	
Beaker mass	30.2385g
Beaker and 1.5ml seawater mass	31.7595g
Filter Weight	.0742g
Filter weight after oven	.0815g
Seawater II	
Beaker mass	28.6795g
Beaker and 1.5ml seawater mass	30.1941g
Filter Weight	.0707g
Filter weight after oven	.0756g

Table I includes the raw collected data for parts II, III, and IV during the experiment.

Table II: Calculations of data involving Chloride

Chloride Calculations	
Precipitate Mass	.1029g AgCl
Mass of Cl-	.0255g Cl-
Mg/L Concentration of Cl-	17000mg/L Cl-
Mmol/L Concentration of Cl-	480mmol/L Cl-
% Mass of Cl-	5.04% mass

This table includes the calculated values for precipitate mass, mass of Cl-, concentration of Cl- in both mg/L and mmol/L and the % mass of Cl-.

Sample Calculations for Cl- Concentration:

Mass of filter: .0853g

[1] https://www.lenntech.com/composition-seawater.htm

After Oven weight: .1882g

Precipitate alone: .1882g - .0853g = .1029g AgCl

.1029g AgCl x 1molAgCl/143.32g AgCl x 1mol Cl-/1mol AgCl x 35.45gCl-/1mol Cl- = .0255g Cl-

.0255g x 1000mg/1g = 25.5mg Cl- / .0015L of seawater = 17000mg/L Cl-

.0255g Cl- / 35.45g Cl- = .00072mol x1000mmol/1mol / .0015L of seawater = 480mmol/L

.1029g / (33.2187g - 31.1762g) x 100 = 5.04% mass

Table III: Calculations of data involving Sulfate

Sulfate Calculations	
Seawater 1	
Precipitate Mass	.0073g BaSO4
Mass of Sulfate	.003g SO42-
Mg/L Concentration of Sulfate	2000mg/L SO42-
Mmol/L Concentration of Sulfate	20.67mmol/L SO42-
% Mass of Sulfate	.48% mass
Seawater 2	
Precipitate Mass	.0049g BaSO4
Mass of Sulfate	.002g SO42-
Mg/L Concentration of Sulfate	1333.33mg/L SO42-
Mmol/L Concentration of Sulfate	14mmol/L SO42-
% Mass of Sulfate	.32% mass
Averages	
Mass of Sulfate	.0061g
Mg/L Concentration of Sulfate	1666.67mg/L
Mmol/L Concentration of Sulfate	17.34mmol/L
% Mass of Sulfate	.4% mass

This table includes the calculated values for precipitate mass, mass of sulfate, concentration of sulfate in both mg/L and mmol/L and the % mass of Sulfate. This table also includes the average values for each section.

Sample Calculations for SO42- Concentration:

Seawater 1:

Mass of filter: .0742g

After oven weight: .0815g

Precipitate alone: .0815g - .0742g = .0073g BaSO4

.0073g BaSO4 x 1mol BaSO4/233.38g BaSO4 x 1mol SO42-/1 mol BaSO4 x 96.06g SO42-/1 mol SO42- = .003g SO42-

[1] https://www.lenntech.com/composition-seawater.htm

.003g x 1000mg/1g = 3mg SO_4^{2-} / .0015L of seawater = 2000mg/L SO_4^{2-}

.003g SO_4^{2-} / 96.06g SO_4^{2-} = .000031g x 1000mmol/1mol / .0015L of seawater = 20.67mmol/L

.0073g / (30.2385g - 31.7595g) x 100 = .48% mass

Seawater 2:

Mass of filter: .0707g

After oven weight: .0756g

Precipitate alone: .0756g - .0707g = .0049g $BaSO_4$

.0049g $BaSO_4$ x 1mol $BaSO_4$/233.38g $BaSO_4$ x 1mol SO_4^{2-}/1 mol $BaSO_4$ x 96.06g SO_4^{2-}/1 mol SO_4^{2-} = .002g SO_4^{2-}

.002g x 1000mg/1g = 2mg SO_4^{2-} / .0015L of seawater = 1333.33mg/L SO_4^{2-}

.002g SO_4^{2-} / 96.06g SO_4^{2-} = .000021g x 1000mmol/1mol / .0015L of seawater = 14mmol/L SO_4^{2-}

.0049g / (30.1941g - 28.6795g) x 100 = .32% mass

Averages:

Mass: .0073 + .0049 / 2 = .0061g

In mg/L: 2000 + 1333.33 / 2 = 1666.67mg/L

In mmol/L: 20.67 + 14 / 2 = 17.34mmol/L

Mass %: .48 + .32 / 2 = .4% mass

% error between Turbidimetric and Gravimetric labs:

2369.64ppm - 1666.67ppm / 2369.64ppm x 100 = 30%

Chloride % error:

18890ppm – 17000ppm / 18890ppm x 100 = 10%

Compared to the turbidimetric analysis performed on seawater, the concentration undergone by gravimetric analysis yielded a lesser concentration for sulfate within the seawater. The % error from this lab compared to the turbidimetric lab was around 30%. Comparing the values of calculated Sulfate and Chloride, the average amounts[1] of sulfate and chloride are 2649ppm and 18890ppm respectively. The chloride % error was about 10%.

Lab Questions:

1. To convert the column into a nitrate form, just pass nitrate ions through the column.
2. If the resin dries, there can be no ions that are able to pass through the dried and solid resin column.

[1] https://www.lenntech.com/composition-seawater.htm

3. If the resin bed is disturbed too much, the packed ions within the resin become loose and able to be removed.
4. Making the dropping too fast yields a higher chance of not having the solution clear of the specific ion that the experiment is trying to measure.
5. Sulfate ions are more negatively charged which means they will have stronger bonds between the resin column versus that of chloride.
6. $2AgCl \rightarrow 2Ag + Cl_2$
7. Whitish gray
8. Deionized water will not get rid of the excess ions within the solution and washing the solution with HNO_3 allows for the removal of potential ions that the experiment is not testing for.
9. $Ba^{2+} + 2HCO_3^- \rightarrow BaCO_3$, barium carbonate is not soluble in water, but in most acids it is.
10. $HNO_3 + HCO_3^- \rightarrow H_2O + CO_2 + NO_3^-$, fizzing occurs because of CO_2 being created from the reaction.
11. To make the reaction shift a direction from equilibrium yielding a better result.

[1] https://www.lenntech.com/composition-seawater.htm