Alan Yu

TA: Supriya

Analytical Chemistry Lab

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Suspended and Dissolved Particulate Matter in Sea Water

Abstract:

After conducting the lab, the calculation of the deionized water density yields .998g/mL. This density is almost the recorded density of water at 24 degrees Celsius. The density of seawater was about .9972g/mL, and compared to the deionized water, it was close. For the density of the dissolved solids, it was calculated to be .03387 g/mL. The suspended solids in mg/L was $4.3x10^{-6}$mg/L and the value for mg/kg was $4.3x10^{-3}$mg/kg, both found in Table 3.

Introduction:

Water is a necessity for all organisms to prosper. Water makes up the majority of the Earth's surface, about 71%. Although the Earth is about 70% of water, less than 5% of the water is drinkable naturally. The natural pH of water is about 7.0, while seawater has all sorts of solids and particulates within it. The actual pH of seawater is unknown and has to be found by experimenting with samples of seawater. These samples of seawater can come from many different regions and so the pH will vary from region to region.

The purpose of this lab was to find the density of the seawater and the amount of unknown suspended particulates within the seawater. These measurements give a sense of the differences between pure water and seawater. The importance of these findings is crucial to finding the amount of each particulate within the sample. With finding the specific particulates within the sample, we could tell what is in the sample that makes seawater acidic or basic depending on the sample.

Experimental Methods:

One method that was used was the use of the automatic pipette. This pipette is used to get an accurate amount of sample, specifically 5mL of deionized water, for each trial. Using a self-measurement yields higher chances of error. To acquire better results, this experiment was done with three trials to see the deviations.

The method to get the amount of suspended particulates was the use of a filter assembly. The assembly filtered two different portions of 750mL of the seawater sample that was acquired. The first filter was through a Millipore APFF04700 filter while the second one was filtered through an Osmonics 04WP04700 which was the primary method of getting the data for the suspended particulates and dissolved solids. The Millipore filtered seawater was the primary source of the data samples from weighing bottles and the oven measurements. After two samples

[1] "Mass, Weight, Density or Specific Gravity of Water at Various Temperatures", www.simetric.co.uk/si_water.htm.

of 750mL of seawater was filtered through a filter respectively, the filtered samples were stored away in a 1L bottle each for later use.

During the experiment a second weighing bottle set is set aside and put into the oven for about an hour so that it can dry after being cleaned. This is so that the set is completely dry and not have a big deviation when weighing. A 5mL sample of Millipore filtered seawater is used to be put in the oven so that the particulates can be weighed after all the seawater has evaporated from being in the oven.

Inclusion of Raw Data:

Table I: Raw Collected Data:

Lab Temp: 24°C	**Density of water at 24°C:** .997296g/mL
Pipette Calibration	
Trial 1:	
Mass of weighing bottle, lid and 5 mL DI water	23.6892g
Mass of weighing bottle and lid	18.8163g
Trial 2:	
Mass of weighing bottle, lid and 5 mL DI water	23.6451g
Mass of weighing bottle and lid	18.7658g
Trial 3:	
Mass of weighing bottle, lid and 5 mL DI water	23.6861g
Mass of weighing bottle and lid	18.7667g
Millipore Filtering Data Collection	
Before Oven	
Weight with lid and bottle	22.0247g
Weight with lid, bottle, 5mL filtered water	27.0603g
After Oven	
Weigh of weighing bottle, lid, and particulate 1	22.1987g
Weigh of weighing bottle, lid, and particulate 2	22.1922g
Osmonics Filtering Data Collection	
Weight of Osmonics Filter Paper before filtering	.0750g
Weight 1 of Osmonics Filter Paper after filtering	.2557g
Weight 2 of Osmonics Filter Paper after filtering	.0782g

Table I contains the data that was collected during the experiment except for the Density of water at 24 degrees Celsius. This was found on the SImetric[1] site. Each section has been bolded to show a difference of each experiment and the amount of trials that were done.

Results and Discussions:

Part I: Density of seawater and concentration of dissolved solids

Table II: Part I Calculated results:

Pipette Calibration-Volume Delivered		**Averages**	**Used Uncertainty**
Trial 1	4.89mL	4.90mL	±.01mL
Trial 2	4.89mL		
Trial 3	4.93mL		
Density of DeIonized Water			
Trial 1	.997g/mL	.998g/mL	
Trial 2	.998g/mL		
Trial 3	.998g/mL		
Uncertainty of Density		±.0046g/mL	
Mass of Particulates			
Mass 1	.174g	.171g	
Mass 2	.168g		
Mass of Seawater in bottle		5.034g	
Volume of Seawater in bottle		5.048mL	
Density of Seawater		.9972g/mL	
Concentration of particulates		.03387 g/mL	

Table II contains the calculated data from the trials for the amount of deionized water delivered from the automatic pipette. The averages and the uncertainty has also been included for what values were used to find the uncertainty of density also in Table II.

Calculations:

Pipette Calibration-Volume Delivered:

Trial 1: 23.6892g – 18.8163g = 4.8729g of filtered water / .997296g/mL = 4.89mL delivered

Trial 2: 23.6451g – 18.7658g = 4.8793g of filtered water / .997296g/mL = 4.89mL delivered

Trial 3: 23.6861g – 18.7667g = 4.9194g of filtered water / .997296g/mL = 4.93mL delivered

Average Volumes: 4.89mL + 4.89mL + 4.93mL = 14.71mL / 3 = 4.90mL

Volume uncertainty: ±.01mL

Average Masses: 4.8729g + 4.8793g + 4.9194g = 14.672mL / 3 = 4.891g

Mass uncertainty: ±.02g

Density of DeIonized Water:

Trial 1: 4.8729g / 4.89mL = .997g/mL

Trial 2: 4.8793g / 4.89mL = .998g/mL

Trial 3: 4.9194g / 4.93mL = .998g/mL

Average of three trials: .997g/mL + .998g/mL + .998g/mL = 2.993 / 3 = .998g/mL

Uncertainty of Density:

Uncertain d = .998g/mL x $\text{sqrt}((.02\text{g}/4.891\text{g})^2 + (.01\text{mL}/4.90\text{mL})^2)$

Uncertain d = ±.0046g/mL

Mass of Particulates:

Mass 1: 22.1987g – 22.0247g = .174g

Mass 2: 22.1922g – 22.0247g = .168g

Average of particulate masses: .174g + .168g = .342g / 2 =.171g

Mass of seawater in bottle: 27.0603g – 22.0247g = 5.034g

Volume of seawater in bottle: 5.034g / .997296g/mL = 5.048mL

Density of seawater: 5.034g / 5.048mL = .9972g/mL

Concentration of particulates: .171g / 5.048mL = .03387 g/mL

1 LB of NaCl calculation:

1 LB = 453.592g NaCl x .005048L / .171g = 13390 mL of seawater

Part I Discussions:

The average calculated volume from the automatic pipette was 4.90mL. While the dial was set to deliver 5.00mL of the deionized water, it only delivered an average of 4.90mL. This means that the pipette had an uncertainty of .10mL. The volume that was actually delivered was as if the dial on the pipette was on the 4.90mL dial.

From the calculated density of the sample, it was .998g/mL. Compared to the .997296g/mL at 24 degrees Celsius from Table I. The uncertainty that was calculated was about .0046g/mL can be found within Table II.

It is not possible to calculate the molarity of the dissolved solids because the equation for molarity is moles of solid / volume. Since there are many particulates within the seawater sample, there is not enough information to just divide the mass by volume to find what kind of concentration it is.

Using the found concentration of dissolved solids in the sample, the amount of seawater that would be able to hold one pound of seawater would be 13390 mL.

Part III: Concentration of suspended particulates

Table III: Part III calculated results:

Mass of suspended particulates	.0032g
Volume of seawater filtered	750mL
Concentration in mg/L	$4.3x10^{-6}$mg/L
Concentration in mg/kg	$4.3x10^{-3}$mg/kg

Table III includes the calculation of the mass of suspended particulates, volume of filtered seawater, and the concentrations in mg/L and mg/kg.

Calculations:

Mass of suspended particulates: .0782g - .0750g = .0032g of suspended particulates

Volume of seawater filtered: 750mL of seawater

Concentration in mg/L: .0000032mg / .75L = $4.3x10^{-6}$mg/L

Concentration in mg/kg: .0000032mg x (1mL / .998g) x (1000g / 1kg) x (1L / 1mL) x (1 / .75L) = $4.3x10^{-3}$mg/kg

Part III Discussions:

The first weigh after filtering was .2557g which was a large difference than the second weigh and the original mass of the filter paper. Either the error was in the amount of time that was allotted for the filter to dry was not big enough, or that the oven was a needed step to get an accurate measurement close to the original weight of the Osmonics sheet, found in Table I, weighing about .075g.

Overall Experiment Discussions:

As the experiment was conducted, the calculation for the density of seawater, .9972g/mL compared to that of water being .99726g/mL at 24 degrees Celsius. This difference could be a result of human error or the pipette induced error. The pipette did not acquire 5mL of sample each time, but a deviation of ±.1mL. The calculation for the density of the deionized water was .998g/mL compared to the .99726g/mL which is extremely close, but not on the dot. This has some human error and machinery error implications as well. These errors can all be reduced with more trials which leads to an average that would be more suitable to do in a bigger time frame.

Lab Question 1: Why should the sample container be capped when not in use?

So that no sample evaporates, or new components enter the sample container.

Lab Question 2: Why are these characteristics of the filter important for this application?

So when the filter gets weighed, the data can be as close as the other weight the filter without messing up that data too much.

Conclusion:

After completing the lab, the automatic pipette can be found to have an uncertainty of ±.1mL. This experiment also shows the density of seawater to be slightly different from that of pure water at 24 degrees Celsius. Table I displays pure water with .997296g/mL and from Table II the density of seawater is about .998g/mL. From that the calculated uncertainty for density was about ±.0046g/mL. Following the uncertainty density, it was found that the concentrations of the suspended particles was $4.3x10^{-6}$mg/L and $4.3x10^{-3}$mg/kg respectively. This end of this experiment opens a gateway for many other experiments that could be done with samples saved.

Grading Grid

	Item		Points
1	Abstract		
2	Introduction		
3	Experimental Methods		
4	Volume delivered by calibrated autopipette	4.90mL	
5	Density of Filtered Seawater in g/mL	.9972g/mL	
6	Uncertainty in Density g/mL	±.0046g/mL	
7	Concentration of Dissolved Solids in g/mL	33.87 g/L	
8	Volume of Water in mL to deliver 1 lb of Table salt	13390 mL	
9	Concentration of Suspended particulates in mg/L	$4.3x10^{-6}$mg/L	
10	Concentration of Suspended particulates in mg/kg	$4.3x10^{-3}$mg/kg	
11	Questions, Presentation, Other		
	TOTAL		