

LAB - HARD WATER ANALYSIS - INQUIRY

*This must be done **after** the Gravimetric Analysis Lab.*

CONTEXT

Have you ever had difficulty lathering soap or find that the scum in your shower constantly needs to be removed? These are signs of “hard water.” Soap doesn’t lather well in hard water because metal ions, such as Ca^{2+} , form precipitates, creating “soap scum.” A *precipitate* is an insoluble compound that forms when soluble ions in separate solutions are mixed together. Because this happens, soap is a less effective cleanser in hard water. Even laundry can appear dingy or feel rough when washed in hard water.

INVESTIGATION

A client is looking to move into your community. While there are multiple factors that will help him decide where to purchase a house, he is hoping to find a location where a water softener will not be needed. Several samples of water were collected from around the area. You need to analyze one of the samples, determining the hardness in mg of CaCO_3 per L of solution.

Each sample has been boiled to concentrate the metal ions. Since water hardness measures CaCO_3 in mg/L, saying that a sample of water is 60 mg/L as CaCO_3 means that there are 60 grams of CaCO_3 for every 1×10^6 g of solution (ppm). Therefore, the volume of the water samples has been reduced by 200 times. This means that 240 mg (0.24 g) of CaCO_3 can be collected from a 20 mL water sample that has been boiled.

MATERIALS:

Chemicals	Equipment	
<ul style="list-style-type: none">50 mL bottle of water samplesodium carbonate to make 50 mL of a 0.5 M solution (direction to make solution are in procedure)	<ul style="list-style-type: none">BeakerGraduated cylinderFunnelStirring rodWatch glass	<ul style="list-style-type: none">25 mL volumetric flaskScaleWash Bottle (for distilled water)Drying oven (optional)
Consumables		
Filter paper		
Student Provided		
<ul style="list-style-type: none">Distilled waterCoffee stirrer or wood splint (to use as a scoop)Stand and Clamp (see document in sidebar to make your own if you cannot borrow these)		

SAFETY and DISPOSAL

All solutions can be flushed down the drain. Normal laboratory precautions should be taken, including wearing goggles at all times. Information about each chemical can be found in the safety section.

PROCEDURE

Based on what you learned in the Gravimetric Analysis Lab, design your own procedure that will determine the unknown concentration of Ca^{2+} ions as mg of CaCO_3 per L of solution, in a 20 mL aliquot of a water sample.

You will make your own sodium carbonate solution to use in this reaction. You will need 50 mL (using about 25 mL for one trial) of approximately 0.5 M sodium carbonate. To make this, dissolve 2.5 g of CaCO_3 in 50 mL of distilled water.

Write out a detailed, step-by-step procedure, a list of materials needed, and a data table for measurements and observations. Consider what data is needed to obtain the concentration of the Ca^{2+} ions. Keep a detailed record of your data and observations.

DATA / CALCULATIONS / CONCLUSIONS

Present your data in a clear and organized manner. Charts or tables are a good way to keep organized. In addition to your data, you will also share your calculations in this section. Always show your work and highlight your final answer in some way that makes it stand out.

You may show the calculation for your final result in this section or may put the conclusions separate. Either way, it should be clear how the data and final result are connected.

In your conclusion, explain how gravimetric analysis was used to determine the hardness of the water.

Go back through the lab and read it several times to look for data you will need to gather and what you will need to present as your final result!

LAB REPORT

Write a formal lab report for this lab. Instructions for formal reports will be posted in the same sidebar as this lab.

Submit to Dropbox / Lab: Hard Water Analysis