Complexometric determination of water essay sample

Environment, Water

Abstract

Determining the water hardness of unknown sample #55 was determined by complexometric titration. With the use of disodium salt EDTA as the solution to chelate the metal impurities and the Eriochrome Black T indicator as the solution used to help visualize when the impurities were completely chelated, along with a few other solutions to help the reaction. Unknown water sample #55 experimental calculations determined that the water hardness was considered in the range of " very hard" water in comparison to Tempe's expected range for municipal water hardness.

Introduction

Determining water hardness can be done in different ways. This lab will determine the hardness of water through a complexometric titration. Using sodium EDTA as the chelating agent to form complexes with the metal impurities in the solutions calcium carbonate and unknown sample. Complexes will form from sodium EDTA reacting with impurities because each element from disodium EDTA carboxylic acid groups will donate an electron pair to the metal impurities ion center. ammonia/ammonium chloride buffer used in today's lab will reassure calcium metal ions and metal ions in unknown water sample remain in solution being determined for accurate results. The Eriochrome Black T indicator will turn the solution being determined a pink color to ensure there is metal cations in the solution being determined. Equation 1 shows the reaction involving the indicator and metal ion.

$H_2In^-(aq) + M^{2+}(aq)$

MIn-(aq) + 2H+(aq)

Equation 1

Once disodium EDTA solution is added the solution will turn form pink to blue. Equation 2 shows reaction occurring.

EDTA4-(aq) + MIn-(aq) + 2H2+(aq) –> H2In-(aq) + MEDTA2-(aq)

Equation 2

Blue color will determine endpoint of titration.

With this experiment the hardness of water for calcium carbonate and unknown sample can be calculated. Calculation will be calculated by determing the molarities (mol/L) and mean molarities of disodium EDTA along with calculating the estimated precision (ppt). Equations can be found in rates and discussion part of this lab. At the end of experiment compare results to expected range for municipal water hardness. This can be found on website (www. tempe. gov/waterquality/typical_values).

Procedure

Prepare 500 mL of 0. 004 M disodium EDTA (Na2EDTA) solution in a bottle; shake vigorously to dissolve the salt.

Experiment to standardize the Na2EDTA solution using a stock calcium ion solution as the primary standard. Prepare 10. 00 mL of standardized calcium ion stock solution (1. 000 g CaCO3/L solution) in a 250-mL Erlenmeyer flask. Add 30 mL of deionized water to this titration flask. Include a magnetic stir-bar for stirring during titration. Add 3 mL of ammonia/ammonium chloride

buffer (NH3/NH4Cl). Stir for 30 seconds. Just prior to titrating the flask, add four drops of Eriochrome Black T indicator solution. Stir for another 30 seconds, then titrate with the Na2EDTA solution. At the endpoint, the color changes from pink to violet to blue.

Repeat this titration two more times, for a total of three trials. Calculate the molarity of your Na2EDTA solution from each titration. Average the molarities from the three trials and calculate the precision. Choose one prepared unknown water sample as provided. Record the code for the unknown water sample, then titrate this water sample with the standardized Na2EDTA solution. Start by transferring 25 mL of the prepared unknown sample to a 250-mL Erlenmeyer flask.

Add 20 mL of deionized water to the titration flask. Stir, then add 3 mL of NH3/NH4Cl buffer. Stir for 30 more seconds and add four drops of Eriochrome Black T indicator solution before titration, as before. Stir another 30 seconds and then titrate this solution with your standardized Na2EDTA solution. Repeat this titration twice more, for a total of three trials. Calculate the hardness of the prepared water sample from each of the titrations. Calculate the average hardness and the experimental precision from the three trials.

Finally, compare the results to the expected range for municipal water hardness. Check your city’s water quality lab website.

Conclusion

Findings of the unknown water sample (#55) were found to be in the range

of “ hard” water. Titrating the disodium EDTA solution into the unknown water sample chelates the metal impurities. Adding the Eriochrome Black T indicator will allow the visualization of when the impurities are completely chelated. Measuring the specific volume of each solution used in the experiment will allow the information needed to calculate the water hardness. Calculating the molarities and mean molarities of all trials, except A3 which was a measurement error, allows the experimental deviation calculations to be obtained.

Calculating the experimental deviation in parts per thousand (ppt) and recalculating the units to grams per gallon (gpg) allowed the comparison of water hardness to ‘ Tempe expected range for municipal water hardness’. The comparison shows that unknown water sample #55 ranged in the category of “ hard” water, with the calculation sum of 23. 3667 gpg. All water hardness values over 200 ppm is considered hard water.

Resources

1) www. tempe. gov/waterquality/typical_values. htm

2) Complexometric Determination of Water Hardness CHM 152 lab manual Fall 2014 3) http://www. mesaaz. gov/water/PDF/2014ccr. pdf