Hardness removal

[Environment](), [Water]()

Lab X3: Hardness Removal The objective of the experiment was to remove water hardness through the use of different methods such as chemical addition, flocculation, and settling.

Equipment Used: Buret 150 mL beaker 1-2L jar Filter paper, funnel Stir bar, magnetic stirrer Rapid mix reactor. Stopwatch Fisherbrand 100-1000?

L digital pipet – serial number: DH94800 pH indicator paper Experimental conditions – 74. 6?

F Data and Analysis Table 1:

Parameters of untreated water	
pH	6. 9
ALK total (mg/L as CaCO3)	188
TH (mg/L as CaCO3)	328
Calcium hardness (mg/L as CaCO3)	296
Magnesium hardness (mg/L as CaCO3)	32

Questions:

1. Based on this experiment what additional step is needed to make the water suitable for human consumption?
2. What was the percentage of removal of total hardness, calcium, and magnesium? The percentage removal for total hardness was 74. 39%, for Calcium 80. 06%, and for Magnesium 21. 88%. Total Hardness Percentage Removal = 100-84328*100= 74. 39 % Calcium Percentage Removal = 100-59296*100= 80. 06% Magnesium Percentage Removal = 100-2532*100= 21. 88%
3. How close did the treatment process come to reaching the practical limits of hardness reduction? Hardness removal limits were not achieved. Calcium was reduced to a concentration of 59 mg/L versus the limit of 30 mg/L. And in the case of Magnesium, the concentration was reduced to 25mg/L versus the limit of 10mg/L. Calcium percent difference: 30-5930= 96. 66% (Absolute value) Magnesium percent difference: 10-2510= 150% (Absolute value)
4. How many metric tons of Ca(OH)2 and NaCO3 are necessary to process 59 million gallons of water per day based on the calculations of 1. a. and 1. b.?

To run this water softening technique in a water plant processing 59 million gallons per day it would require 51 tons ofCa(OH)2 and 33 tons of NaCO3 2. 27*10-4kgL*223. 02*106L*(ton1000 kg)= 51 tons of CaOH2 per day 1. 48*10-4kgL*223. 02*106L*(ton1000 kg)= 33 tons of NaCO3 per day.

Discussion

Hard water is an issue for industries that rely on large amounts of water to operate. Hardness generated by elements such as calcium and magnesium cations produces scum in pipes and with many industrial chemicals reduces their overall effectiveness. That is why it is important to have economic and reliable ways of reducing water hardness in large scales. The particular method used in this experiment was lime-soda softening. It has to be noted that this particular procedure only works for water that has an initial pH level lower than 8. Based on stoichiometry and the addition rules according to Nazaroff and Alvarez-Cohen, we are able to find what concentration of Ca(OH)2 and NaCO3 are needed to remove hardness from the water. Based on our results the softening of the water was a success. Initial total hardness was recorded at 328 mg/L, after softening the concentration was found to be 84 mg/L. Looking individually at the reduction of calcium and magnesium the concentration was reduced from 296 mg/L to 59 mg/L and 32 mg/L to 25 mg/L respectively. Even though a large amount of the hardness was removed from the water it was nowhere near the practical limit levels. This can be attributed to the fact that the reactions that dictate hardness removal suffer from diminishing returns. Sources of error in this lab can be attributed to the fact that the sample water was only allowed to precipitate for 15 minutes instead of the 20 that were required as stated by the procedure.