Water quality: determination of alkalinity

ASSIGN BUSTER

Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the end-point pH used. Alkalinity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

Alkalinity is significant in many uses and treatments of natural waters and wastewaters. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents. The measured values also may include contributions from borates, phosphates, silicates, or other bases if these are present. Alkalinity in excess of alkaline earth metal concentrations is significant in determining the suitability of a water for irrigation.

Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes. Raw domestic wastewater has an alkalinity less than, or only slightly greater than, that of the water supply. Properly operating anaerobic digesters typically have supernatant alkalinities in the range of 2000 to 4000 mg calcium carbonate (CaCO3)/L. 1

OBJECTIVES

To determine the alkalinity of the water sample.

To compare the alkalinity of the lake water and distilled water.

METHODOLOGY

MATERIALS

Sodium thiosulfate, 0. 1 N. Dissolve 25g sodium thiosulfate and dilute to 1L with distilled water.

Standard 0. 02 N hydrochloric acid, HCL.

Phenolphthalein indicator: weight 5g of reagent and dissolve in 500ml of ethanol. Add 500ml of distilled water while stirring.

Mixed bromcresol green-methyl red indicator. Dissolve 25g of methyl red sodium salt and 100mg of bromcresol green sodium salt in 100ml distilled water.

METHOD

2. 50ml of the sample measured. 1 drop of 0. 1N sodium thiosulfate added.

1. Samples collected using the polyethylene bottle. The bottles filled without any air bubbles in the bottle. The collection analyzed as soon as possible within 24 hours.

3. 2 drops of phenolphthalein indicator added. The color of the solution should turn into pink. If the solution doesn’t, proceed to number 4. If there is a change, titrated with 0. 02 N HCL until the pink color disappears and the amount of titrant used recorded.

4. Several drops of bromcresol indicator added. The sample titrated with 0. 02 N HCL until the pH 4. 5 endpoint where the color changes from blue to

pink is reached. The total volume of the acid needed to reach the endpoint recorded.

Figure 1. 0 Determination of alkalinity

PRINCIPLE ANALYSIS

Alkalinity measures the acid-neutralizing capacity of a water sample. It is an aggregate property of the water sample and can be interpreted in terms of specific substances only when a complete chemical composition of the sample is also performed. The alkalinity of surface waters is primarily due to the carbonate, bicarbonate, and hydroxide content and is often interpreted in terms of the concentrations of these constituents. Water with higher alkalinity will have greater the capacity to neutralize the acid. Conversely, if the alkalinity is lower, less neutralizing capacity will be needed.

The water sample that is used to determine the alkalinity is the SST lake water. The water sample has to be taken using a polyethylene bottle without leaving ant water bubbles. This to ensure that the water bubbles does not influence the reading of the sample. The titration process is used to determine the alkalinity of the water sample. Phenolphthalein indicator used to determine the changes of the color of the water. Phenolphthalein turns colorless in acidic solution and pink in basic solution. To determine the basic of the water sample from SST lake, we used the phenolphthalein to see either it changes color to pink or not.

The color of the solution does not turn into pink, so the bromcresol green indicator used. Bromcresol Green (BCG) is a dye of
the triphenylmethane family which is used as a pH indicator. Then the

solution titrated with 0. 02 N HCL till the endpoint of pH 4. 5 reached. Here the solution colour changes from bluish green to pink.

RESULT

DISTILLLED WATER

SST LAKE WATER

INITIAL

50 ml

50 ml

FINAL

49. 6 ml

47. 7 ml

CALCULATION

Total alkalinity as mg/L CaCO3 = (A + B) x N x 50 000 mL sample

where,

A= record the amount of titrant used (A) from No. 3

B= record the amount of titrant used (B) from No. 4

N= Titrate, standard, hydrochloric acid (HCl) Normality

For distilled water,

50 ml

Total alkalinity as mg/L CaCO3 = (0+0. 4) x 0. 02 x 50 000

= 8 mg/ L CaCO3

For SST lake water,

50 ml

Total alkalinity as mg/L CaCO3 = (0+2. 3) x 0. 02 x 50 000

= 46 mg/ L CaCO3

DISCUSSION

From the experiment, we had obtained the alkalinity for the distilled water and also the SST lake water. For the distilled water it has the alkalinity of 8 mg/L CaCO3 while SST lake water is 46 mg/L CaCO3.

In natural water, the water alkalinity can be determined through the source of water and the pathway of the water flow from the sources. Main sources of water alkalinity are rocky places where carbonate, bicarbonate and hydroxide compounds are present. These materials are affecting the water hardness which caused by calcium carbonate, CaCO3. Sometimes, CaCO3 can be referred as water alkalinity. Most hard water contains CaCO3 which has high-buffering capacity to resist pH changes. Area where granites or igneous rocks are dominant will have lower pH with low-buffer capacity.

There are two types of indicators used in this experiment; phenolphthalein and bromcresol green-methyl red indicator. Phenolphthalein is used for indication presence of hydroxide ion, OH- which phenolphthalein alkalinity is more than half of the total alkalinity. Bromcresol is used to detect carbonate, CO32- which has less than half of the total alkalinity.

The results show the total alkalinity of the samples investigated. From the result, we found that the alkalinity of SST lake water is higher than the distilled water. In general, distilled water is neutral solution with ph ±7. 0. Distilled water has less mineral content than the original source. Compared with the SST lake water, the alkalinity is higher than the distilled water. The difference may be caused by other factors such as mineral content or organic content. For distilled water, the possibility of having higher mineral or organic content is low. This will explain the alkalinity level of the distilled water. For SST lake water, it is possible that the mineral or organic content are higher in the water bodies.

Geographically, SST lake is located at open space surrounded with grassland, bare soil and also nearer buildings. When rains occur, the rainwater will flow on the ground surface covered by vegetation and sedimentary rocks. Topsoil of the ground has weathered rocks and any other organic matter. These materials will flow along with the rainwater to the lake sites. Calcium carbonates, $CaCO_3$ can be found among these materials that flow along with the rainwater flow. $CaCO_3$ can affect the alkalinity of the water since it has high-buffer capacity to resist the pH changes in lake water body. Open soil or bare soil can be found not far from the lake. There are also sources of waste discharge from the nearer building which mostly came from the laboratory. The waste discharge may affect the pH of the lake water since different possible wastes were discharge in minimal input.

Back to the lab analysis, for both samples, we had found that colour changes did not occur after mixed with phenolphthalein droplets. Form that, we knew that the pH of the samples might be lower than expected. When added with

bromcresol green-methyl red indicator and titrated with HCl, the colour changes from bluish into pink. After the titration, we had calculated the total alkalinity for both samples by using the formula stated in the result section.

There are standard that had been fixed for the alkalinity of the freshwater:

Total alkaline value (mg/L)

Natural System

5-500

Freshwater

116 (mean value)

Seawater

Based on the result that we had obtained, the SST Lake water alkalinity is 46 mg/ L CaCO3. If we compared, we had determined that the alkalinity was complied with the standard.

CONCLUSION

In conclusion we had achieved all the objectives for this experiment. Both samples have different alkalinity; SST lake water with 46 mg/ L CaCO3 and distilled water with 8 mg/ L CaCO3.