Determination of the Some Chemical Parameters of Water and Soil From Twin Ma Lake at Kani Township Sagaing Region

Than Than Win[1], Chaw Theingi Khin[2], Aye Aye Aung[3], Hlaing Myint Thu[4], Yin Mon Soe[5]

Department of Chemistry, University of Monywa

Abstract

The main aim of this paper was to analyze water and soil from the Twin ma Lake in Lae shay Village, Kani Township Sagaing Region. The water samples were collected in April 2016. The conductivity, pH, total hardness, total solids, suspended solid and elemental contents were determined from these water samples. The soil samples were also collected from the selected areas beside Twin ma Lake in April 2016. From this research work, the percentage of chemical constituents of soil can be determined. Elemental analysis of soil samples was also determined by using Atomic absorption spectrophotometer.

Key words: Twin ma Lake, water, soil, total hardness, elemental analysis

Introduction

Water is most abundant in the world except air. Two third of world is made up of water and the rest is land. Water is also the most abundant compound in living cells, which usually contain 65 to 95% of water by weight.Water is needed for the existence of human being, animals and plants. It is estimated that two-third of our human body is made up of water. People use water for many purposes. Therefore, safe and adequate supplies of water are needed for people. Many diseases contain in supplies of water and they can be damaged to human health. It has been estimated that as many as percent of all diseases in the world are associated with unsafe water.

Water is a good solvent and picks up impurities easily. Pure water is tasteless, colourless and odorless. Minerals which are essential for human can be obtained partially as one way from water. Many scientists have discovered dealing with water all over the world. In Myanmar, most chemists have to analyze water containing them as a responsibility.Soil is the thin layer of finely divided mineral and organic matter, water and air spaces capable of supporting plant life. Soil, the materials make up a complex chemical and biochemical system. The organic portion of the soil consists of the remains of plants in various stages of decay. It is necessary to know whether the water and soil of Twin ma lake in Kani area contain distinct constituents or not and, is suitable as uses or not. It may be expected to contain characteristic constituents. The analysis of water and soil in the selected area was explored during the departmental research. In the present research work, physical and chemical parameters of the samples were thoroughly investigated.

Experimental

Materials, Methods and Instruments

The chemical used were common analytical grade reagent. They were produced from British Drug House (BDH) London and Merck. Qualitative and quantitative elemental analysis could be done by common laboratory apparatus, AAS spectroscopy. All analytical determinations, instrumental analyses, and monitoring of the process systems were carried out at the Department of Chemistry, Monywa University and Universities Research Centre, University of Yangon.

Sample collection

In this present work, the water samples and soil samples were collected in April (2016), from Twin ma lake at Kani Township, Yinmabin District, Sagaing Region. Water sample 1 was collected in Twin ma lake, water sample 2 was in water resource near Twin ma lake and sample 3 was collected from well ware near lake.

Determination of Physical Parameters of Water Samples

The temperature and pH of water samples were determined by thermometer and pH meter. Colour of the samples were recorded by visualization. Odor of the samples were also manuralized. Conductivity of the samples were determined by conductivity meter at 24°C. Experimental data was listed in Table 1.

Determination of Total Solids of Water Samples

Apparatus and procedure

Porcelain crucibles, a 10 ml graduated pipette, a hot plate, 100 ml beaker and an electric oven were used. 10 ml of filtered water was evaporated to dryness in a heated porcelain crucible (Adoni, 1985). The crucible with residue was put into the oven and dried for 1 hour at 105°C. After this, it was cooled and weighed. Experimental data was listed in Table 1.

Determination of Total Hardness

The total hardness of water sample was determined by the EDTA titrimetric analysis. As the chemicals, Disodium salt of EDTA (Analar), ammonia (32% w/v), ammonium chloride, calcium carbonate, erichrome black T and sodium chloride from BDH were used.

Preparation of solutions

Ammonia buffer solutions (pH 10): Ammonium chloride (3.5011 g) was dissolved in 28.4 ml of concentrated ammonia solution; 0.2358 g of disodium salt of EDTA was dissolved in distilled water and the volume was made up to 50 ml in a volumetric flask. These two solutions were mixed thoroughly at pH- 10.

0.0072 M EDTA solution: Disodium salt of EDTA (0.3728 g) was dissolved in distilled water and the volume was made up to 100 ml in a volumetric flask. A 10 ml solution of 0.01 M calcium carbonate was pipetted into a 150 ml conical flask and a tiny amount of the indicator mixture was added. This solution was titrated with (approximately 0.01 M)

EDTA solution using a 50 ml burette. The concentration of EDTA solution was found to be 0.0072 M.

0.01 M standard calcium carbonate solution: Calcium carbonate (0.2503 g) was placed in a conical flask and 1:1 hydrochloride acid (w/v) was added to the powder until all of the latter dissolved. Then 50 ml of distilled water was added and boiled for a few minutes to expel CO_2 gas. The solution was cooled, a few drops of methyl red indicator were added and the colour was adjusted to orange with 1:1 hydrochloric acid or concentrated ammonia solution. Then the solution was diluted to 250 ml with distilled water in a volumetric flask. This standard solution (1 ml) is equivalent to 1 mg of $CaCO_3$.

Eriochrome black T indicator: Eriochrome black T (0.05 g) and 1.0 g of sodium chloride were mixed to obtain a dry powder mixture.

Apparatus

Beakers 250 ml, 100 ml and 250 ml volumetric flasks, a glass funnel, 50 ml burette, 150 ml conical flask and a hot plate were used.

Procedure

A buffer solution (1 ml) was added to 10 ml of sample solution. A small amount of the dry powder indicator was added to this solution. The standard EDTA titrant was added slowly, with continuous strring until the last reddish tinge disappeared from the solution; the colour of the solution at the end point was blue. Experimental data are listed in Table 1.

Determination of Some Elemental Contents of Water Samples

The elemental contents in water samples were determined by atomic absorption spectroscopy (AAS) at URC (Universities Research Center), Yangon. Experimental data are listed in Table 2.

Sampling and Preparation of Soil Samples

Two samples from different sites near Twin ma Lake were collected for analysis. Soil sample 1 was collected in little grass growing land and sample 2 was collected in land of without growing any plant. Both soils were taken from a depth of about one feet of the surface. In the laboratory, the samples were spread out in shallow trays to dry in the atmosphere. When the samples were dried, those were sieved through a 2mm sieve to remove larger particles of vegetable matters and stones. The residue from the sieve was rubbed up in a motor with a pestle and was again sieved. The samples passing the sieve were used for subsequent analysis (Brady, N.C & R.W. Ray, 1996).

Determination of Some Physical Parameters of Soil Samples

Determination of Moisture Content

Constant weight of weighing bottle was first determined. Then about 5.00 g of sample was transferred into weighing bottle and weighed accurately. It was allowed to dry in an electric oven at 105˚C. Then it was dried to constant weight. From the loss in weight, the percentage of moisture of the sample under analysis was calculated.

Determination of Soil Texture

Reagent

10% sodium pyrophosphate solution

About 10g of sodium pyrophosphate was dissolved in distilled water and made up to 100 cm^3.

Procedure

10g of sample was weighed accurately and placed in a 500cm^3 conical flask and some amount of distilled water was added. The flask was heated till boiling, 10 cm^3 of 10% sodium pyrophosphate solution was added to disperse the soil colloids and heating was continued for about 15 min. Then it was cooled. After cooling, the contents were transferred to a1000 cm^3 graduated cylinder and the solution was made up to the mark with distilled water and then kept overnight to allow the soil colloids to settle. The next day, the contents were stirred for about 4 min, the solution from 9 cm depth was pipetted with 25cm^3 pipette and then it was transferred to a porcelain basin and evaporated on a water bath. From this residue, the percentage of clay and silt were calculated.

After 4 hr of the stirring, the solution was pipetted with 25 cm^3 pipette from 4 cm depth and evaporated. From this residue, the percentage of clay was calculated. Then the percentage of silt was obtained by difference. To determine the amount of sand, the remaining solution was poured into 50 μm sieve and the clay and silt were washed with water. The percentage of sand was then calculated.

Determination of Chloride Contents

Apparatus

1.Porcelain basin, 2.Burette, 3.Glass rod

Reagents

Silver nitrate solution; 0.02 M: 3.398 g silver nitrate was dissolved in distilled water and made up to 1 dm^3. It was standardized with 0.02 M sodium chloride solution and kept in a brown bottle.

Potassium chromate solution: 5.000g of K_2CrO_4 was dissolved in 100 cm^3 of distilled water.

1:5 soil water extract: 120g soil was dissolved in 600 cm^3 dis: water, shaken 30 min, and stand until clear solution was obtained and then filtered. 1:5 soil water (filtrate) extract was observed.

Procedure

1 cm^3 of 1:5 soil water extract was taken in a porcelain basin. 5g of sodium bicarbonate and 9 cm^3 of distilled water were added to make it slightly alkaline. 1cm^3 of potassium chromate solution was added. Then above solution was titrated against 0.02M silver nitrate solution. The contents were stirred in the basin with a glass rod till a chocolate brown precipitate of silver chromate appeared. The white milky colour of the basin serves as a good background to observe the colour of the precipitate and the end

point was marked precisely. The volume of silver nitrate used was noted. The percentage by weight of chloride was calculated.

Determination of Some Elemental Contents of Soil Samples

The elemental contents in soil samples were determined by atomic absorption spectroscopy (AAS) at URC (Universities Research Center), Yangon. Experimental data are listed in Table 4.

Determination of Available Nitrogen (Alkaline Permanganate Method)

Soil sample (20.00 g) was transferred into 500 mL distillation flask and 20 cm^3 of distilled water was added, followed by 100 cm^3 of 0.32% $KMnO_4$ and 100 cm^3 of 2.5% NaOH solutions. Both reagents were freshly prepared. The contents were distilled into a known amount (10 cm^3) of 0.01M H_2SO_4 until 30 cm^3 of distillate were collected. Then the excess of acid was titrated against 0.02 M NaOH solution by using methyl red as an indicator. A blank determination was carried out as above. The percentage of nitrogen was calculated.

Determination of Available Phosphorus (Olsen's Method)

Firstly calibration curve was constructed using potassium dihydrogen phosphate. Pure potassium dihydrogen phosphate (0.2195 g) was dissolved in a little quantity of distilled water and made up to 1 dm^3 with 0.5 M $NaHCO_3$ solution. This stock solution contained 50 microgram of P/cm^3. The standard phosphorus solution was prepared from this stock solution.

The stock solutions containing 2, 4, 6, 8, 10, 12 and 14 microgram phosphorus were pipetted out into the 25 cm^3 volumetric flasks. Molybdate reagent (5 cm^3) was added and washed down the stem of the flask and mixed. Dilute stannous chloride solution (1 cm^3) was added and made up to the mark. After 10 min the intensity of the colour developed was read in each case in the Fisher electrophotometer by using red filter (or 650 nm). The electrophotometer reading were used to construct a curve against the quantity of phosphorus present as microgram in each standard.

Sample (5.00 g) was taken in a conical flask and 1.0 g of carbon black was added. Then, 100 cm^3 of 0.5 M $NaHCO_3$ solution were added to the flask and shaken for half an hour. It was filtered through Whatman No.1 filter paper. The filtrate was colourless. Next, 5 cm^3 of the filtrate was pipetted out into a 25 cm^3 volumetric flask and 5 mL of molybdate reagent were added and washed down the stem of the flask and mixed. Dilute stannous chloride solution (1 cm^3) was added and made up to 25 cm^3. The contents were mixed thoroughly. After 10 min the colour intensity was read in the Fisher electrophotometer by using red filter (or 650 nm). The value (microgram of phosphorus) was read from the standard curve. The percentage of available phosphorus as P_2O_5 was calculated.

Determination of Available Potassium (1 M Ammonium acetate extraction method)

Finely ground sample (10.00 g) was weighed and placed in a shaking bottle. Then, 100 cm^3 of 1 M ammonium acetate solution was added, shaken for an hour and it was filtered into the Erlenmeyer flask. The concentration of available potassium was measured by using Atomic Absorption Spectrophotometer.

Results and Discussion

The Results of Physicochemical Properties of Water Samples

The water samples were collected in April (2016), in Kani Township. The results were taulated in Table 1.

Table 1. Results of Physicochemical Properties of Water Sample

No.	Parameters	Sample Result			WHO standard (2015)
		S 1	S 2	S 3	
1.	Temperature	23°C	24°C	22°C	<32°C
2.	pH	11	9	9.5	6.5-8.5
3.	Colour	Turbid	Clear	Clear	Clear
4.	Conductivity (μs/cm)	17150	1217	1642	-
5.	Dissolved solid (ppm)	12406	768	1100	<250
6.	Suspended solid	690	80	32	-
7.	Total hardness (ppm)	67	298	467	< 16
8.	Calcium (Ca^{++},ppm)	48	213	334	<8
9.	Magnesium (Mg^{++},ppm)	19	85	133	<8

Colour of the samples were turbid, it was suggested that high value of particulates. It was different from WHO standard due to the high pH and high dissolved solid. According to the odor of the sample, it was suggested that sample consist of high organic matter content. From the result of Temperature value (in summer, the sample < 30°C) the water samples may be presented in high carbonate content and low sulphate content and this value is related to environmental condition According to the high value of conductivity (at 24°C), the samples consist of high dissolved ions. pH of the collected water sample from twin ma lake was high deviation from the WHO standards (9.0-11.0). The pH values of water vary with geological nature of the sources and the presence of dissolved solids. Accordig to high value of dissolved solid, all samples contain high impurities.

The Results of Some Heavy Metals Contents of Water Sample

The Results of Some Heavy Metals Contents of Water Sample were shown in Table 2.

Table 2. Results of Some Heavy Metals Contents of Collected Water Sample

No.	Name of Elements	Measuring value (ppm)			Maximum permitted level (ppm)
		S 1	S 2	S 3	
1	Arsenic	ND	ND	ND	0.55
2	Lead	0.028	0.026	ND	0.106
3	Chromium	ND	ND	ND	0.36
4	Cadmium	ND	0.016	0.011	0.015
5	Iron	ND	ND	ND	31.5
6	Nickel	ND	0.032	0.03	1.07
7	Copper	ND	ND	ND	3.58
8	Magnesium	1.063	7.03	9.07	5.99

ND= not detected

According to this table, some heavy metals such as lead and magnesium contents were observed in trace amount in these collected samples. But, these values were lesser quantity (except Mg) than maximum permitted level. Thus, these values were not harmful for user.

The Results of Physicochemical Properties of Soil samples

Experimental results of physicochemical parameters of selected soil samples were shown in Table 3.

Table 3 The Results of Physicochemical Properties of Selected Soil Samples

No.	Parameters	Sample (1)	Sample (2)
1	pH	10.4	9.9
2	Moisture (%)	1.55	1.46
3	Conductivity (dS/m)	0.59	26.9
4	Organic matter (%)	1.30	1.80
5	Humus(%)	2.288	3.168
6	Colour	Pale brown	Pale brown
7	Chloride (%)	32.00	577.00

According to these data such as pale colour, very low organic matter, moisture content, and very high pH and conductivity, the two selected soil samples were not suitable for agriculture.

The Results of Some Elemental Contents of Soil Sample

The results of elemental contents of selected soil samples were mentioned in Table 4.

Table 4 The Results of Elemental Contents of Selected Soil Samples

No.	Samples	Exchangeable value (mmol/kg)			Extractable value (mg/kg)			
		Ca	Mg	Na	Zn	Fe	Mn	Cu
1	S 1	30	42	63	0.2	2.2	5.1	0.3
2	S 2	20	16	73	0.2	3.5	1.0	2.3

According to the results of iron content which was extracted with DTPA of sample 1 is deficient value. But sample 2 is margenal. DTPA extracted zinc content in both samples are deficient value but copper contents were adequate value. The manganese contents were adequate and deficient values for sample 1 and 2. Calcium value for both was low value. Magnesium is high and sodium is very high for both soil samples.

The Results of N, P, K Value of the Two Soil Samples

The results of N, P, K Value of the selected soil samples were illustrated in Table 5.

Table 5 Results of N, P, K Value of the Two Samples

No.	Components	(%)		Rating	
		Sample 1	Sample 2	1	2
1	Available nitrogen	0.0022	0.0074	Very low	Medium
2	Available phosphorus	0.0004	0.0054	Low	Excessive
3	Available potassium	0.628	2.025	High	Excessive

Classification

	Very high	high	medium	low	very low
N	> 0.012%	0.009-0.012%	0.006-0.009%	0.003-0.006%	< 0.003
P	> 0.004%	0.003-0.004%	0.001-0.003%	0.0005-0.001%	< 0.0005
K	> 0.037%	0.025-0.037%	0.013-0.025%	0.0012-0.013%	< 0.0012

The Results of Texture of Soil Samples

Experimental results of the texture of selected soil samples were shown in Table 6 and figure 1.

Table 6 Texture of Soil Samples

Soil Type	Sample 1 (%)	Sample 2 (%)
Sand	87.28	70.35
Silt	5.51	7.28
Clay	7.21	22.37

According to the results of texture of the samples, sample 1 is Loamy sand type and sample 2 is Sandy clay loam type. Therefore, these types are very low water holding capacity and cannot growing for grass or plants. they are poor quality of nutrient holding capacity and water-holding capacity. But sand is good in water-infiltration capacity and aeration.

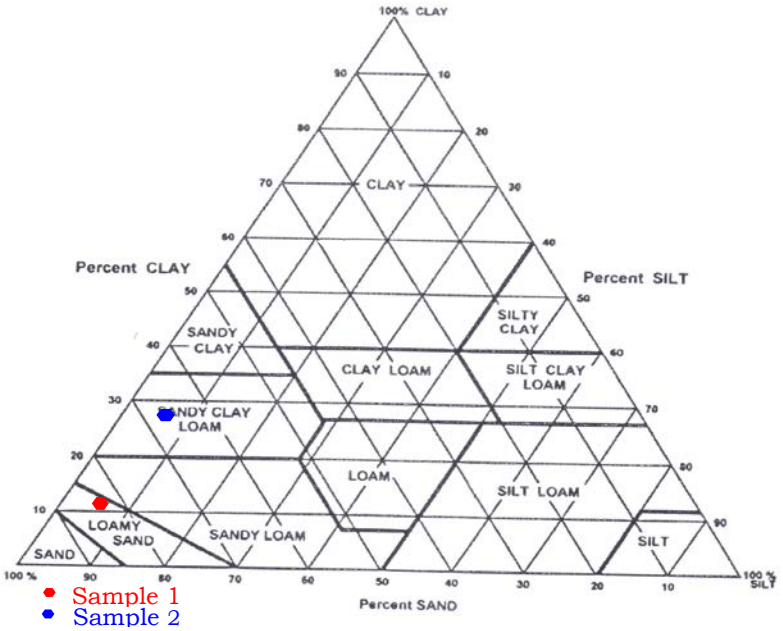

Figure 1. Textural Triangle for Classification of Soil

Conclusion

In this research work, the samples (three water samples and two soil samples) were collected from Twin ma lake in Kani Township. Physicochemical constituents of water and soil samples were determined. According to pH value, all samples are alkaline. From the results of temperature values of water samples, carbonate contents are rich. Total solid, total hardness, Ca and Mg hardness, values are different from WHO standard (2015) values. Some metal such as As, Pb, Cr, Cd, Fe, Ni, Cu and Mg (ppm) contents were examined by AAS spectroscopic method. From these results, Three water samples are absent of As. Mg content in both samples is little high from WHO standard. So the water from Twin ma Lake may be unsuitable for agricultural.

The moisture value of the two soil samples are low value. Organic carbon and Humus vale are also very low. Colour of the soils is pale brown, so these soils are not suitable natural fertilizer. And then, N, P, K values of the soil samples was determined. P and K values are high values. From the result of texture type, soil sample 1 is loamy sand and sample 2 is sandy clay loam type. According to elemental results both samples are absent of toxic metal but Mg is little high. This research contributes some information for the assessment of chemical constituents of soil sample. From these findings, the soil samples near Twin ma Lake are unsuitable for cultivation of vegetables.

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