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Analysis of Water from Indawgyi Lake in Mohnyin Township (Kachin State)

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Abstract

Now a day, some of Lakes water qualities are gradually degraded due to the environmental impact of human activities. In this research work, chemical investigations have been made to assess the quality of water from Indawgyi Lake, Mohnyin township in 2015. Analyses have been made in three sample areas, near the Shwemyitzu pagoda, Lowemon and Loneton respectively. The experimental works have been done in three portions, physical examinations, determination of chemical constituents and bacteriological analysis. Most parameters (except bacteria results) were in conformity with the WHO guide-line limits for drinking purpuse. Bacteriologial examination also show that all samples were unsatisfactory for drinking purpose due to the presence of *E.coli*. So, this water should be used only after boiling for health safety.

Key words: Indawgyi Lake, physical parameters, chemical paremeters, bacteriological determination

Introduction

Water in its liquid form is the material that makes life possible. Organism can exist only in places which have access to adequate supplies of water. These abilities make water extremely valuable for society and industrial activities.

Indawgyi Lake is located in Mohnyin Township in Kachin State of northern Myanmar. It is the largest inland lake in Myanmar. It lies between the north latitudes of 25° 2' and 25° 16' and between the east longitudes of 96° 17' 30" and 96° 22' 30". It has a length of about 24.08 km from north to south and a width of about 7.73 km from east to west with a total area of about 97.66 km^2. Its area is variable by seasonal changes. The whole lake lies under 170 m above sea level. The lake is surrounded by mountain except from north eastern portion. Indaw creek is the only outlet of Indawgyi Lake and flows out to Hpakant Township on the north and enters Moganung creek. The streams which originate in these mountain ranges and flow into Indawgyi Lake are the Namyin Hka, the Nammun, the Hkaungtaung Hka, the Hnenpase, the Nampade, the Namsanda, the Mokso, the Hepu and Hepagyi together with many other streams. The water in Indawgyi Lake was analyzed in 2001 by myself, it was safely used for drinking water. Eleven village tracts with the population of over 60,000 are included in Indawgyi Area. Gradually increased population and extended economic activities enhance the degradation of environment. That is why the water quality of Indawgyi Lake may be threatened by various sources of pollution. So, the main aim of this research is to find out "whether the water quality of Indawgyi Lake is polluted or not".

Aim and Objectives

The main aim of this research is to compare the water quality of Indawgyi Lake between 2001 and 2015.

The objectives are to collect the samples, to characterize the physical parameters, to determine the amount of heavy toxic metals by AAS (atomic absorption spectroscopy), to determine the chemical constituents (Mandalay City Development Committee, Water and Sanitation Department, Water Laboratory) ,to determine the bacteriological analysis of water (Public Health Laboratory Mandalay)

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Experiment

Sample Collection

In this investigation, water samples are collected from three sample areas. These are (1) 3 feet in depth, median line of lake, in near the **Shwemyitzu pagoda** (2) 3 feet in depth, 30 yards distance from the bank, in **Lowemon village** and (3) 3 feet in depth, 30 yards distance from the bank, in **Loneton village**, respectively. The samples were collected in clean plastic bottles which had been washed with a detergent and distilled water. The bottles were completely and tightly capped. Samples were analyzed as soon as possible after collection.

Physical Examination

Estimation of Color (Apparent)

Method: APHA Platinum Cobalt Standard Method

Principle: Color is determined by comparison of the sample with known concentration of colored solutions. The platinum-cobalt method of measuring color is the standard method. The unit of color is produced by 1 mg platinum/L in the form of chloroplatinate ion. The color of water is extremely pH dependent and invariably increases as the pH of the water is raised.

Apparatus: Hach Spectrophotometer, DR/5

Procedure: Sample (25mL) was placed in the sample cell and the color was determined at 455nm against 25 demineralized water bland.

Estimation of Conductivity Method: Direct Measurement Method.

Apparatus: Hach Conductivity Meter (range: 0-20.000µmhos/cm)

Procedure: The conductivity of the sample was directly determined by the conductivity meter.

Estimation of Filterable Residue, Total

Method: Evaporation at 180˚C.

Principle: A well-mixed sample is filtered, evaporated and dried to constant weight at 180˚C. The increase in weight represents the total residue.

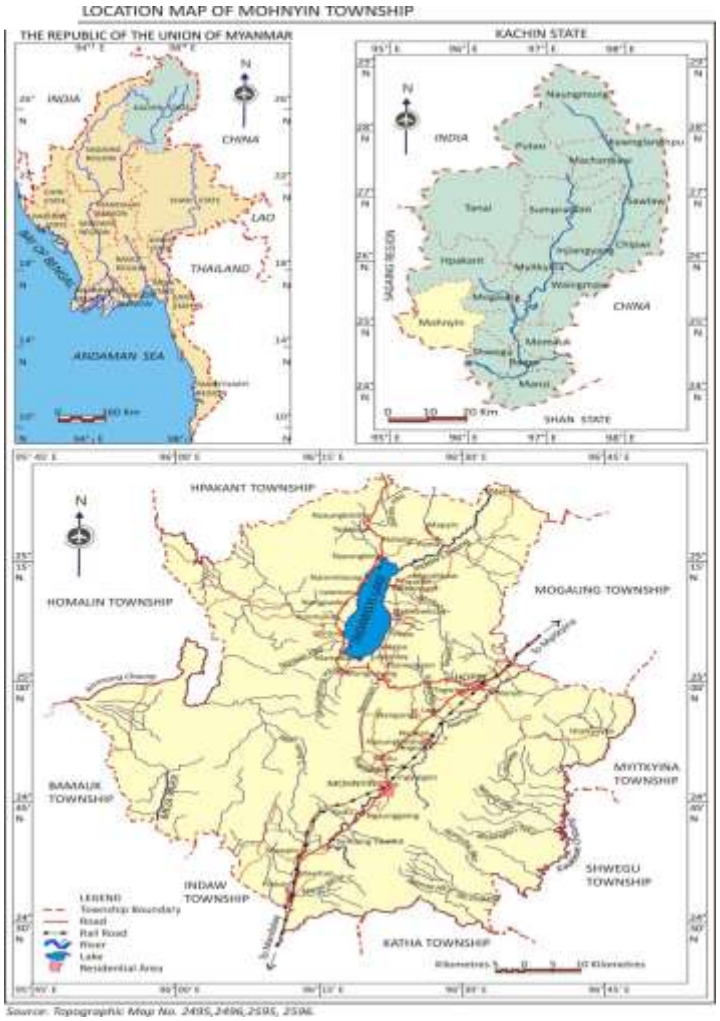
Apparatus: Evaporating dishes, furnace, steam bath, drying oven, desiccators, analytical balance, filters (glass, fiber) and filtration apparatus were used.

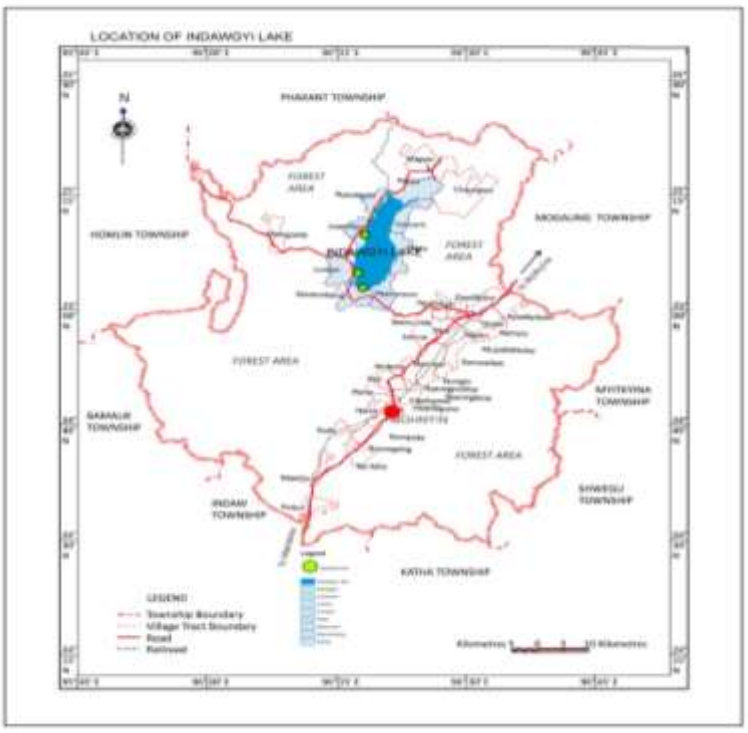
Procedure: The constant weight of the nickel basin was first determined. 100mL of water sample was quantitatively transferred to the pre-weight basin and evaporated to dryness on a steam bath. Then, the sample in the basin was dried in an oven at 103˚C- 105˚C for 1 hour. The basin holding residue was cooled in desiccators and weighed. The cycle of drying at 103˚C-105˚C, cooling, desiccating and weighing was repeated until the constant weight was obtained.

Calculation: Total filterable residue, mg/L = [(A-B) x 100] / sample volume (mL)

Where, A= weight of sample and basin in mg, and

B= weight of basin in mg


LOCATION MAP OF MOHNYIN TOWNSHIP
THE REPUBLIC OF THE UNION OF MYANMAR
KACHIN STATE
INDIA
CHINA
LAO
THAILAND
ANDAMAN SEA
SHAN STATE
HPAKANT TOWNSHIP
HOMALIN TOWNSHIP
MOGAUNG TOWNSHIP
BAMAUK TOWNSHIP
MYITKYINA TOWNSHIP
INDAW TOWNSHIP
SHWEGU TOWNSHIP
KATHA TOWNSHIP
LEGEND
Township Boundary
Road
Rail Road
River
Lake
Residential Area
Source: Topographic Map No. 2495,2496,2595, 2596.


LOCATION OF INDAWGYI LAKE
PHAKANT TOWNSHIP
HOMALIN TOWNSHIP
MOGAUNG TOWNSHIP
FOREST AREA
BAMAUK TOWNSHIP
MYITKYINA TOWNSHIP
INDAW TOWNSHIP
SHWEGU TOWNSHIP
KATHA TOWNSHIP
LEGEND
Township Boundary
Village Tract Boundary
Road
Railroad

Estimation of Turbidity

Method: Absorptometric Method

Apparatus: Hach Spectrophotometer, DR 5.

Procedure: The turbidity of 25 mL sample was directly measured at 450 nm against colorless distilled water blank.

Estimation of Calcium

Method: EDTA Titrimetric Method

Principle: When EDTA (ethylene diamine tetra-acetic acid or its salt) is added to water containing both calcium and magnesium, it combines first with calcium. Calcium can be determined directly with EDTA, when the pH is made sufficiently high so that the magnesium is largely precipitated as the hydroxide and an indicator that combines with calcium only is used . Several indicators are used as murexide. Eriochrome Black T give a color change when all of the calcium has been complexed by the EDTA at a pH of 12 to 13.

Apparatus: Burette, pipette and conical flask were used.

Reagents: Sodium hydroxide solution (1M), solid indicator mixture (100 g NaCl and 0.2 g murexide were ground to 40-50 mech), EDTA titrant 0.01M(3.732 g dry disodium ethylene diamine tetra-acetate dehydrate per 1L distilled water) were used.

Procedure: Sample (25mL) was mixed with 25mL distilled water and 50 mL of distilled water was taken as color comparism, 2 mL of NaOH solution and 0.2 g of murexide indicator were added to the sample and blank, 2 or 3 drops of EDTA titrant were added to the blank to produce an unchanging color. The sample was titrated immediately with EDTA solution until the color changed as blank.

Calculation: Mg Ca/L = (A x B x 400.8)/ mL sample (or)

Ca hardness as mg $CaCO_3$ /L = (A x B x 100)/ mL sample

Where: A = mL titrant for sample and

B = mg $CaCO_3$ equivalent to 1.00 ml EDTA titant at the calcium indicator end point

Estimation of Magnesium

Method: Calculation Method

Magnesium can be calculated by the following formula.

mg Mg/L = (Total hardness as $CaCO_3$ /L - Ca hardness as mg $CaCO_3$ /L) x 0.244

Estimation of Fe, Mn, As, Cu, CN, Pb, Cl, SO_4, N-NO_3, DO and BOD

Method: Atomic Absorption Spectrophotometric Method

Apparatus: Atomic Absorption Spectrophotometer

Determination: The samples were sent to Mandalay City Development Committee (MCDC), Water and Sanitation Department, Water Laboratory and the content of Fe, Mn, As, Cu, CN, Pb, Cl, SO_4, N-NO_3, DO and BOD were determined by the Atomic Absorption Spectrophotometer.

Estimation of Bacteriological Results

The routine tests generally used in bacteriological examination of water are:

1. A quantitative test for all coloform bacilli known as presumptive coliform count.
2. A differential test of typical coliform bacilli (Esch Coli) known as the differential coliform test.

Determination: The samples were sent to the Public Health Laboratory, Mandalay to determinate the bacteriological examination of water.

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Results and Discussions

Physical properties

Physical parameters examined for the quality of the water in Indawgyi Lake are color, conductivity, turbidity, total dissolved solid and total suspended solids.

Color

In the present investigation, analytical data for color of all water samples were found to be around 5 units. These values were not beyond the maximum acceptable limit.

Turbidity

Turbidity is used to describe the presence of substances in water which interferes with its clarity. It is important to municipal water treatment plants and food beverage industries. Turbidity values for all samples were less than maximum-acceptable limit of 5 FTU. Hence, the water has attractive appearance.

Conductivity

Conductivity measurements are used to determine the purity of water and total dissolved solid in boiler and cooling tower water. The conductivity values of all water samples were 112.7, 84.3 and 84.6 μ mhos/cm.The mandatory health limit of drinking water standard is 800 μ mhos/cm.

pH

Water having a pH of 7.0 is neither acidic nor alkaline. pH lower than 4 will produce sour taste and higher value above 8.5 will produce bitter taste. Lower pH increases corrosive tendency. pH measurement is important in corrosive tendency. pH measurement is important in treatment process such as chlorination, softening and corrosive control. The pH of all water samples was slightly lower than pH 7 (pH = 6.8) and hence it was said to be slightly acidic.

Total dissolved solids

The values of total dissolved solids were found to be 59.6, 44.4 and 44.6 mg/L. The WHO 1972 drinking water standard recommendation limit of total dissolved solid is 500-1500 mg/L. The experimental results were not beyond the standard limit. So, these samples were suitable for drinking.

Total suspended solids

The total suspended solids contents of the samples were found to be 1, 8 and 2 mg/L.

Chemical properties

Total hardness

The maximum desirable limit for total hardness is 100 mg/L. The total hardness of water samples were 68, 60 and 52 mg/L.

Table (1) Water is classified in the United states as follows;

Very Soft water	Less than 50 mg/L of total hardness
Soft water	50-100 mg/L
Medium hard water	100-200 mg/L
Hard water	200-300 mg/L
Very hard	above 300 mg/L

Water hardness causes no ill effects in man . Conversely there have been a number of studies, where the results suggest that water hardness protects against diseases. According to WHO limit, these water samples were soft water.

Calcium and magnesium

Calcium and magnesium are essential elements for all life forms. Calcium is necessary for proper bone and teeth formation. Aqueous calcium compounds are generally non-toxic and has no known health hazard. Injection of magnesium also produces no adverse effects. Calcium and magnesium are major contributors to " water hardness". The maximum desirable limits for calcium and magnesium are 75 mg Ca/L and 50 mg Mg/L. The observed values of all water samples were 16, 8 and 10 mg Ca/L and 5, 10 and 6 mg Mg/L respectively.

Total alkalinity

The alkalinity of natural water is due to its content of carbonates, bicarbonates and hydroxides of alkali and alkaline earth metals. The total alkalinity of three water samples were found to be 80, 68 and 60 mg/L and phenolphthalein alkalinity values of all water samples were less than half of the value of total alkalinity, this indicating the absence of hydroxide alkalinity.

Chloride

Chloride is one of the major inorganic anions in water. In portable water, the salty taste is produced by the chloride concentrations and is variable and dependent on the chemical composition. High chloride content may harm metallic pipes and structures as well as growing plants. The chloride contents in all water samples (8, 5 and 8 mg/L) were lower than the acceptable limit of 200 mg/L proposed by WHO.

Sulphate

The major physiological effects resulting from the ingestion of large quantities of sulphate are catharsis, dehydration and gastrointestinal irritation. Water containing magnesium sulphate at level above 600 mg/L act as a purgative in humans. The presence of sulphate in drinking water can also result in a noticeable taste; the lowest taste threshold concentration for sulphate is approximately 250 mg/L, as the sodium salt. Sulphate may also contribute to the corrosion of distribution systems.The observed concentrations of sulphate were lower than the value of the standard recommendation limit (200-400 mg/L). So, these water samples do not have a laxative effect on humans.

Nitrogen nitrate

Nitrates generally occur in trace quantities in surface waters but may attain high levels in some ground waters. Nitrate in water is either due to the oxidation of ammonium compounds or due to the reduction of nitrate. It can be toxic to certain aquatic illness known as methemoglobinemia in infants. The results of nitrogen nitrate contents of three samples (8.8 mg/L) do not exceed the imperative limit (45 mg/L).

Ammonia-nitrogen

Ammonia-nitrogen were not detected in all samples. Therefore these water samples cannot give harmful effect on health.

Iron and Manganese

Excess of iron and manganese in water causes taste, odour and incrustation problems. Long time consumption of drinking water with a high concentration of iron can lead to liver diseases (hemosiderosis). High concentration of iron in water is not items. Iron content of domestic water should be less than 0.3 mg/L.

Manganese is also an essential element for man. It is required as cofactor in a number of enzyme systems. Several studies suggest that manganese may have an anticarcinogenic effect. Manganese also causes clogging, staining and stimulates organic growth. For drinking water, its content should be less than 0.05 mg/L.

The observed values of iron and manganese contents of all samples were equal 0.01 mg/L, which do not exceed the standard recommendation limits 0.1-1.0 mg Fe/L and 0.05-0.5 mg Mn/L, W.H.O, 1972.

Arsenic, Copper, Cyanide and Lead

The concentration of arsenic, copper, cyanide and lead were not detected in all three samples.

DO and BOD

Dissolved Oxygen is the amount of oxygen dissolved in water. DO content indicates whether the water is fresh or not. DO test is one of the most important analyses in determining the quality of natural water.

BOD is the amount of oxygen consumed by bacteria as they oxidized organic matter in water. It indicates biochemical oxidizable organic matters. COD is the amount of oxygen required for chemical oxidation of organic matter in water. Pure water shows oxygen consumed values of less than 1.0 mg/L, while untreated surface water containing vegetation. Color of some pollution will show higher amounts of BOD and COD also pollution indicators.

DO values of all water samples were 4.18, 5.21 and 1.67 mg/L. The suitability of water for fish and other organisms and the process of self purification can be estimated from DO content. According to European Standard (WHO), DO for drinking water should be at least 5 mg/L. So the water from Indawgyi Lake have objectionable DO value.

BOD values of all samples were 9.5, 8.1and 13 mg/L. BOD values of all water samples are higher than the imperative value. COD contents of all samples were not detected. So, it is indicated that all water samples are unpolluted.

Bacteriological Results

The bacteriological analysis of water was done to determine its portability i.e., fitness for drinking. As many diseases such as typhoid, dysentery cholera, etc. have been known to be transmitted to humans through taking in polluted water.

The bacteriological results of all samples show that the quality of water was unsatisfactory. Thus, these water samples should be used for drinking and cooking only after proper treatment.

Comparative Analysis

According to comparative analysis from the results of 2001 and 2015, it was found that, although all parameters of properties were slightly changed, the water quality of Indawgyi Lake was fit according to WHO standard and it was suitable for domestic use, agricultural use and industrial use. It can be concluded that the water in Indawgyi Lake is not polluted. However, it should be used for drinking water only after proper treatment. (see table)

Table (2) Results of Water Samples From Indawgyi Lake in Mohnyin Township

Parameters 23-11-2015	2015 sample 1	2001 sample 1	2015 sample 2	2001 sample 2	2015 sample 3	2001 sample 3	WHO standard	
							Desirable	imperative
pH (scale)	6.8	7.1	6.8	7.2	6.8	6.9	7-8.5	6.5-9.2
Color (units)	5	<5	5	<5	5	<5	5	50
Turbidity (N.T.U)	1.8	<5	1.75	<5	4.15	<5	5	25
Conductivity (μ mhos/cm)	112.7	200	84.3	150	84.6	145	100	400
Total Dissolved Solids (mg/L)	59.6	119.9	44.4	114.8	44.6	114.8	500	1500
Total Suspended Solids (mg/L)	1	2.3	8	5.6	2	3.5	-	-
Calcium as Ca (mg/L)	16	24	8	16	10	16	75	200
Total Hardness as $CaCO_3$ (mg/L)	68	130	60	90	52	90	100	500
Mgnesium Mg (mg/L)	5	7.2	10	4.8	6	4.8	50	150
Chloride as Cl (mg/L)	8	20	5	20	8	20	200	600
Total Alkalinity as (mg/L) $CaCO_3$	80	160	68	185	60	190	200	500
Total iron as Fe (mg/L)	0.01	0.011	0.01	0.01	0.01	0.01	0.1	1.0
Manganese as Mn (mg/L)	0.01	ND	0.01	ND	0.01	ND	0.05	0.5
Sulphate as SO_4 (mg/L)	< 200	99	< 200	101	< 200	109	200	400
Nitrogen nitrate ($N\text{-}NO_3$) (mg/L)	8.8	2.9	8.8	2.9	8.8	2.1	-	45
Dissolved oxygen (DO) (mg/L)	4.18	4.86	5.21	3.80	1.67	3.75	-	5
Oxygen demands, Biochemical (mg/L)	9.5	ND	8.1	ND	13	ND	-	2
As,Cu, CN, Pb	ND	ND	ND	ND	ND	ND	-	-

Conclusion

The investigation of Indawgyi Lake in Mohnyin Township, Kachin State, leads to the following conclusion.

The quality of water from Indawgyi Lake (2015) is generally enough for drinking purpose. The water is physically clear and colorless. It was found that the physical properties such as pH, color, turbidity, conductivity, total dissolved solids and total suspended solids of three water samples were inconformity with WHO desirable limit.

It was also found that the water has low concentration of iron and manganese. The contents of arsenic, copper, cyanide and lead are not detected. Thus, the water from Indawgyi Lake is acceptable for drinking.

Most of the concentrations of inorganic metallic constituents do not exceed the standard limit. Therefore, the water in Indawgyi Lake may not be injurious to health and it

may occur no migration of toxic metals. According to Alkalinity Relationship Table, there is no hydroxide alkalinity.

From the results of sulphate and nitrogen - nitrate concentrations, it may be recorded that the water from Indawgyi Lake is not polluted.

From bacteriological examination of water by the Public Health Laboratory Mandalay, *E .coli* was isolated. All samples were given unsatisfactory remark. Thus the water from Indawgyi Lake are said to be unwholesome and 15 minutes boiling before drinking should be done.

According to comparative analysis from the results of 2001 and 2015, it was found that, although all parameters of properties were slightly changed, the water quality of Indawgyi Lake was fit according to WHO standard and it was suitable for domestic use, agricultural use and industrial use. It can be concluded that the water in Indawgyi Lake is not polluted by physicochemical results. However, it should be used for drinking water only after proper treatment.

Systematic land utilization will be required and conservation of natural environment was essential to maintain the water quality of Indawgyi Lake.

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