

# Polluting Effects on Quality of Naungtone Lake Water in Kengtung Township, Eastern Shan State

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## Abstract

Physico-chemical parameters have been analyzed in water sample collected every four months for one year from Naungtone Lake. The objective of this work was to analyze annual variations of Naungtone Lake water quality. The results revealed that some of the parameters such as total dissolved solid (TDS), chloride, chemical oxygen demand (COD), biochemical oxygen demand (BOD) and sulphate were not agreement with recommended by the European legislation. Therefore, water from Naungtone Lake is not adequate for human consumptions or industrial purposes and needs to be purified to apply for drinking water.

**Keywords:** Naungtone Lake water, European legislation, physico-chemical parameters

## 1. Introduction

Lake is one of the water resources for drinking, irrigation and industrial purposes. Naungtone Lake is situated in No. (5) Ward of the Kengtung Township, Golden Triangle of Eastern Shan State of Myanmar. People that live near Naungtone Lake directly discharge domestic wastewater into it. Furthermore, Naungtone Lake is located in a natural depression on the earth's surface and untreated wastewater, manure discharges and runoff from agricultural fields that can cause water pollution are directly discharged into it. The color of Naungtone Lake water is green because of a vast amount of domestic sewage. Water pollution can kill a lot of fish and other animals in an affected area. In this work, physico-chemical parameters have been analyzed to investigate the water quality of the Naungtone Lake.

## 2. Materials and Methods

### 2.1 Sampling Situation

Naungtone Lake is situated in No. (5) Ward of the Kengtung Township, Golden Triangle of Eastern Shan State of Myanmar. The investigated Naungtone Lake section is located at 21°15'0" and 99°36'0". Naungtone Lake is approximately 15 m deep, 400 m long in N-S direction and 200 m wide in E-W direction.

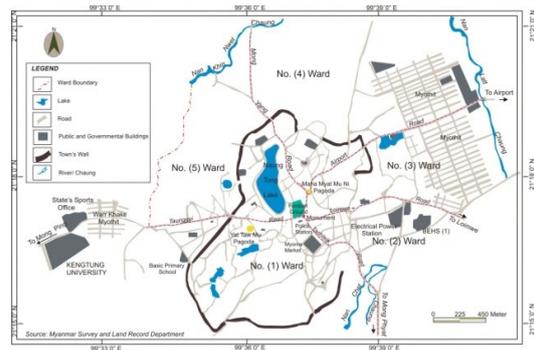


Figure 1. Location map of Kengtung Township



Figure 2. Location of water sample at Naungtone Lake

### 2.2 Sample Collection

The water samples were collected from Naungtone Lake in Kengtung township during three seasons over a period of one year (Dec 2010 to Oct 2011). Samples were collected from the middle of the Naungtone Lake at a depth of 10 cm, from the bamboo raft. Prior to sample collection, sampling device and containers (sterilized polythene bottles) were washed for two times with the water to be sampled.

### 2.3 Methods

For parameters such as pH, and dissolved oxygen (DO) were measured at the sampling site. The color, turbidity and iron of the water samples were measured by Hach spectrometer (dr 5000). Samples were brought to the laboratory for analysis of other physico-chemical parameters like total alkalinity, total hardness, calcium, magnesium, chloride, sulphate, Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

For analysis of Total Dissolved Solid (TDS) and sulphate, gravimetric method was used, while EDTA

titration method was applied in determination of hardness and calcium in the samples. The determination of chloride was carried out by Argentometric method. For alkalinity, titration method was used. The measurement of BOD and COD in the samples was performed according to Iodometric method and permanganate method.

### 3. Results and Discussion

Water is the most important for living systems, industrial processes, agricultural production and domestic use. The principal factors for water quality consideration are turbidity, acidity and alkalinity, trace elements and nutrients such as nitrogen, phosphorous, chloride ions and alkali metals, calcium, magnesium, microorganisms and dissolved oxygen content.

Recommended guide levels and maximum levels of these variables and maximum levels accepted by the European Directive 80/778/EEC concerning the quality of water intended for human consumption were indicated in Table 1[3]. The physico-chemical parameters that studied in this work are slightly variable seasonally.

#### 3.1 Turbidity

Turbidity is a measure of water clarity. The result indicated that the turbidity of sample water studied is lower the maximum standard limit of 25 NTU. This turbidity of water in summer was found to be (14 NTU) while it could not be detected in rainy and winter season.

#### 3.2 Color

The color of water is due to organic matter of vegetable or oil origin, colloidal and soluble iron and manganese. The color of water samples in the present study lies between the desirable level.

#### 3.3 pH

The pH of a water sample measures its hydrogen ion concentration and indicates whether the sample is acidic, neutral or basic. In the present study, the pH values in the collected water samples ranged from 7.8 to 8.1 (average pH = 8) which were all within the limit. The pH of the Lake water slightly varies seasonally. The variation occurs in the pH values due to change in the values of CO<sub>2</sub>, carbonate and bicarbonate in the water.

#### 3.4 Total Hardness, Calcium and Magnesium

The amount of calcium or magnesium salts or both are mainly responsible for hardness of water [4]. The total hardness value in water samples showed the range from 110 mg/L (rainy season) to 140 mg/L (summer and winter season) with an average value of 130 mg/L.

Calcium ions are major causes to water hardness [2]. The presence of calcium ions in water is due to water running through rocks containing minerals such as gypsum (CaSO<sub>4</sub>·2H<sub>2</sub>O), calcite (CaCO<sub>3</sub>), dolomite

(CaMg(CO<sub>3</sub>)<sub>2</sub>). Magnesium is essential growth of chlorophyll and acts as a controlling factor for growing of phytoplankton [5].

In this study, the observed values for Ca were 30–32 mg/L with an average of 28.7 mg/L and those for Mg ranges from 5–7.2 mg/L with an average value of 6.4 mg/L. These parameters such as hardness, Mg, Ca (Table 2) exhibited no significant problem and agreed with recommended guide levels.

#### 3.5 Alkalinity

Alkalinity determines the acid neutralizing ability of water and is due to the presence of hydroxide, carbonate and bicarbonate ions in the water. Weak bases such as phosphates, silicates and borates may also contribute to alkalinity. The alkalinity in the water samples of Naungtone Lake ranged from 195 to 455 mg/L.

#### 3.6 Total Dissolved Solids (TDS)

Solids refer to the suspended and dissolved matter in water. The total dissolved solids in the water sample ranged from the 390 to 720 mg/L. There may be due to the addition of organic matter and solid waste into the lake.

#### 3.7 Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Dissolved Oxygen (DO)

In order to better understand the quality of Naungtone Lake water, an attempt was made to analyze some important parameters such as BOD, COD, and DO. BOD is the amount of oxygen consumed by bacteria to break down organic material present in water sample at a certain temperature. The BOD reported from water samples was ranged between 3.7 to 4.8 mg/L.

COD is the amount of oxygen consumed to chemically oxidize organic water contaminants to inorganic end products. In the present study, COD values of water samples ranged between 6.3 and 8.0 mg/L.

The DO is a measure of how much oxygen is dissolved in water. The DO level varies with temperature. DO levels are highest in the afternoon due to photosynthesis and lowest just dawn. DO is fish and aquatic life including microbial forms to breathe. The value of DO (4.8 mg/L) in summer is lowered (Table 2). Fishes in Naungtone Lake are sometimes dead in summer (due to increased temperature) because of insufficient DO. The runoff from agricultural fields can cause nutrient pollution in Naungtone Lake that can increase plant and algae growth. The bacteria that eat dead plant material consume oxygen from water. Organic matter from animal and crop waste discharges and untreated waste water is decomposed by microorganisms in the Lake, which use up oxygen in the process, leading to areas of low DO. In the present investigation, DO level of Naungtone Lake is not significantly lowered seasonally. However, a lot of fish died in recent year because of water pollution in Naungtone Lake. Further

investigations are required to understand the causes of fish die in Naungtone Lake.

As could be seen in Tables 1 and 2, average concentrations of some variables such as TDS, chloride, COD, BOD and sulphate are higher than those recommended by the European legislation, therefore this water is not suitable for human consumptions or industrial purposes and needs to be purified. Increases in BOD might be due to animal and crop wastes and domestic sewage in Naungtone Lake water.

### 3.8 Chloride, Sulphate and Iron

The chloride in water comes from natural sources, sewage and industrial effluents, urban runoff containing de-icing salt and saline intrusion. A chloride concentration in Naungtone Lake was noticed between 70 to 140 mg/L. The highest chloride reported in summer was 140 mg/L due to water evaporation. High chloride ion concentration exhibited organic pollution in the water [1]. The lowest value of chloride in rainy season was 70 mg/L due to the dilution of Naungtone Lake water by rain. The high sulphate contents found in water of Naungtone Lake are probably a consequence of the morphology of soils irrigated by the Lake.

**Table 1. Recommended Guide Levels and Maximum Concentrations Allowed by the European Directive 80/778/EEC Concerning the Quality of Water Intended for Human Consumption [3]**

Parameter	Min	Max	Guide level	Max
Turbidity (NTU)	5	25		
pH	7.2	8.8	6.5-8.5	9.5
Color (HU)	5	50		
TDS (mg/L)	273	524		1500
Total Hardness (mg/L)	179.1	302.9		
Alkalinity (mg/L)	200	600		
Calcium (mg/L)	58.8	91.2	100	
Magnesium (mg/L)	6.2	23.8	30	50
Chloride (mg/L)	12.2	46.1	25	200
Sulphate (mg/L)	50	150	25	250
Iron (mg/L)	0.01	0.19	0.05	0.2
BOD (mg/L)	1.5	6.5		
COD (mg/L)	0.7	10	2	5
DO (mg/L)			above-5	

Trace amount of iron (heavy metal) is found in sample water. The concentrations of heavy metals above trace amount are generally toxic to living things.

Various human activities affect the quality of water. Local people in Kengtung Township have little

knowledge about the contamination of Naungtone Lake Water. There is needed to give public awareness to avoid discharging of animal and crop wastes and domestic wastes into Naungtone Lake and to reduce the excessive use of chemical fertilizers in agricultural fields in order to reduce the water pollution. In addition, the awareness of local people can be raised by sharing towards water pollution issues such as high level of TDS, BOD, COD and sulphate content in Naungtone Lake, toxic effects and health risks.

It was recommended that the pretreatment of water such as, sedimentation, coagulation, filtration precipitation, disinfection should be carried out to ensure Naungtone Lake water is fit for drinking and other purposes.

**Table 2. Physico-chemical variables of Naung-tone Lake water sample for three seasons**

Parameter	Summer	Rainy	Winter	Average
Turbidity (NTU)	14	-	-	
pH	8.1	7.8	8.1	8
Color (HU)	20	15	20	18.3
TDS (mg/L)	590	390	720	567
Total Hardness (mg/L)	140	110	140	130
Alkalinity (mg/L)	325	195	455	325
Calcium (mg/L)	32	24	30	28.7
Magnesium (mg/L)	7.2	7	5	6.4
Chloride (mg/L)	140	70	100	103
Sulphate (mg/L)	120	69	117	102
Iron (mg/L)	0.023	0.02	0.021	0.021
BOD (mg/L)	4.8	3.7	4.1	4.2
COD (mg/L)	8	6.3	7.2	7.2
DO (mg/L)	4.8	5.2	5.0	5.0

### 4. Conclusion

The essential parameters that determine the quality of water such as TDS, chloride, COD, BOD and sulphate are higher than those recommended by the European legislation. Based on the above observations, Naungtone Lake water is undrinkable and is not suitable to be used for industrial and domestic purposes. Naungtone Lake water needs to purify in order to use for drinking water, domestic uses and other purposes. These findings have become an important research objective that seeks the quality of water of Naungtone Lake. Further work such as microbial examination is necessary for the better understanding of the quality of water in Naungtone Lake.

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