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Physico-chemical investigations of Major Lakes of Thattekere, Hunsur, Karnataka

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Abstract

Chemical parameters of water analysis are very essential and important to test the water before it is used for drinking, domestic, agriculture or industrial purpose. A Physico-chemical analysis include tests for Turbid, Colour, Taste, pH, Odour, Temperature, Alkalinity, Acidity, Free carbon dioxide, Chloride, Total Dissolved Solids, Total suspended Solid, Total Hardness, Chemical Oxygen Demand, Dissolved Oxygen and Biological Oxygen Demand. In the present study some of the The results of Physico-chemical investigations of Hosakote lake water recorded EC values from 200–301µS/cm. TDS 135–201 mg/L, Total hardness from 540–680.7 mg/L, TSS ranged from 20.0–41.8 mg/L, Chemical Oxygen Demand (COD) was 28–37.2 mg/L, DO ranged from 7.7 – 9.3 mg/L, and BOD ranged from 2.5–5.5 mg/L, alkalinity 361 – 432ppm.The results of Makanahalli lake waer recordedEC values from 320–380µS/cm. TDS 205–245 mg/L, Total hardness from 320–480.7 mg/L, TSS ranged from 20.0– 40.5 mg/L, (COD) was 35–40.0mg/L, DO ranged from 9.1–9.3 mg/L, and BOD ranged from 2.4–3.4 mg/L,alkalinity 369–413ppm. During the present investigations lakes were not contaminated and fit for aquatic life, domestic, agriculture and industrial purpose.

Introduction

In living things, water is by far the most important solvent, the dissolving substance that is present in greatest amount. Thus, molecules of various solutes are dispersed among molecules of water in solutions in living things. The division of the habitats of living thing into aquatic and terrestrial once is based mainly on the amount of water present in the respective environments. Aquatic ecosystems are usually divided into fresh water, marine water and estuarine water. There are two basic types of fresh water

ecosystem i.e. lentic and lotic. Lentic water is of two type lakes and pond. Lake differs from ponds by retaining permanent water in the centers and by having some sandy shores. The source of a lake's water supply is very important in determining its water quality and in choosing management practices to protect that quality (Arora, 2012). The quality of water determines the distribution and abundance of aquatic flora and fauna. Following properties are important from ecological point of view.

There has been a diurnal and seasonal change in the temperature of water in pond, lake etc. temperature has been used to determine the type of lake. Light influences the fresh water ecosystem by interfering with their productivity. Shallow lake receives light upto its bottom surface resulting into abundant growth of vegetation. Light controls the growth and position of several aquatic organisms. Oxygen remains dissolved in fresh water. Phytoplankton and aquatic plants supply water with oxygen as a product of photosynthesis. Oxygen primarily utilized in respiration by organisms as well as in the decomposition of dead organisms. Carbon dioxide plays an important role in aquatic ecosystems. Aquatic vegetation and phytoplankton require carbon dioxide for photosynthetic activity. It is present in fresh water as carbonate and bicarbonates of calcium, magnesium and other minerals. Water system that receives sewage effluents and other pollutants show an abundance of H_2S as decomposition product. Methane and carbon monoxide are other toxic gases, which are the product of decomposition. Nitrogen, hydrogen, sulphur dioxide and ammonia are other gases that may be found dissolved in fresh water. Hydrogen ion concentration of the fresh water is an important limiting factor. Dissolved oxygen is an important factor that determines the quality of water in lakes and rivers. The higher concentration of dissolved oxygen, proved better water. BO and COD are the measure of organic material contamination in water, specified in mg/L. Both BOD and COD are key indicators of environmental health of a surface water supply (Nigam *et al*., 2013). Alkalinity, pH and hardness affect the toxicity of many substances in the water (Patil *et al*., 2013). Turbidity is important because it affects both the acceptability of water to consumers, and the selection and efficiency of treatment processes and must always be low preferably below 1 NTU (WHO 1993).

A water supply for domestic use should be free of disease causing organisms and substances which make the water non acceptable to its users. There are several ways to find out if a water supply is safe to drink. The two most important types of analysis for small community water supplies are the bacteriological tests and Physico-chemical tests. Bacteriological analysis identifies organisms associated with disease. Physico-chemical analysis identifies elements in a sample that make water turbid, offensive or poisonous to users (Rana 2010).

Physico-chemical analysis include tests for turbidity, colour, taste, pH, odour, temperature, alkalinity, acidity, free carbon dioxide, chloride, total dissolved solids, total suspended solid, total hardness, chemical oxygen demand, dissolved oxygen and biological oxygen demand. Being a basic need of human development, health and

wellbeing, safe drinking water is internationally accepted human right (WHO 1993), which has been enlisted as one of the ten targets in Milllennium Development Goals (MDGs). The present study is Physico-chemical investigations of Hoskotelake and Makanahalli lakes of Thattekere, HunsurTaluk, Karnataka.

Materials and Methods

Thattekere is a village in Hunsur, Karnataka with a population of 1462 is 6 kms away from Hunsur. Makanahalli lake area is 2.8 hectare, (Figure1) east to west 138×10 meter, North to south 115×8.5 meter and12.31° N and 76.29° W and Hosakote lake area is 23.8 hectare 12.45° N 74.69° (Figure 2). It is agricultural land including crop land and agro- horticulture plantation. These lakes is used for domestic purpose, agriculture and also fishing. This lake contains rich grow of lotus, lily and also algae. This lake water is specially used for worship of god Anjaneya temple situated at Thattekere.The climate is local Steppe with annual temperature of 23^{o}C and average rainfall 748mm.

The water samples were collected from Feb 2015 to April 2015 the sampling spot by dipping one litre polyethylene bottle just below the surface of water during morning hours for Physico-chemical water analysis. For estimation of dissolved oxygen by Winkler methods the samples were fixed at the sampling site by using BOD bottles for collection of water sample and the oxygen was fixed by adding manganese sulphate and alkaline potassium iodide and next carried to the laboratory. Temperature was recorded by placing thermometer in the water until the mercury column stops moving by immediately after collection of the water samples. The pH of water was determined by using digital pH meter. Turbidity is measured with an apparatus called Jackson Candle Turbidometer. Electrical conductivity (EC) was measured by electrode method by calculating the resistance using KCl as standard.

The amount solids (TDS) present in water is determined based on the residues left out after out evaporation (Kotaiah and Kumaraswamy 1994). Total hardness (TH) was estimated by EDTA titrimetric method EDTA titrimetric method to determine the total, Ca, Mg hardness present in the given sample of water. Total Suspended Solids (TSS) was estimated by filtering known amount of water sample through a pre weighed filter paper. The filter paper was the dried at 103 -105^{0}C . TSS was determined by using the Standard formula (Gorde and Jadhav, 2013). Estimation of Chloride was done by Argentometric method (Gopalan *et al*., 2009). Biological oxygen demand (BOD) refers to the amount of oxygen utilized by microorganisms in stabalizing the organic matter and is the amount of oxidizable organic matter present in sample. BOD is the difference in first day and fifth day value of DO value in ppm. (Kotaiah and Kumaraswamy 1994). Chemical oxygen demand (COD) and dissolved oxygen (DO) were measured as per Kotaiah and Kumaraswamy (1994) and Akan *et al*. (2012), respectively. The alkalinity of water was determined by titrating the water sample with Sulphuric acid of known value of pH, volume and concentrations.

Figure 1 Makanahalli lake area A-North view, B-South view

Results and Discussion

Present work is the study of Physico-chemical parameters of water analysis of Hosakote lake (L_1) and Makanahalli lake (L_2). The Physico-chemical characteristics of water for the period of three month from February 2015 to April 2015 represented in

Figure 3 and 4. The results of the Physico-chemical parameters are given in Table 1 and Table 2.Natural water is often coloured due to the presence of vegetable extracts tannins, humic acid, metal ion like iron, nickel etc. are primarily responsible for the colour of water. In the present study area of L_1 and L_2 showed colourless because less number of dissolved salts and also seasonal variation. Colour is due to presence of dissolved salts.

Figure 2 Hoskate lake area A-East view, B-South view

Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism. In the present study temperature of L_1 ranged from 28.0–30.0°C and L_2 temperature ranged from 27.0–28.0 °C. It showed minimum temperature because of in this lake presence of high amount of dissolved oxygen and also showed seasonal variation. High temperature reduces the amount of dissolved oxygen in water thereby affecting aquatic lives (Akan *et al*., 2012). In an established system the water temperature controls the rate of all chemical reactions, and affects fish growth, reproduction and immunity. The pH values are temperature dependent. pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. pH is considered as an important ecological factor and provides an important information on many types of geochemical equilibrium or solubility calculation (Shyamala *et al*., 2008). The present study minimum value of 7.5 was recorded in the both the period of February and April and maximum value of 7.6 was recorded in the season of March in L_1 and L_2 which showed the minimum range from 7.1 to Maximum of 7.5. In the present study of pH is values considered alkaline and compared with the standard values of IS is 6.5 to 8.5. The water of L_1 and L_2 is within the permissible limit of WHO (1993) and it is suitable for drinking purpose. Most lakes are basic (alkaline) when they are first formed and become more acidic with time due to the build-up of organic materials. As organic substances decay, CO_2 forms and combines with water to produce carbonic acid, a weak acid, which lowers water's pH. Most fish can tolerate pH values of about 5.0 to 9.0 (Akan *et al*., 2012). The maximum pH was recorded by most of bio-chemical and chemical reactions are influenced by the pH (Bondugula and Babu, 2013). Various factors bring about changes the pH of water (Kambale *et al*., 2009).

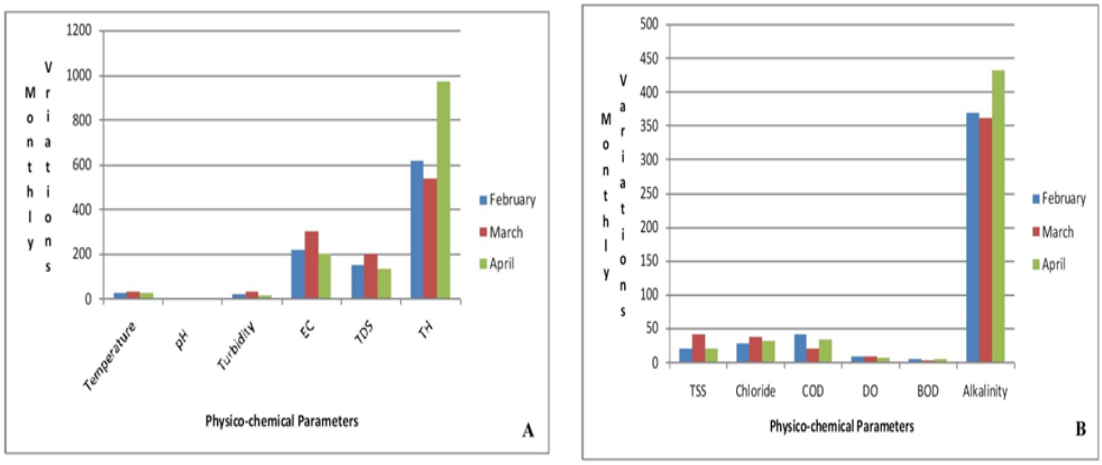

Figure 3 Graph A and B showing monthly variations of Physico-chemical parameters of Hosakote Lake

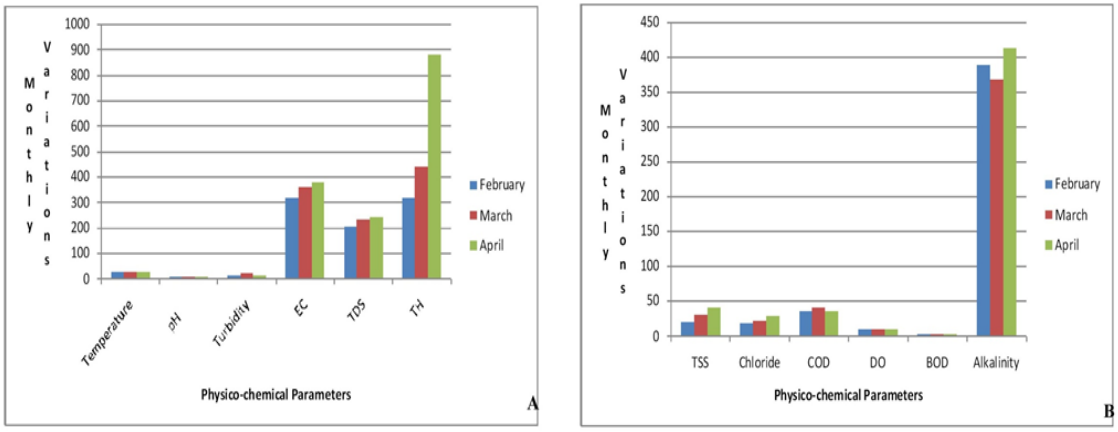

Figure 4 Graph A and B showing monthly variations of Physico-chemical parameters of Makanahalli Lake

Table 1: Results of Physico-chemical parameters of water analysis of Hosakotelake

S.N.	Parameters	February	March	April	Average	WHO standards
1	Temperature(℃)	28±0.50	30±0.11	29±0.11	29± 0.5	25-30
2	pH	7.5±0.11	7.6±0.55	7.5±0.25	7.5 ±0.5	7.5
3	Turbidity (NTU)	21.2±0.26	30.8±0.22	18.9±0.32	23.3± 6.3	10
4	Electrical Conductivity (EC) (μS/cm)	220±0.25	301±0.20	200±0.20	240.3± 57.4	300
5	Total Dissolved Solids(mg/L)	150±0.20	201±0.25	135±0.11	162 ± 34.6	500
6	Total hardness (mg/L)	620.5±0.15	540.4±0.55	680.7±0.25	613.3± 70.2	300
7	Total Suspended Solids (mg/L)	20.6±0.89	40.8±0.15	20.0±0.32	27.2± 11.7	50
8	Chloride (mg/L)	28.36±0.25	37.22±0.11	31.90±0.20	32.5± 4.3	250
9	Chemical Oxygen Demand (mg/L)	41±0.11	20±0.32	34±0.55	31.6± 10.6	30
10	Dissolved Oxygen (mg/L)	9.3±0.55	8.9±0.12	7.7±0.11	8.6± 0.8	4-8
11	Biological Oxygen Demand (mg/L)	5.5±0.50	2.5±0.55	4.5±0.20	4.1± 1.5	6
12	Alkalinity(ppm)	368±1.0	361±1.2	432±1.0	361± 39.8	200

The turbidity of water is due to presence of suspended matter that interferes with the passage of light through the water. Clay, mud, silica, algae, rust, bacteria and calcium carbonate are common substances found suspended in water. Turbidity causes light to be scattered and absorbed rather than transmitted through the sample. It depends on the amount and particle size of the suspended matter present in water (Gopalan *et al*., 2009). In the present study minimum value of 18.9 NTU was observed in the period of April in L_1 and maximum values of 30.8 NTU was recorded because more amount of human activities, soil run off (and also March season decrease in the water levels). In L_2 ranged from 11.7 – 20.1 NTU because less human activities. Study lakes showed above the permissible limits of 10 NTU of WHO (1993) values.

Electrical conductivity (EC) is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts and is a useful tool to evaluate the purity of water. The pure water has a very high resistance to the flow of electricity because the only ions are present are trace quantities of H_3O^+ and OH^- arising from the auto ionization of water. Natural water usually contains dissolved ionic salts and these

ions provide a path way for the flow of electrons through the solution. Therefore, it conducts electricity (Gopalan *et al*., 2009). In the present study minimum values are recorded in L_1 (200 µS/cm) in the period of April and maximum value of 301µS/cm in the period of March and L_2 showed minimum value of 320 µS/cm to maximum values of 380µS/cm in April. The changes of EC depends on the other parameters of heavy metals concentrations because lakes are present near the agricultural field. L_2 showed the maximum permissible limit 320 µS/cm of WHO (1993). Conductivity shows significant correlation with ten different parameters.

Table 2: Results of Physico-chemical parameters of water analysis of Makanahalli lake

S.N.	**Parameters**	**March**	**April**	**May**	**Average**	**WHO standards**
1	Temperature(℃)	28±0.12	28±0.35	27±1.0	28± 0.5	25-30
2	pH	7.1±0.55	7.2±0.32	7.5±0.11	7.2± 0.5	7.5
3	Turbidity (NTU)	11.7±1.0	20.1±0.11	11.8±0.12	14.5± 4.8	10
4	Electrical Conductivity (μS/cm)	320±0.11	360±0.12	380±0.55	353.3 ±30.5	10
5	Total Dissolved Solids (mg/L)	205±0.32	235±0.55	245±0.52	228.3 ±20.8	300
6	Total hardness (mg/L)	320.14±0.55	440±0.35	480.7±0.11	413.3 ±83.2	500
7	Total Suspended Solids (mg/L)	20.5±0.11	30.6±0.52	40.5±0.12	30.5± 10	50
8	Chloride (mg/L)	17.725±0.12	21.25±0.44	28.36±0.55	22.4 ±5.4	250
9	Chemical Oxygen Demand (mg/L)	35±0.55	40±0.52	36±0.22	37 ±2.6	30
10	Dissolved Oxygen (mg/L)	9.1±0.52	9.3±0.45	9.3±0.52	9.1± 0.5	4-8
11	Biological Oxygen Demand (mg/L)	3.4±0.55	2.4±0.11	2.4±0.11	2.7 ±0.51	6
12	Alkalinity(ppm)	388±0.12	369±0.12	413±0.55	39.0 ±22.0	200

TDS is a good general measurement of the concentration of ionic substance in water. In general, fresh water has less than 1500 mg/L of TDS and saline water has above 5000 mg/L of TDS (Gopalan *et al*., 2009). In the present study of L_1 TDS ranged from 135–201 mg/L and L_2 ranged from 205–235 mg/L and it was less than the permissible limits of WHO (1000 mg/L), thus fit for drinking purpose. The concentration of TDS in natural water is usually less than 500 mg/L, while more than 500 mg/L is undesirable for drinking and many industrial uses. TDS value of 500 mg/L as the desirable limit and 2000 mg/L as the maximum permissible limits. Water containing more than 500 mg/L of TDS causes gastrointestinal irritation. High value of TDS influences the taste, hardness and corrosive property of the water. TDS analysis has great implications in the control of biological and physical waste water treatment processes (Kambale *et al*., 2009).

Total Hardness is defined as the sum of calcium and magnesium hardness, in mg/L as $CaCO_3$. According to some classifications, water with hardness up to 75 mg/l is classified as soft, 76 -150 mg/l is moderately soft, 151- 300 mg/l as hard and more than 300 mg/l as very hard (Saravanakumar and Kumar 2011). The hardness values of the present study L_1 area ranged from 540.4 – 970.7 mg/L and L_2 ranged from 320.14 – 880.7 mg/L. The L_1 and L_2 having the maximum hardness which exceeds the WHO limits (100 mg/l- 500 mg/l) in period of April because of rain fall and agricultural field soil erosion. In the present values indicate the water of L_1 and L_2 are hard water. The term solids comprise a wide variety of organic and inorganic materials in water. Suspended particles in water are termed as Total Suspended Solids (TSS). TSS inversely

proportional to temperature and BOD (Hosmani *et al*., 2014). As levels of TSS increase, the water body begins to lose its ability to support a diversity of aquatic life. Settling suspended particles may trap bacteria and bring them to the bottom of the lake or river. In the present study TSS ranged from 20.0–40 mg/L in L_1 and L_2 TSS ranged from 20.5 – 40.5 mg/L. This result showed TSS in present study below the permissible limits of WHO guidelines of 50 mg/L. With excessive concentration of organic wastes, bacterial action may lead to anaerobic decomposition and anoxic condition in water. Hence the TSS of the sample L_1 and L_2 is within the permissible limits it supports the aquatic life.

Chloride a major anion in potable and industrial water, that has no adverse effect on health, but imparts bad taste to drinking water (Nirmal *et al*., 2012). The maximum permissible limit of chloride in potable water is 250 mg/L (Nigam *et al*., 2013). In the present L_1 area chloride ranged from 28.36 mg/L to 37.22 mg/L and L_2 ranged from 17.72 mg/L to 28.36 mg/L. Presence of chloride in these lake of L_1 and L_2 below the level of permissible limits 250 mg/L of WHO. The chloride concentration serves as an indicator of pollution by sewage. In the present study COD ranged from 20 mg/L to 41 mg/L in L_1 and L_2 ranged from 35 mg/L to 40 mg/L. The value of COD is above the permissible limits 10mg/L of WHO which may be due to human activities or surface run off carring chemicals into lakes.

DO is essential for the maintenance of healthy lakes and rivers. It is measured of the ability of water to sustain aquatic life. The dissolved oxygen content of water is influenced by the source water temperature, treatment and chemical or biological process taking place in distribution solution. In the present study DO in L_1 and L_2 similar ranged from 7.7–9.3 mg/L. Both L_1 and L_2 water showed above the permissible limits of 4–5 mg/L and this lake water is in the healthy condition and fit for aquatic life. The standard for sustaining aquatic life is stipulated at 5 mg/L a concentration below this value adversely affects aquatic biological life, while concentration below 2 mg/L may lead to death for most fishes (Akan *et al*., 2012). The higher concentration of dissolved oxygen, provide better water quality (Nigam *et al*., 2013). The high DO in summer is due to increase in temperature and duration of bright sunlight has influence on the % of soluble gases (O_2 and CO_2). During summer the long days and intense sunlight seem to accelerate photosynthesis by phytoplankton, utilizing CO_2 and giving off oxygen. This possibly accounts for the greater qualities of O_2 recorded during summer in lake L_2 which increased from 9.1 mg/L to 9.3 mg/L in April. BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic compounds and the oxidation of certain inorganic materials (e.g., iron, sulfites) (Patil *et al*., 2013). When BOD levels are high, dissolved oxygen (DO) levels decrease because the bacteria are consuming the oxygen that is available in the water. Since less dissolved oxygen is available in the water, fish and other aquatic organisms may not survive. In the present study BOD ranged from 2.5 – 5.5 mg/L in L_1 and L_2 2.4 – 3.4 was recorded and were within the prescribed limits 6 mg/L of WHO. Generally, the BOD levels recorded in the entire

sampling points were higher than the EU guidelines of 3.0 to 6.0 mg/L (BOD) for the protection of fisheries and aquatic life and for domestic water supply.

Alkalinity is primarily a way of measuring the acid neutralizing capacity of water. In other words, its ability to maintain a relatively constant pH. In the present study Alkalinity ranged from minimum of 361 mg/L to maximum of 432 mg/L. In L_2 ranged from minimum of 369 mg/L to maximum of 413 mg/L .In the present study showed above the permissible limits of 200 mg/L of IS values. Alkalinity, pH and hardness affect the toxicity of many substances in the water. Hydroxyl alkalinity is protects the corrosion of Alkalinity. The alkalinity of groundwater is mainly due to carbonates and bicarbonates. The acceptable limit of alkalinity is 200 mg/l and in the absence of alternate water source, alkalinity up to 600 mg/l is acceptable for drinking (Nigam *et al*., 2013). Hence the present values indicate the water of L_1 and L_2 are acceptable for the drinking.

CONCLUSION

In the present study of Hosakotelake and Makanahalli lakes it was found that most of the Physico-chemical parameters were below the permissible limits prescribed by WHO (1993) for domestic purposes like irrigation,washing and bathing. During the present investigations lakes are not contaminated by analysed parameters. In the study lakes are in good condition and are fit for aquatic life and agriculture. Because the Temperature, pH, TDS and TSS are within the permissible limits, and Chloride present below the permissible level thus the water is safe for crops and domestic use. DO in above the permissible level hence lakes are healthy condition.

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