Physico-Chemical Properties and Eutrophication Status of Shahpura Lake, Bhopal

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Abstract— The water of Shahpura Lake is suffering from severe contamination which is due to heavy discharge of pollutants without adequate treatment to remove harmful compounds. This is leading to the damaging effects not only to the individual species and population but also to natural biological community. The present work highlights the water quality index of Shahpura Lake of Bhopal. Water Quality Index (WQI) of Shahpura Lake bhopal using water quality parameters like Temperature, Chloride, Hardness, Alkalinity, pH, Conductivity, Total Dissolved Solids (TDS), Fluoride, Iron, Turbidity, Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD). The analysis reveals that Shahpura Lake needs some treatment before consumption.

Key words: Physico-chemical parameters, Water Quality Index, Eutrophication

I. INTRODUCTION

Globally, there is increasing awareness that the water will be one of the most critical natural resources in future. Water scarcity is increasing worldwide and pressure on the existing water resources is increasing due to growing demand of different sectors such as domestic, agriculture and industrial, hydropower etc. Therefore evaluation of water quality is important research topic in the recent years. Water is one of the most important factors for every living organism on this planet. Water is generally used for drinking, fisheries and other domestic purposes in this area. The available fresh water to man is hardly 0.3 to 0.5% of the total water available on the earth and therefore its judicious use in imperative. Lakes are one of the important water resources used for irrigation, drinking, fisheries and flood control purposes. The Shahpura Lake is situated near Manisha Market of Bhopal. It is surrounded by hospitals, schools and most importantly the population living around the lake area. The lake shows the marshy vegetation growing at the bank of the lake along with drains and pools that quantify pollution cost by municipal and industrial waste. A large part of this contamination is due to the organic material that comes from neighbouring urban sewage, live stocks, industrial waste and hospital waste. The water is also infested with water hyacinth which stabilized the water quality and provides substantial support to bacterial density which inturn contributes significantly to its growth and nutrient dynamics

Various physico-chemical parameters were studied to analyse the water quality of the lake. The pollution of this lake is a matter of great concern, since it has reached an alarming level due to inflow of large volume sewage and solid wastes. The lake receives a large amount of raw sewage from its densely populated habitation. The water body is a eutrophic lake where the amount of nutrient is very high and oxygen depletion is prominent (Varughese Globally, there is increasing awareness that the water will be one of the most critical natural resources in future. Water scarcity is increasing worldwide and pressure on the existing water resources is increasing due to growing demand of different sectors such as domestic, agriculture and industrial, hydropower etc. Therefore evaluation of water quality is important research topic in the recent years. Water is one of the most important factors for every living organism on this planet. Water is generally used for drinking, fisheries and other domestic purposes in this area. The available fresh water to man is hardly 0.3 to 0.5% of the total water available on the earth and therefore its judicious use in imperative. Lakes are one of the important water resources used for irrigation, drinking, fisheries and flood control purposes. The Shahpura Lake is situated near Manisha Market of Bhopal. It is surrounded by hospitals, schools and most importantly the population living around the lake area. The lake shows the marshy vegetation growing at the et al., 2004).Anaerobic conditions predominate throughout extensive areas of highly eutrophic lakes observed by Hutchinson (1975). Hypolimnion is often observed with the phenomenon of frequent oxygen depletion with the consequent increase in BOD, COD reported by Pani and Misra (2000).Johri (1990) studied the limnological and water quality status of two lakes of Bhopal. Saxena (1990) assessed the limnological and water quality status of Lower Lake of Bhopal

II. STUDY AREA AND SAMPLING DETAILS

Shahpura Lake is one of the important lake of Bhopal, Madhya Pradesh. Shahpura Lake is situated near the Manisha Market of Bhopal. It has an area of 8.29 km². The source and main use of the lake water is to rain sewage water of residential colony, irrigation recreation and aqua culture also. The storage capacity of the Shahpura Lake is 2.29Mm3. The maximum depth of the lake is 5.6 m and minimum depth of the lake is 1.5 m. and its coordinates are 23°12'17"N and 77°25'35"E. Water samples collected from eight sampling stations selected for the analysis are Rishabhdev Park as S1, Near Bansal Hospital as S2,Near Apna collection as S3 , Mamta marriage garden as S4, near Kolar road as S5,Near Windsor Temple as S6,Near chitransh nursery as S7 and Manisha market Road as S8. Samples are collected in the month of December.Samples for analysis are collected in sterilized bottles using the standard procedure for grab (or) catch samples in accordance with standard methods of APHA (American Public Health Association). The analysis of various physico – chemical parameters namely Temperature, Chloride, Hardness, Alkalinity, pH, Conductivity, Total Dissolved Solids (TDS), Fluoride, Iron, Turbidity, Dissolved Oxygen

(DO) and Biochemical Oxygen Demand (BOD) are carried out. All the chemicals and reagents used were of analytical grade.

Fig. 1:

SAMPLE	LOCATION	LATITUDE	LONGITUDE
S1	Rishabhdev Park Near	23°12'17"N	77°25'35"E
S2	Bansal Hospital	23°12'25"N	77°25'30"E
S3	Near Apna collection Mamta	23°13'17"N	77°25'28"E
S4	marriage garden	23°12'46"N	77°25'05"E
S5	Near Kolar road Near	23°13'08"N	77°25'69"E
S6	Windsor Temple Near	23°12'65"N	77°25'08"E
S7	chitransh nursery	23°13'91"N	77°25'08"E
S8	Manisha market Road	23°13'54"N	77°25'35"E

Table 1:

III. PARAMETERS CALCULATED

A. Temperature:

Water temperature is a physical property expressing how hot or cold water is. Temperature is an important factor to consider when assessing water quality. In addition to its own effects, temperature influences several other parameters and can alter the physical and chemical properties of water. The average temperature of the present study ranged is 22.125°C.

B. Chloride:

Chloride is present in all natural waters, but mostly the concentrations are low. In most surface streams, chloride concentrations are lower than those of sulfate or bicarbonate. Chloride ions may be retained in solution through most of the processes which tend to separate out other ions. Chloride values obtained in the study are found in the range between 72.6 to 74.8 mg / lt.

C. Hardness:

Calcium and magnesium dissolved in water are the two most common minerals that make water "hard." The hardness of water is referred to by three types of measurements: grains per gallon, milligrams per liter (mg/L), or parts per million (ppm). The hardness values of the present study were found to range between 235 to 249 mg/lit.

D. Alkalinity:

Alkalinity is a measure of the capacity of water to neutralize acids. The predominant chemical system present in natural waters is one where carbonates, bicarbonates and hydroxides are present. The bicarbonate ion is usually prevalent. In the present investigation the total alkalinity of the water samples is found in the Range 379 to 385 mg/lt.

E. pH:

pH is a measure of how acidic/basic water is. The range goes from 0 - 14, with 7 being neutral. ***p***H of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. pH is really a measure of the relative amount of free hydrogen and hydroxyl ions in the water. The pH values of the present investigation were between 7.2 to 7.9.

F. Conductivity:

Conductivity is used to measure the concentration of dissolved solids which have been ionized in a polar solution such as water. The unit of measurement commonly used is one millionth of a Siemens per centimeter (micro-Siemens per centimeter or µS/cm). The values obtained are in the range 1140 to 1173 ms/cm.

G. Total Dissolved Solids:

Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulphates) and some small amounts of organic matter that are dissolved in water. TDS values ranged within 573 to 596 mg/lt.

H. Turbidity:

Turbidity is the cloudiness or haziness of a fluid caused by suspended solids that are usually invisible to the naked eye. It is an aggregate optical property of the water and does not identify individual substances; it just says something is there. It is an aggregate optical property of the water and does not identify individual substances; it just says something is there.

I. Fluoride:

Fluoride is the simplest anion of fluorine. Its salts and minerals are important chemical reagent. In terms of charge and size, the fluoride ion resembles the hydroxide ion. Fluoride ions occur on earth in several minerals, particularly fluorite, but are only present in trace quantities in water. Fluoride contributes a distinctive bitter taste. It contributes no color to fluoride salts. In study it varies in the range of 0.66 to 0.93 mg/l.

J. Iron:

In present study it is found in the range 0.29 to 0.42 mg/l.

K. Dissolved Oxygen:

Dissolved oxygen concentrations are constantly affected by diffusion and aeration, photosynthesis, respiration and Decomposition. While water equilibrates toward 100% air saturation. The DO values obtained in the present study are within 5.0 to 5.7 mg/L.

L. Biochemical Oxygen Demand:

Biochemical oxygen demand (BOD) is the amount of dissolved oxygen needed (i. e., demanded) by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. This parameter values obtained in the present study are within 100 to 200 mg/l.

IV. CALCULATION OF WQI

Parameter	Mean test result(December month)	Unit	Standard permissible value (Si)
Temperature	22.1	OC	-
Chloride	74.1	(mg/L)	250
Hardness	243	(mg/L)	300
Alkalinity	382	(mg/L)	200
pH	7.5	-	8.5
Conductivity	1154	(mS/cm)	300
TDS	584	(mg/L)	500
Fluoride	0.81	(mg/L)	1
Iron	0.35	(mg/L)	0.3
Turbidity	53.05	(mg/L)	5
DO	5.4	(mg/L)	5
BOD	105	(mg/L)	6

Table 1: Statistics description of the analyzed physico-chemical parameters

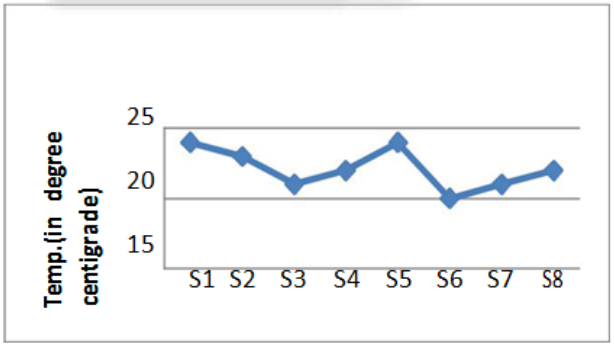
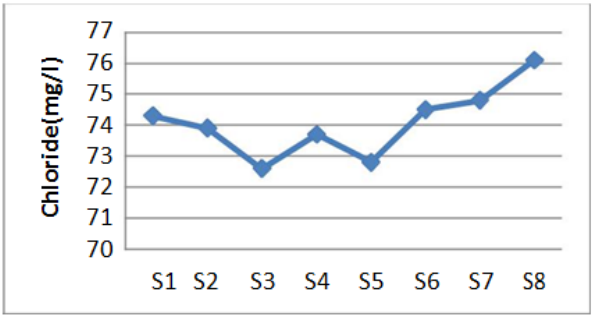


Fig. 2:



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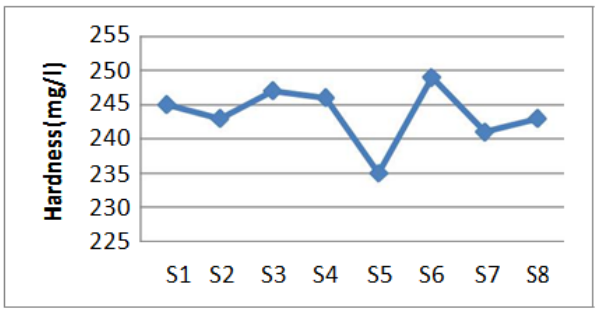

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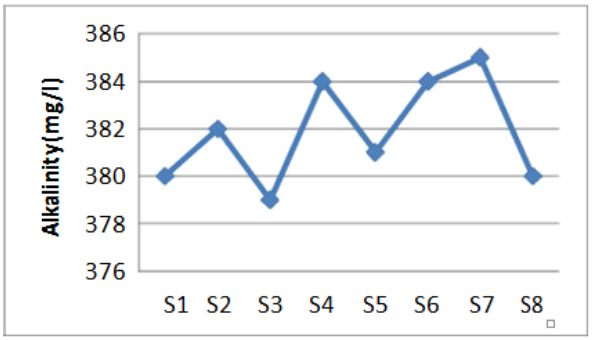

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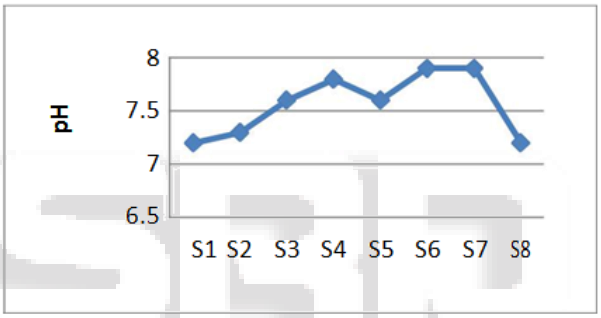

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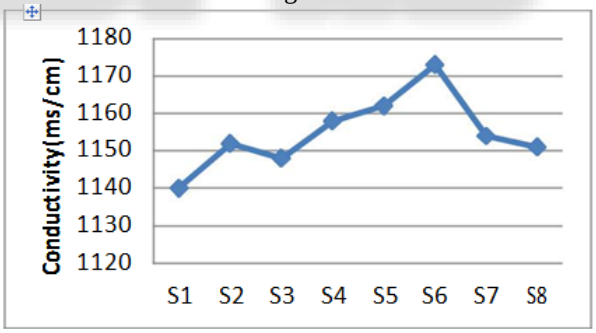

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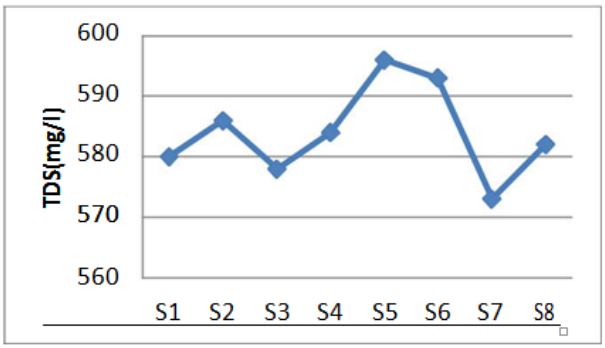

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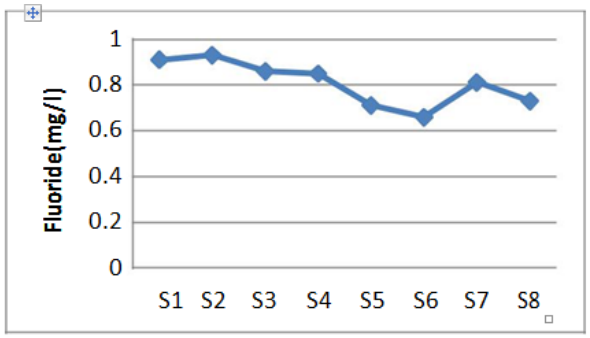

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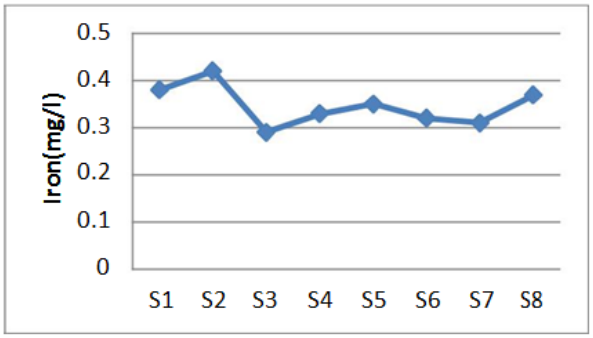

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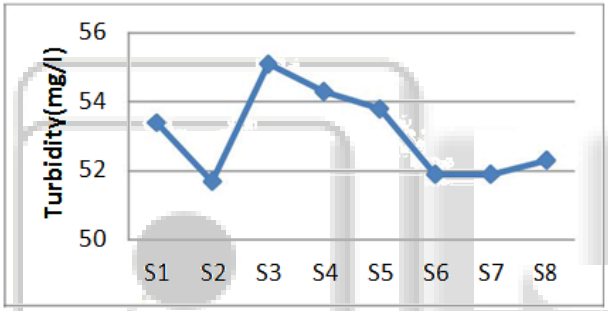

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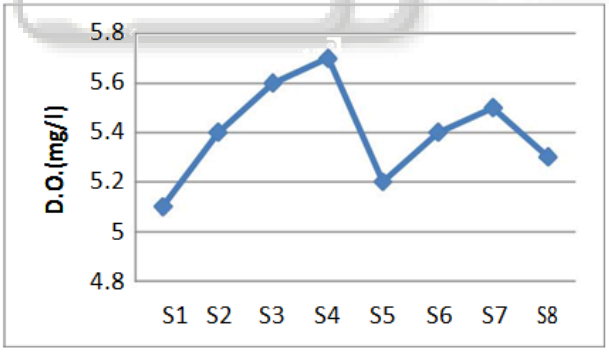

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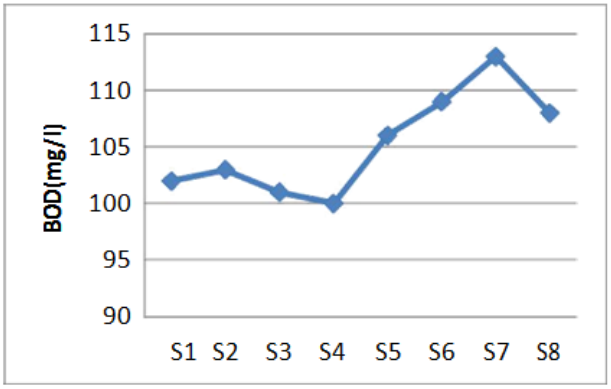

Fig. 13:

V. Conclusion

On the basis of results of research civil engineering structure which control the pollution in lake. To control the pollution in lake through major sewers by Intercept and treat all sewage at Intersection of lake by volume. Divert some and Intercept the others.Treat remaining sewage at intersection of lake. Install sewage treatment network upstream at sources and Intercept for final Treatment at Lake. And to control pollution in lake through minor drains by Connect to main sewers as per gradient or lift stations. Cluster drains in pockets and treat before discharge into lake. Connect Drains to points and lift stations for treatment nearby.

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