Restoration & Management of Urban Lakes: Case Study-Kotitirth

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***Abstract*-Lakes have a special role to play in Life of humankind. Lakes have supported mankind since historical period. However, the use of lake water is for drinking and agricultural pentose, but not all lakes are supporting for the same use. Because by virtue of some particular property and value every lake performs, particular function. The function depends upon location, size a various ecosystem characteristics of lake and of contras the degree of human interference in the matter of water pollution.**

I. Introduction

The human body contains from 55% to 78% water, depending on body size. To function properly, the body requires between one and seven liters of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity, and other factors. The human body contains from 55% to 78% water, depending on body size. To function properly, the body requires between one and seven liters of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity, and other factors.

The use of water for transportation of materials through rivers and canals as well as the international shipping lanes is an important part of the world economy. Water bodies such as springs, streams, rivers, lakes ponds, bog etc.

II. Need of Study

Many aquatic ecosystems have become severely de-graded and need to be restored. In many countries, large sums of money now are being spent to restore such lakes. The last three decades' good experience and expertise has increased worldwide. But the high investments, that are needed demand for a more scientific and sustainable ecosystem management, i.e. to restore the degraded lake to a level that can be permanently sustained through protection and conservation. The water quality target should be in accordance with quality of natural waters, and without the stresses, that cause degradation, i.e. with a good ecosystem health, long- term stability and sustainability. Such conditions prevailed in the pre-industrial time.

Though Kotitirth Lake is having historical value now it is abounded by cluster type of settlement particularly Panzer pole, part of Udyam Nagar, Shahu mill etc. Residences of these settlements are performing all their day-to-day work e.g. bathing, cloth and cattle washing, which finely increases pollution of lake water.

III. About Environment Of Kolhapur

Kolhapur city is located in the south-western part of Maharashtra and is endowed with extremely fertile soil and plenty of water. In the recent past the city has rapidly progressed from being predominantly agricultural town to an industrial city. Due to the increase in the internal population and the rapid influx of people from surrounding areas the population of Kolhapur hasrisen to 549,283 as per 2011 census provisional data, with a decadal growth rate of 19.39%. Kolhapur is founded in locations where nature has offered various attractions such as rivers and lakes that could be used for water supply and waste disposal, and in fertile river valleys with extensive food and animal resources.

COORDINATES: 16°41'39"N 74°14'12"E

Research Methodology and Data: The data for ongoing study is made available from the empirical, field survey and documented sources. The values of the chemical parameters have been taken in to consideration as a temporal factor for year 2013.The comparison therefore between these two years have been conducted. The empirical methods have been used for chemical analysis of the water samples which have been consecutively collected from the intensive field work. Study form the topo sheet has also been done accordingly. The empirical sources include physico – chemical analysis of water quality such as pH, DO, TDS, COD, TSS with other physical characteristics like odor, color turbidity, transparency etc.

IV. Objectives

While discussing the physico–chemical properties of the water the attempt has been made to study the quality of lake water to evaluate their suitability for drinking and irrigation purpose Physico-Chemical Properties of Water: In the present paper the discussion of the physico-chemical properties of the water has been made to study the quality of lake water. The samples of the lake waters are duly evaluated to verify their suitability for drinking and irrigation purpose.

1. Perform preliminary survey to collect information of lake from the local population and government bodies.
2. To collect the water samples of Kotitirth lake and

analyzing the water quality.

3 To carry out quantitative tests of water.
4 To measure approximate quantity of solid waste, especially during festivals.
5 To suggest improving measures to restore the lake and make the water usable for industrial and domestic purposes.

V. Study Area

It is said that about 5 acres of land covered by Kotitirtha lake water. Though this lake is having historical value now it is abounded by cluster type of settlement particularly Panzer pole, part of Udyam nagar, Shahu mill etc. Residences of these settlements are performing all their day- to-day work e.g. bathing, cloth and cattle washing, which finely increases pollution of lake water. Beside there are few natural infiltration source of water to this lake. Since the surrounding area of lake is densely, populated suspended human west is much more in the lake water. We are going to analyze the quality of water and to suggest measures to save the KOTITIRTH LAKE.

VI. Preliminary Survey

Our observations were as follows:

1 Cloth-washing, cattle-washing was going near the entrance gate of Garden.
2 There is a temple-cum-meditation center, named "Swami Samarth math."
3 A garden has been established by the municipal corporation of Kolhapur which is averagely maintained by a gardener appointed by authority.
4 There is another temple of god Shiva at the end of garden.
5 Water was having greenish color and turbidity at all the accessible points.
6 There was a residential building next to Shahu mill. We suspected that huge amount of solid waste was being disposed from that building into the lake.
7 Algae were formed over the water surface.
8 Solid wastes of temple were being disposed of directly from the Shiva mandir and Swami Samarth math.
9 As the Shahu mill is not in working condition now, we got the information from the authorities that no wastage is being thrown from their side into the lake. Observed some living species like fishes in the lake.

VII. Water Analyzing Tests

Following qualitative tests were conducted to determine the quality of water.

1 pH value
2 Alkalinity
3 Chlorides
4 Hardness
5 Dissolved Oxygen
6 B.O.D
7 Chemical Oxygen Demand
8 Nitrogen content
9 Phosphorous content
10 T.S.S. & T.D.S.
11 Heavy metals-Iron, Zinc, Lead

A. pH Value

The acidity or alkalinity of water is measured in terms of its pH value or H-ion concentration. The pure water (H_2O) consists of positively charged hydroxyl or OH-ions. But the process of dissociation takes place in pure water & hence, it contains some uncombined negatively charged H-ions. The water becomes acidic (pH-value is less than 7) when positively charged H-ions are in excess than negatively charged OH- ions & it becomes alkaline (pH-value is more than 7) when reverse is the case. For neutral water, the concentrations of H-ions & OH-ions are equal.

Discussion And Conclusion: pH value of water samples collected is more than 7, hence water is alkaline. pH of the water sample collected at the station-1 is slightly more than other station points. It may have happened because of cloth washing and cattle washings and thereby the release of carbonates & bi-carbonates into the lake water near station-1.

B. Alkalinity

The alkalinity is the measure of capacity of water to neutralize a strong acid. The alkalinity in water is generally imparted by the salts of carbonates, bicarbonates, phosphates, nitrates, Borates, silicates etc. together with little concentration of other alkalinity imparting ions. Bicarbonate represents a major part of alkalinity. In polluted water salts of week acids such as acetic acid & hydrogen sulphide may be produced & would also contribute to the alkalinity. Total alkalinity, carbonates & bicarbonates can have estimated by titrating the sample with the strong acid, first to pH 8 .3 using phenolphthalein as an indicator and then further to pH 4.2 to 5.4 with methyl orange as an indicator in first case the value is called phenolphthalein alkalinity (P.A) & in second case it is total alkalinity (T.A)

Discussion & Conclusion: as per IS: 10500-1991 the alkalinity of water is required to less than 200 mg/lit. The average alkalinity of water calculated by us is more than the standard limit. Alkalinity at station-1 is more than remaining.

C. Chlorides

The chloride contents, especially of sodium chloride or salt, are worked out for a sample of water. the excess presence of sodium chloride in natural water indicates pollution of water due to sewage, minerals. edible oil mill operations, ice-cream plant effluents chemical industries sea water intrusion in coastal regions etc.

Excess of chlorides is unfit for use. The chloride can be determined by titrating the water with silver nitrate and potassium chromate silver nitrate reacts with chloride to form very slightly soluble white precipitate of AgCl. At the end point when all the chlorides get precipitated free silver ions react with chromate to form silver chromate of reddish brown color.

Discussion & Conclusion: As per IS: 10500; the chloride content in water should be less than 250 mg/lit. Chloride content calculated by us is within permissible limit. Chloride content is increased because of the sewage directly entering into the lake from residential area near station-3. Excess amount of chloride gives saline taste to water and may cause various tastes.

D. Hardness

Hardness is generally caused by calcium and magnesium ions present in water. Polyvalent ions of some other metals like strontium, iron, zinc &manganese, etc. are also present capable of precipitating the soap and thus contributing to the hardness however the concentration of these ions is very low in natural waters, therefore, hardness is generally measured as concentration of only calcium and magnesium (as calcium carbonate), which are far higher in quantities over other hardness producing ions. Hardness is generally determined by Versenate method. In this method, the water is titrated against EDTA salt solution using Erio-chrome Black-T as indicator solution. While titrating, color changes from wine red to blue.

Discussion & Conclusion: As per IS: 10500, given water is hard. Hardness is more because of the dissolved pollutants coming from cloth washing and other religious practices. Average harness of water samples calculated is within 121-180mg/lit, Hence the water is hard. Hard water may clog industrial equipment's; therefore, it should be as soft as possible.

E. Dissolved Oxygen:

The amount of oxygen found present in given sample of water at the given temperature is called as dissolved oxygen. Surface water contains large amount of dissolved oxygen, because they absorb it from atmosphere. Algae and other tiny plant life of water also give oxygen to the water. The presence of oxygen in water in dissolved form is necessary to keep water fresh & sparkling. Dissolved oxygen decreases with increase in temperature & chloride concentration. Addition of organic pollution in water also decreases D.O as it consumed by bacteria to decompose & stabilize organic matter on other hand if D.O present in large quantity then it causes corrosion of pipes. While determining D.O, the manganous sulphate reacts with the alkali (KOH or NaOH) to form white precipitate of manganous hydroxide which in the presence of oxygen gets oxidized to a brown color compound. In the strong acid medium, manganic ions are reduced by iodide ions which get converted into equivalent the original against Sodium thiosulphate using starch as an indicator.

Discussion & Conclusion: As per IS: 10500, dissolved oxygen in water should be within 6.5 to 8 mg/lit. The dissolved oxygen present in sample as calculated is within permissible limits. Dissolved oxygen is more at station-2 because of lesser pollution. For industrial use, dissolved oxygen content should be lesser as it may corrode the machines.

F. B.O.D.:

The oxygen is demanded in water for the oxidation of inorganic matter and organic matter. The demand of oxygen by organic matter is known as the biochemical oxygen demand which is commonly abbreviated as B.O.D. The bacteria present in water have got capacity of taking up oxygen from water. The bacteria get energy by decomposing organic matters into the simplest form CO_2 and H_2O in presence of oxygen. This requirement of oxygen by microbes is called B.O.D. Due to this process D.O depletion takes place.

There are two methods to determine the B.O.D

1 Direct method
2 Dilution method

In the direct method, the sample of sewage is kept in contact with a definite volume of air or oxygen in a specially prepared vessel. The B.O.D can be then be measured manometrically. We calculate the B.O.D by the Dilution method, in which water sample is diluted with distilled water. Then the D.O is calculated, then sample is kept in incubator for 5 days & again D.O is calculated at the end of 5 days. The depleted dissolved oxygen is calculated per liter which is B.O.D.

Discussion & Conclusion: As per IS:10500 the B.O.D of potable water should be nil. Average B.O.D calculated is 32.56 mg/lit. This is much more than that of permissible limits. Aeration technique should be used to reduce it. B.O.D. indicates the self-purification capacity of any streams and it may serve as a check for effluents being discharged into water.

G. T.S.S & T.D.S

Total solids include the solids in suspension, colloidal & in dissolved form. the quantity of suspended solids is determined by filtering the sample of water through a fine filter, drying & weighing. The quantity of dissolved & colloidal solids is determined by evaporating the filtered water (obtained from suspended solid test) & weighting the residue. The total solids in a water sample can be directly determined by evaporating the water & weighing the residue

Discussion & Conclusion: As per IS: 10500, the total solids present in water should be less than before "GANESH FESTIVAL" the total solids present in water is within permissible limits (i.e. 413.33 ppm) but, after Ganesh festival

the total solids present in water is 846.67 ppm. This is much more than that of permissible limit.

H. Heavy Metals

The metals present in water are also tested before & after Ganesh festival. these is done to check the Ganesh festival impact on quality of water. Ganesh idols are generally consisting of P.O. P& shadu (special type of mud). Lead (Pb), Zinc (Zn), Iron (Fe) is the main substances which are present in colors used for painting of Ganesh idols.

Discussion & Conclusion: The metals (Lead, Iron, Zinc) are present in water. Iron & Zinc were within the permissible limits stated by IS:10500-1991, but lead is greater than that of specified.

SURVEY OF GANESH IDOL IMMERSION IN LAKE: We observed the immersion proceedings their whole day and measured number of idols which were immersed in lake. As it is responsible to some extent for Lake Disturbance.

In 12 hrs. (9.00am to 9.00 pm) about 1500 idols were immersed in lake.

VIII. Summary And Discussion

Results of water quality testing when was compared with standard limit of IS :10500-1991, following parameters were found to be not as per standards.

1. Alkalinity 2. Hardness 3. B.O.D 4. Heavy Metals-Lead

We identified, following sources of contamination which are responsible for lake degradation. 1. Sewage directly entering from the residential area 2. Ganesh idol immersion and other religious practices 3. Cloth washing and cattle washing. 4. Dumping of solid waste. 5. Lack of awareness among people regarding environment

A. Restoration:

After studying the water quality and sources of contamination of „Kotitirth lake, We have proposed following techniques for restoring the water quality.

1.Aeration

Aeration is a process to provide dissolved oxygen to microorganisms (aerobes) in the aerated liquid to degrade (or convert) organic wastes to carbon dioxide and water. The advantages of aeration treatment of liquid wastes include 1) Minimum odor when properly loaded and maintained. 2) Large BOD removals providing a good quality effluent. 3) High rate treatment allowing smaller scale systems, e.g., less land required (for mechanical aeration only). 4) The final discharge contains dissolved oxygen which reduces the Immediate oxygen demand on receiving water. 5) The aerobic environment eliminates many pathogens present in agricultural wastes.

Effect of aeration on BOD and sludge concentration in the liquid

In phase A, microorganisms are adapting themselves to the aeration environment and store necessary nutrients for growth, during which little biomass production and BOD reduction are observed. In the following phase, rapid growth of aerobic bacteria and accelerating removal of BOD are taking place, accompanied by high demand of oxygen. Phase C indicates the end of growth period with moderate oxygen demand and the onset of cell autolysis, followed by phase D when cell destruction increases with low oxygen demand. Years of research have ascertained that BOD is a reliable indicator of odor offensiveness from organic wastes including animal manure so reducing BOD in wastewater under aeration treatment becomes critical to controlling odor emission. Also, the efficiency and effectiveness of aeration systems in mitigating malodor production can be evaluated by examining the extent and rate at which BOD is removed.

Aeration in Kotitirth Biochemical oxygen demand (B.O.D.) of lake water is high so to reduce it Surface type of aeration can be used in Kotitirth Lake This water of proposed pond can be used in industries. Along with aeration, following treatments should be given:

1 Screening
2 Sedimentation
3 Biosorption of heavy metals:

The Mechanism of metal bio sorption is complicated process. The status of biomass living or nonliving, types of biomaterials, properties of metal solution chemistry, ambient or environmental conditions such as pH, influence the mechanism of metal bio sorption. The metal bio sorption process by living by living cells is a two step process. In the first step metal ions are adsorbed to the surface of cells by the interaction between metals and functional group displayed on the surface of the cells. All the metal ions before gaining access to the cell membrane and cell cytoplasm come across the cell wall. The cell walls consist of variety of polysaccharides and proteins hence offers a number of active site capable of binding metal ions. Difference in a cell wall composition

4 Magnetic field method to reduce hardness of water:

In this study magnetic field intensities of zero Tesla (as a witness), 0.05 Tesla, 0.075Tesla, and 0.1 Tesla, were examined. With doing examination by 3 times have shown that changing magnetic field intensity, amounts of water influent, and also together influence their factors, have significant effects at level of 99 percent on reducing of water hardness. The method of preparing magnetic field This device is containing of seven U shape magnet, with north pole and south pole (Figure 1), That have consoled in form of same axis and is create length equal 25 cm on the magnetic field.

Sample of magnet with north pole and south pole This magnet is formed from central nucleus that has twisted of copper suggested armature with determining round number on that. It has used from 300-gram copper wire, for each magnet, in such a manner copper wire has twisted as handmade round of central nucleus. For being the work, calculated magnetic field intensities on Electronic Laboratory in Bu-Ali-Sina University. For measuring magnetic field intensity of each magnet, we used the magnetic balance. The magnetic field intensity of magnets is calculated by reading the magnetic balance force,

$$B = \frac{FX10^{-5}}{[X]}$$

In this B is a magnetic field intensity according to Tesla, F is a read force amount by magnetic balance (that calculated according to Newton by to multiply on 10-5), I is a flow intensity on magnetic balance according to Amperes, L (according to cm) is length of part of balance that magnet is consoled on this part. In this balance L equivalent is 2 cm and I is equivalent 1 Amperes that worked with voltage of 5 V.

Experiments have shown that the magnetic field affected on water quality and that production of magnetic water has an ability on water hardness reducing until 51 percent. The factors of magnetic field intensity, situation of magnets setup, amount of enter water flow and enter water hardness has a significant effect on water hardness reducing and increasing of treatment efficiency in level 99 %. Increasing on amount of enter water flow and increasing on magnetic field intensity, has culminated in increasing efficiency of treatment, and in results, reduced of water hardness. Setup of magnets inform of inversion, shown increasing the efficiency rather than state of non-inversion. The results of water chemical analyze shown that after magnetic treatment, has reduced size and greater particles number. The magnetic treatment has increased amount of aragonite in sediment of

$CaCO_3$ to 70 percent. This increase is being to 99.99% according to the magnetic field intensity and other factors.

5 *Reducing hardness of water of Kotitirth lake using magnetic field intensity*

Horse-shoe shaped magnets can be used along the pipe which is Will be used to supply water after pumping out from the lake. Variation in magnetic field intensities can reduce hardness up to 99%. Even though, this method is expensive, it can be used as industries will get absolute soft water from near-by area.

- First of all we'll need to excavate the base of lake to remove silt as shown by the red line in above picture.
- A wall of waste coconut coir is to be made of height slightly more than the water level of lake.
- Then after, all Ganesh idols should be immersed in the area behind red line.

6 *Coconut Coir Wall*

Coconut coir is waste material which remains after the coconut is used completely. It can absorb heavy metals like lead content of water. It is an inexpensive method to reduce heavy metals as well as total solid contents of water.

Utilization of water after restoration of Kotitirth lake: Kotitirth lake is situated near the industrial area of city, Shivaji Udyam Nagar. Various types of industries, workshops and foundries have been established in Udyam Nagar. After restoration of lake, water quality will be improved than the present. Therefore, it can fulfil water requirements of this near-by area partially or fully.

For the management of lake measures proposed are – 1. De-siltation of lake bed. 2. Improvement of Lake Shoreline. 3. Aerators should be used for improving D.O. levels. 4. Solid waste management programs should be implemented in the Lake Catchment. 5. Environmental awareness and community participation. 6. Constant monitoring of the lake water quality and establishing a Database for the lake management system.

IX. Conclusion

After analyzing water quality parameters sources of contamination of Kotitirth lake we conclude that following restoration techniques can be applied to improve the water quality of Kotitirth lake. Aeration Bio Sorption Magnetic field method Utilization of Coconut Coir After the proper restoration and management of Kotitirth lake, its water can be used for industrial purposes in the near-by area, Shivaji Udyam nagar. This would minimize the load of water demand on water supply system of Kolhapur city

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