Seasonal variation in the water quality of Gota Lake

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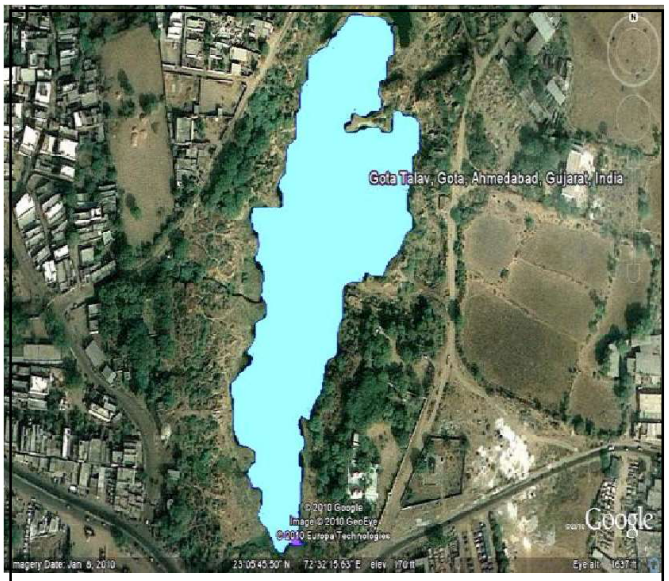
ABSTRACT

The objective of this work is to evaluate the water quality of Gota lake. Seasonal variation of some physical parameters such as pH, Turbidity, Electrical conductivity, Total dissolve solid, and some of the chemical parameter such as Alkalinity, Dissolved oxygen, Biological oxygen demand, Total Hardness, Calcium, Magnesium, Chloride, Carbon dioxide, Sulphate, Nitrate and Phosphate were studied. The study was carried out from March 2009 to February 2010. Analysis of physical and chemical parameters were carried out by using the method suggested by APHA (1985), Kumar and Rabindranath (1998) and Trivedy and Goel (1984). The variation found during the analysis was as a result of human activity and the discharge of waste water to the lake. The waste water of complete Gota village is directed into the Gota lake and because of this reason very soon Gota lake would become ecological inactive

Keywords: Water, Gota Lake, Pollution, Ahmedabad, Physico-chemical parameter.

INTRODUCTION

The condition of a lake at a given time is the result of the interaction of many factors—its watershed, climate, geology, human influence, and character istics of the lake itself. With constantly expanding databases and increased knowledge, limnologists and hydrologists are able to better understand problems that develop in particular lakes, and further develop comprehensive models that can be used to predict how lakes might change in the future. While the development of a limnological database and knowledge is important, no amount of generalization can provide a full understanding or predict conditions of any particular lake. Each lake system is unique, and its dynamics can be understood only to a limited degree based on information from other lakes. Just as a physician would



GOTA LAKE

not diagnose an individual's medical condition or prescribe treatment without a personal medical examination, a limnologist or hydrologist cannot accurately assess a lake system or suggest a management strategy without data and analysis from that particular lake and its environment.

In Ahmedabad there are many number of water bodies, among all these water bodies many of them are natural and many of them are artificial. Initially all the water bodies in Ahmedabad were natural, but now some of this lake were improved by "Ahmedabad Urban Development Authority" (AUDA) and "Ahmedabad Municipal Corporation" (AMC) to restore the rain water and to recharge underground aquifers. The present study was carried on Gota lake. Gota lake is located in the western part of Ahmedabad city. The lake is natural lake and is located in the center of Gota village. The sewage waste of complete Gota village is directly discharge into this lake, and people of the village also use to wash their cloth in this lake. The cattle of the villagers also take bath in this lake. The lake covers an area of 20,298 m^2. And its latitude and longitude are $23^0$05'41.20" N and $72^0$32'13.87" E.

MATERIALS AND METHODS

The present study was carried out for Gota Lake, located in Ahemdabad city. In the present study the sampling was done during morning hour. The water samples were collected in the polyethylene bottles. The closed bottle was dipped in the lake at the depth of 0.5 to 0.7 m, and then a bottle was opened inside and was closed again to bring it out at the surface. The samples were collected from five different points and were mixed together to prepare an integrated sample. From the time of sample collection to the time of actually analyses, many physical and chemical reactions would change the quality of the water sample; therefore to minimize this change the sample were preserved soon after the collection. The water samples were preserved by adding chemical preservatives and by lowering the temperature. The water temperature, pH, DO, EC and TDS were analyzed immediately on the spot after the collection, whereas the analyses of remaining parameters were done in the laboratory.

The study was carried for a period of 1 year (March 2009 to February 2010). Monthly data was collected, but results were represented season wise. Four month make one season [March to June summer season, July to October monsoon season, and November to February winter season].The collected water samples were brought to the laboratory and relevant analysis was performed. pH was determined electrometrically using digital pH meter, electrical conductivity was measured by conductivity meter, dissolved oxygen is measured by DO meter, total dissolve solid was measured by using TDS meter and similarly turbidity is measured by Nepthalo turbidity meter. Alkalinity, chloride, TDS, calcium, magnesium, total hardness, nitrate and phosphate were determined by method suggested by APHA (1985), Kumar and Rabindranath (1998) and Trivedy and Goel (1984). Estimation of sodium was done by Flame Photometric method. The mean value of the monthly data was calculated as season wise and standard error was also calculated by using following formula

Standard deviation $\sigma = \sqrt{\frac{\sum (x_i - m)^2}{n-1}}$

Standard error $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

RESULT AND DISCUSSION

Temperature

Desai (1995) suggested that the water temperature may depend on the season, geographic location and sampling time. The temperature plays a crucial role in physico-chemical and biological behavior of aquatic system (Dwivedi and Pandey, 2002). Whereas according to Singh and Mathur (2005) temperature is one of the most important factors in the aquatic environment.

The temperature of Gota lake ranges between 16 ±1.22 °C to 28 ±1.47 °C the maximum temperature were noted during the summer season and the minimum was noted during winter season. Similar result was observed by Saha (1980). According to Bohra (1975) in winter the water temperature remain low due to low atmospheric temperature. Water temperature influence aquatic weeds and algal blooms (Zafar, 1964).

Electric conductivity

Electrical conductivity in the water is due to salt present in water and current produced by them. It measures the electric current which is proportional to mineral matter present in water. Electric conductivity recorded in Gota lake ranges between 2.64 ±0.07 mhos/cm to 3.78 ±0.11 mhos/cm. The high value of conductivity was recorded during the summer season were as low value was recorded during winter season. Due to evaporation the water in the Gota lake decreases during summer. Addition of sewage waste from the surrounding village into lake result into the increase in the value of electrical conductivity during summer season. Ahluwalia (1999) and Solanki (2001) observed similar type of result.

Turbidity

Turbidity is the measure of the light scattered by suspended particles. The substances not present in the form of solution cause it. Turbidity in Gota lake recorded ranges between 18 ±1.83 NTU to 24 ±1.41 NTU. The maximum turbidity in water was recorded during monsoon season whereas minimum turbidity was recorded during summer season. According to Mariappan and Vasudevan (2002) high turbidity shows presence of large amount of suspended solids. Suber (1953) ; Verma *et al*., (1978) suggested that higher turbidity affects the life indirectly, as its cut of light to be utilized by the plants for photosynthesis there by lowering the rate of primary productivity

Total dissolve solid

Esmaeili and Johal (2005) dissolve solids are composed mainly of carbonates, bicarbonates, chloride, sulphate, nitrate, calcium, magnesium potassium iron and manganese in natural water. Due to contamination of domestic waste water, garbage, fertilizer, etc in the natural surface water body the value of TDS was reported to be high. The amount of total dissolve solid in Gota lake ranges between 1576 ±17.4 ppm to 1824 ±40.3 ppm. The maximum amount of total dissolve solid was recorded during winter season and minimum was recorded during monsoon. The amount

of TDS recorded is above the desirable limit, given by BIS (1991) and WHO (1984). The increase in the amount of TDS is due to addition of sewage waste and detergent from the surrounding region. This addition of waste in lake release organic substance in the water which results into high value of TDS. The decrease in the amount of TDS during monsoon season was also recorded this might be due to dilution of water by the rain water. This result is supported by Gonzalves and Joshi (1946). Similar result was also observed by Freeda *et al.,* (2006) and Murugesan *et al.,* (2006).

pH

Verma *et al.,* (1978) and Sharma *et al.,* (1981) have reported that generally in India many small confined water pockets particularly are alkaline in nature. The water of Gota lake also remain alkaline throughout the year. The pH value recorded ranges between 8.3 ±0.13 to 9.1 ±0.18. The maximum pH was recorded during summer season and the minimum pH was recorded during monsoon season. Wani and Subla (1990) reported that the pH value above 8 in natural water are produced by photosynthetic rate that demand more CO_2 than quantities furnished by respiration and decomposition. The pH of water also depend on the relative quantities of calcium, carbonate and bicarbonate. Moitra and Bhattacharya (1965) observed that high pH value was related to heavy bloom of phytoplankton. According to Bridge and Jaday (1911) pH value of water depends largely on the amount of free CO_2.

Total alkalinity

The alkalinity of water depends on the carbonate and bicarbonate solely and to lesser degree with magnesium, sodium and potassium. The amount of total alkalinity recorded in Gota lake ranges between 224 ±6.48 ppm to 246±11 ppm. The minimum value of alkalinity was recorded during monsoon season and the maximum value of alkalinity was recorded during summer season. The main source of alkalinity in the water of Gota lake is the addition of soap and detergent used by villager for bathing and washing purpose. Similar result was observed by Wani and Subla (1990) and Ahmad and Singh (1993).

Total hardness

Hardness of water is not a specific constituent but is a variable and complex mixture of cations and anions. It is caused by dissolved polyvalent-metallic ions. Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring a considerable amount of soap to produce lather. The total hardness recorded in the water of Gota lake ranges between 314±10.4 ppm to 346±8.87 ppm. The maximum amount of total hardness in the water of Gota lake was recorded during summer season and the minimum amount of total hardness was recorded during monsoon season. The high value of hardness during summer may be due to evaporation of water and addition of calcium and magnesium salts by mean of plants and living organism. Bagde and Verma (1985) observed similar result in J.N.U lake. The above result was also supported by Udhayakumar *et al*., (2006). High values of hardness are probably due to regular addition of large quantities of sewage and detergent into lakes from the nearby residential localities. Similar observation was made by Kaur *et al.*, (1996) and Mohanta and Patra (2000).

Calcium

Jhingran (1975) suggested that calcium is most abundant ions in freshwater and is important in

shell construction, bone building and plant precipitation of lime. The amount of calcium in the water of Gota lake ranges between 68 ±3.65 ppm to 84 ±4.24 ppm. The maximum amount of calcium recorded in water was during summer season, whereas the minimum amount of calcium in water was recorded during monsoon season. Calcium is present in water naturally, but the addition of sewage waste might also be responsible for the increase in amount of calcium. Udhayakumar *et al*., (2006) and Angadi *et al*., (2005) also observed similar result in their studies of water bodies. The amount of calcium increases during summer season due to rapid oxidation /decomposition of organic matter. Billore (1981) observed similar result.

Magnesium

Magnesium is also present with calcium in natural water albeit in lower concentration than calcium and has similar source of entry. Govindan and Devika (1991) have suggested that the considerable amount of magnesium influence water quality. The amount of magnesium recorded in the water of Gota lake ranges between 33 ±2.65 ppm to 35 ±3.87 ppm the maximum amount of magnesium in the water was recorded during monsoon season where as the minimum value was recorded during summer season. Magnesium in absolutely essential for chlorophyll bearing algae plant. Magnesium enters into combination with anions other than CO_2 in lakes such as chloride and sulphate (Jhingran, 1975).

Dissolved oxygen

Addition of oxygen demanding wastes consumes the dissolved oxygen present in water. The organism in water required a particular concentration of dissolved oxygen. Measurement of dissolved oxygen is a primary parameter in all pollution studies. Dissolve oxygen value is higher in those lake where there was good aquatic life. The amount of dissolved oxygen recorded in the water of Gota lake ranges between 3.12 ±0.07 ppm to 6.64 ±0.32 ppm. The minimum amount of dissolved oxygen in the water of Gota lake was recorded during summer season, whereas the maximum amount of dissolved in the water of Gota lake was recorded during monsoon season. Seasonal fluctuation of dissolve oxygen with high value observed during monsoon may be as a result of the increased solubility of oxygen at lower temperature (Prasannakumari *et al*., 2003). The low value during summer and high value during monsoon is because of the phenomenon of reoxygenation of water during monsoon may be due to circulation and mixing by inflow after monsoon rain. Similar observation was made by Kumar (1996) and Unni (1996).

Biochemical oxygen demand

Biochemical oxygen demand depends on aquatic life; variation in BOD indicates dynamism in aquatic life present in the pond. BOD refers the oxygen used by the microorganism in the aerobic oxidation of organic matter. Therefore with the increase in the amount of organic matter in the water the BOD increases. The BOD value in Gota lake ranges between 2.10 ±0.11 ppm to 3.96 ±0.2 ppm. The minimum demand of oxygen in the water was recorded during summer season, whereas the maximum demand was recorded during monsoon season. The higher value of BOD during monsoon was due to input of organic wastes and enhanced bacterial activity. Similar result was observed by Campbell (1978).

Chloride

Sirsath *et al*., (2006) observed that the most important source of chloride in the water is the discharge of domestic sewage. The amount of chloride recorded in the water of Gota lake ranges between 102 ±4.69 ppm to 116 ±3.83 ppm . The minimum amount of chloride in lake water was recorded during the monsoon season and the maximum amount was recorded during winter season. Chloride in water influences salinity balance and ion exchange and is contributed by dissolution of salt deposits, sewage discharges, effluents from chemical industries and irrigation drainage to natural water. The higher concentration of chloride during summer month may be associated with frequently run-off loaded with contaminated water from the surrounding. Sunder (1988) and Kumar (1995) also observed similar result in their study.

Sodium

Sodium is a natural constituent of raw water, but its concentration is increased by pollutional sources such as rock salt, precipitation runoff, soapy solution and detergent. The amount of sodium recorded in the water of Gota lake ranges between 37 ±4.2 ppm to 56 ±2.94 ppm. The minimum amount of sodium in the water of Gota lake was recorded during monsoon season and the maximum amount was recorded during winter season. The high level of sodium and calcium may be brought by input to the reservoir water and low level of these elements may be due to the bioaccumulation by living organism.

Nitrate

Nitrates are contributed to freshwater through discharge of sewage and industrial wastes and run off from agricultural fields. The amount of nitrate recorded in the water of Gota lake ranges between 6.4 ±0.42 ppm to 9.14 ±0.09 ppm. The minimum amount of nitrate in the water of Gota lake was recorded during summer season, whereas the maximum amount of nitrate in water was recorded during winter season. Lower concentration during summer was due to its utilization by plankton and aquatic plants. Similar result was observed by Kannan (1978). Nitrate in natural water is likely to vary.

Phosphate

Algae require only small amount of phosphate. Excess amount of phosphate may cause eutrophication leading to extensive algal growth called algal blooms. Phosphate is one of the limiting factor for phytoplankton productivity because of geochemical shortage of phosphate in drainage basin. The amount of phosphate recorded in the water of Gota lake ranges between 1.38 ±0.04 ppm to 2.12 ±0.07 ppm. The minimum amount of phosphate recorded in the water of the lake was during summer season and the maximum amount was recorded during monsoon season. Phosphate is considered to be the most significant among the nutrients responsible for eutrophication of lakes, as it is the primary initiating factor. The water body receives the influx of sewage effluents and decomposed organic matter. It might also be due to addition of human waste and release of detergent into the aquatic environment. Kumar and Gupta (2002) made similar type of observation.

CONCLUSION

The result obtained during study was compared with WHO (1971) and BIS (1991) standards

and it was found that maximum number of parameters in Gota lake were above desirable limit in all the three season. This result shows that in Gota lake very high amount of sewage waste was discharge by the villagers. And the water of lake is highly contaminated. And If the similar condition continue for the longer period, Gota lake may soon become ecological inactive.

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Table-1

Sr. no.	PARAMETERS	YEAR 2009 - 2010		
		Summer Mean ± S.E.	Monsoon Mean ± S.E.	Winter Mean ± S.E.
1.	Temperature in ^{0}C	28 ±1.47	22 ±1.47	16 ±1.22
2.	Electrical conductivity in mhos/cm	3.78 ±0.11	3.15 ±0.15	2.64 ±0.07
3.	Turbidity in NTU	18 ±1.83	24 ±1.41	22 ±0.91
4.	Total Dissolve Solid in ppm	1628 ±33.7	1576 ±17.4	1824 ±40.3
5.	pH	9.1 ±0.18	8.3 ±0.13	8.8 ±0.17
6.	Alkalinity in ppm	246 ±11	224 ±6.48	232 ±10.3
7.	Total Hardness in ppm	346 ±8.87	314 ±10.4	326 ±11.6
8.	Calcium in ppm	84 ±4.24	68 ±3.65	73 ±4.34
9.	Magnesium in ppm	33 ±2.65	35 ±3.87	35 ±2.08
10.	Dissolved Oxygen in ppm	3.12 ±0.07	6.64 ±0.32	5.28 ±0.19
11.	Biochemical Oxygen Demand in ppm	2.10 ±0.11	3.96 ±0.2	2.68 ±0.15
12.	Chloride in ppm	108 ±6.27	102 ±4.69	116 ±3.83
13.	Sodium in ppm	48 ±5.77	37 ±4.2	56 ±2.94
14.	Nitrate in ppm	6.4 ±0.42	7.64 ±0.24	9.14 ±0.09
15.	Phosphate in ppm	1.38 ±0.04	2.12 ±0.07	1.80 ±0.06

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