



Hydrological status of Danteshwar pond, Vadodara, Gujarat, India

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Abstract

The present investigation deals with the study of physico-chemical status of Danteshwar pond. For such assessment the water quality for parameters like water temperature, pH, acidity, alkalinity, dissolved oxygen, chloride and calcium, magnesium and total hardness, phosphate, nitrate, total solids were analyzed monthly during October 2009 to September 2010. Samples were collected from selected site of the pond. The analysis was done based on the standard methods. The results indicate that most of all the parameters were within permissible limits for potable water standards of WHO except water temperature, pH. Throughout the study period water was alkaline in nature. Chloride showed positive relation with water temperature. Water temperature showed high significant negative correlation with dissolved oxygen. Phosphate showed negative correlation with most of all parameters except acidity and dissolve oxygen. Nitrate showed negative correlation with most of all parameters except water temperature and phosphate. It also showed significant negative correlation with total hardness. Only total hardness showed significant monthly variation.

Keywords: Water quality, physico-chemical parameters, correlation, Danteshwar pond.

Introduction

Fresh water has a great role in sustenance of life of human beings, other organisms of the environment and maintaining the balance of nature. Water resources are being used by human being for various purposes like agriculture, industries, hydropower, fisheries and recreational uses. At present the quality of water largely under threat due to releases of municipal, industrial, domestic and sewage wastes in the surface and ground water reservoirs. Water quality parameters provide current information about the concentration of various solutes at a given place and time and the basis for judging the suitability of water for its designated uses and to improve existing conditions. Due to the increase in population, industrialization, lack of sanitation facilities and improper waste treatment the quality of urban water bodies in India is deteriorating rapidly and a great pressure has been put on the existing water resources. Due to domestic and industrial waste about 80% of urban water supply finds its way back into the drainage system¹. Water quality affects directly or indirectly by physico-chemical parameters. Some factors like source of water, type of pollution, seasonal fluctuation etc, change these parameters widely. Such limnological studies are helpful in interaction between the climate, surrounding environmental conditions and biological processes in the water. In recent year several studies have been made on the limnology of fresh water bodies²⁻⁶.

The present investigation deals with the study of monthly variation in physico-chemical status of water quality of Danteshwar pond, Vadodara.

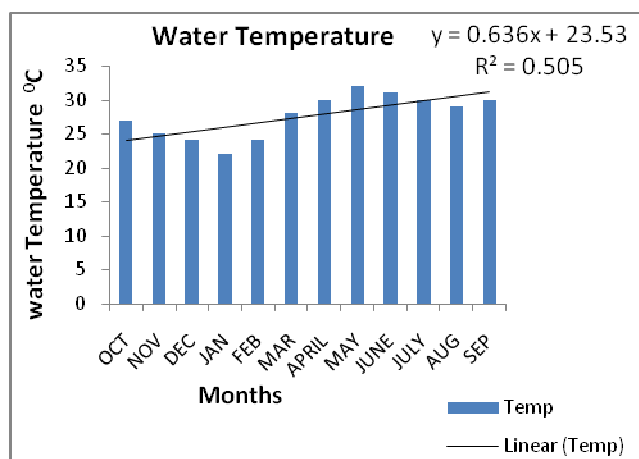
Material and Methods

Danteshwar pond is located in Vadodara city (figure-1). It is a perennial urban pond, located near temple and surrounded by the slum area and human habitation, which is used by inhabiting people around it for various activities like bathing, fishing, washing clothes, and dumping sewages etc. Physico-chemical status of Danteshwar pond was studied monthly for one year during October 2009 to September 2010. Water samples were collected from various sites at random from the pond in the morning time between 7 to 8 am in plastic bottles. Water temperature was recorded by standard centigrade thermometer on site.

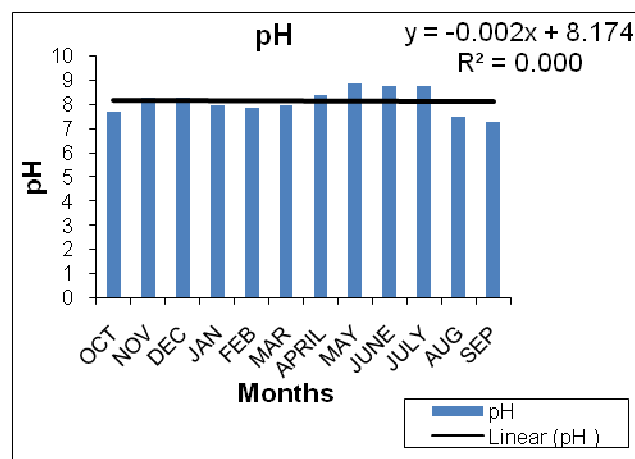
For the estimation of dissolved oxygen, water samples were collected separately in 300 ml BOD bottles and oxygen was fixed at the time of sampling on field. pH was recorded by standard pH meter. All other remaining parameters were analyzed immediately on return to the laboratory by titrimetric methods. The physico-chemical parameters for water quality were assessed using standard methods^{7,8}. The standard deviation, mean, correlation coefficient for all parameters were computed.



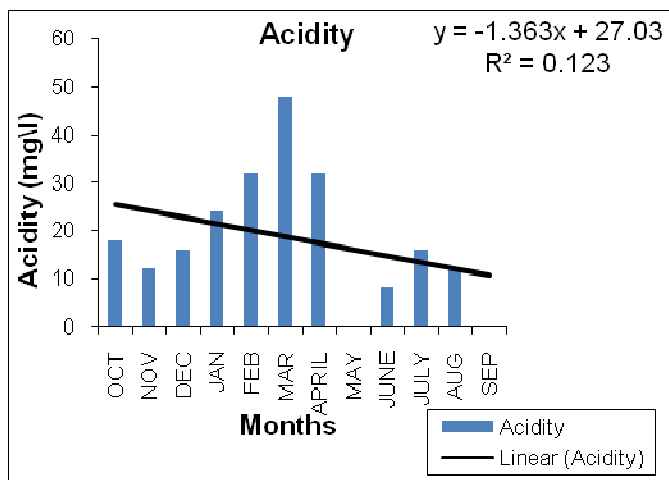
Figure-1
Representation of study area



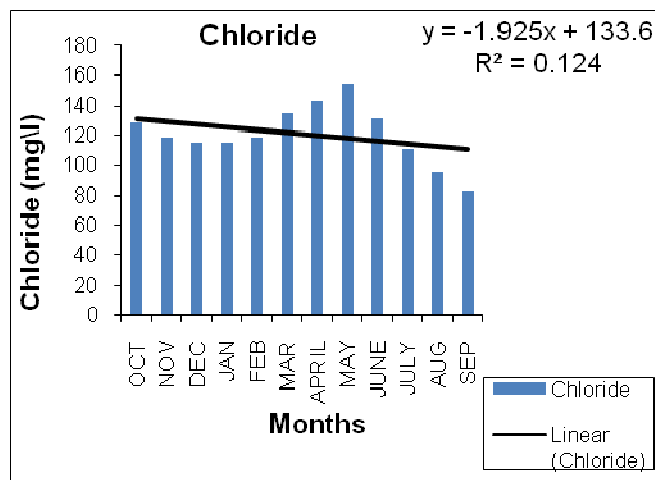
2 (a)



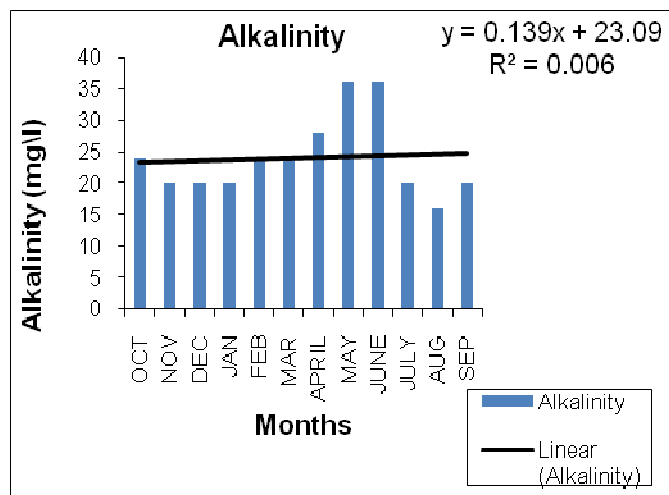
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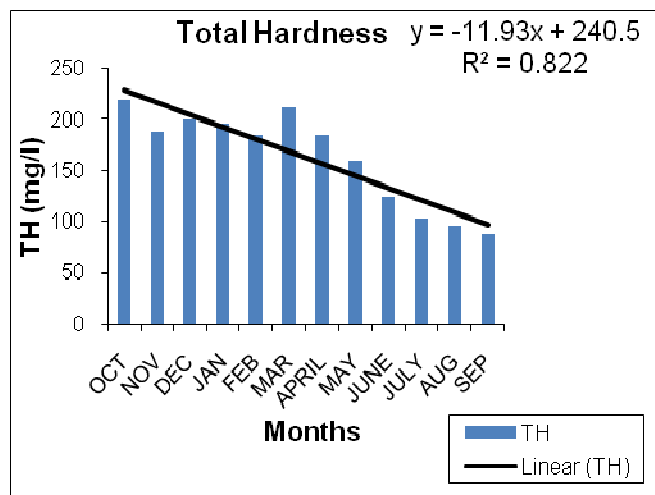
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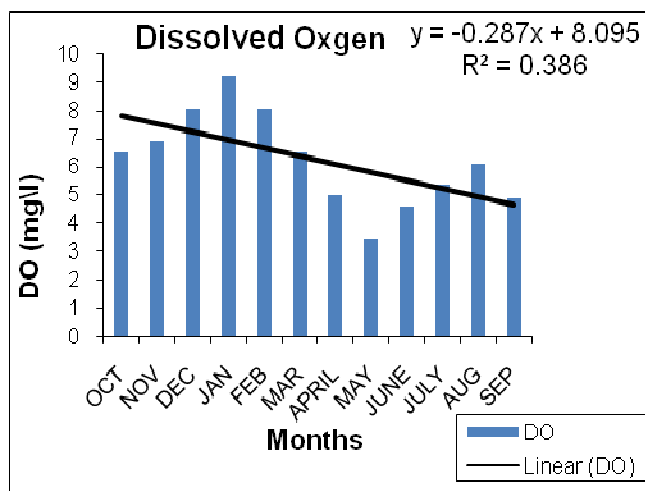
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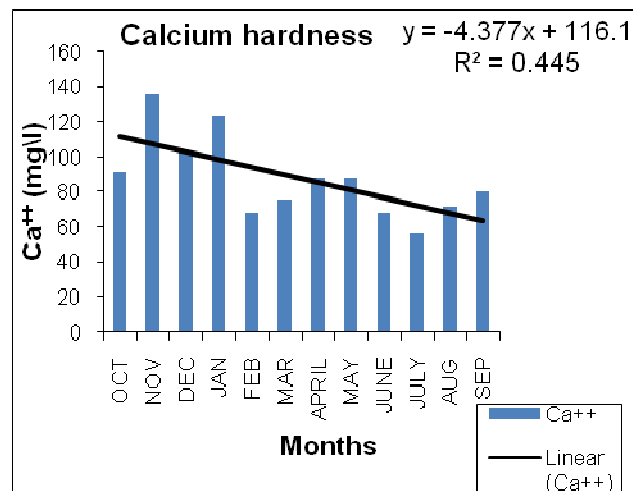
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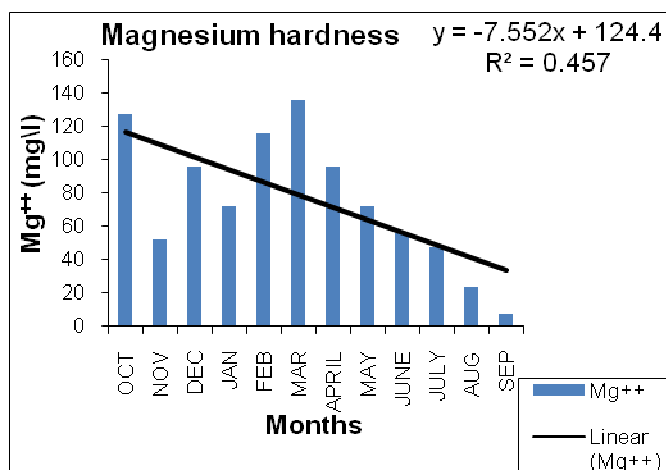
2 (g)



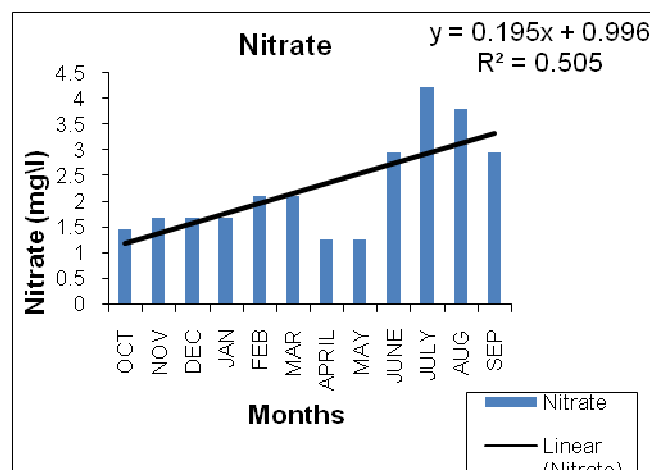
2 (e)



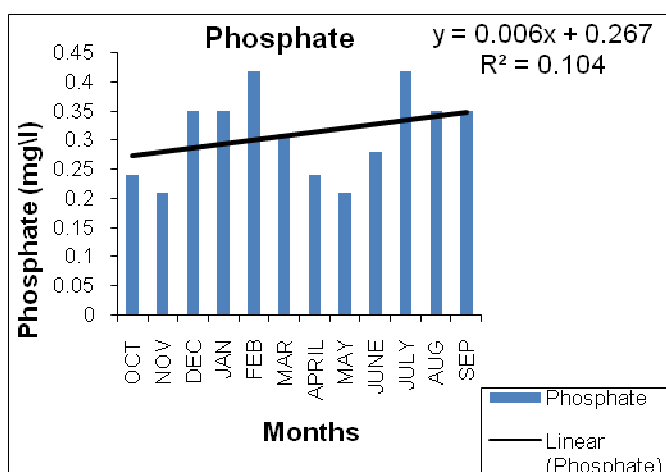
2 (h)



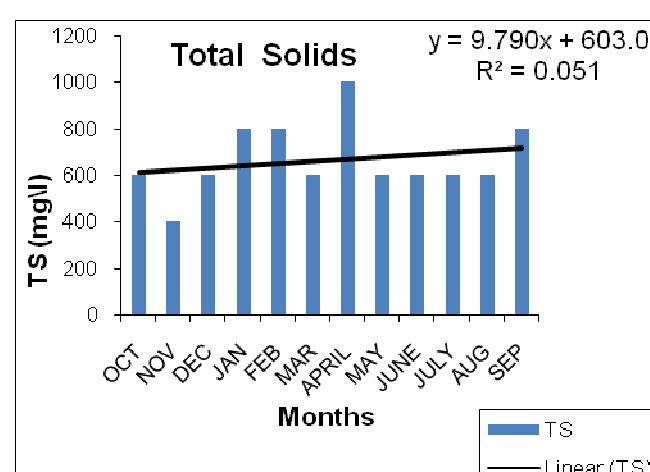
2 (i)



2 (k)



2 (j)



2 (l)

Figure-2 (a-l)
Showing annual variation in various water quality parameters

Results and Discussion

The study area and the results of water quality parameter of Danteshwar pond are represented by figure-1 and figure-2 (a) to 2(l) respectively. The mean, standard deviation and correlation coefficients of water quality parameters are shown in table-1 and table-2 respectively.

Water temperature is an important parameter for any aquatic ecosystem by its value of influence on aquatic life directly or indirectly. In the present study water temperature was gradually decreasing from October to January and increasing from February to May. It was ranged from 22°C (January) to 32°C (May). Similar observations were recorded for various lakes and reservoirs of India⁹⁻¹¹. Due to high solar radiation, clear atmosphere, and low level of water, the water temperature may be high in May¹² and was above the permissible limits by WHO¹³. Water temperature represented high significant negative relationship with Dissolve oxygen.

The pH was above 7 during all months. The maximum pH was in May (8.9) and minimum was in September (7.3). The pH values showed that the water was alkaline in nature throughout the study period. Similar result was observed for fresh water urban pond¹⁴. The alkaline nature of pH may be the result of various biological activities¹⁵. The pH was above the permissible limits.

The acidity ranged from 0 mg/l (May and September) to 48 mg/l (March). The presence of acidity in water may be due to free CO₂. The alkalinity was ranged from 16 mg/l (August) to 36 mg/l (May, June). The alkalinity was maximum in summer¹⁶ and minimum in monsoon. The alkalinity was high during summer may be due to decreased water level, raised temperature, increase the rate of organic decomposition and the concentration of nutrients in water. Decreasing of alkalinity concentration in monsoon may be due to dilution of pond by rain water.

Table-1
Statistical analysis of physico-chemical parameters of Danteshwar pond

	WT	pH	Acidity	Alkalinity	DO	Chloride	TH	Ca hardness	Mg hardness	PO ₄ ³⁻	NO ₃ ⁻	TS
Average	27.66	8.15	18.16	24	6.22	121.09	163	87.66	75.33	0.31	2.26	666.66
SD	3.22	0.51	13.99	6.38	1.66	19.65	47.42	23.66	40.24	0.07	0.99	155.69

WT = Water temperature, DO = Dissolve oxygen, TH = Total hardness, SD = Standard deviation

Table-2
Correlation coefficients of water quality parameters of Danteshwar pond

Parameters	WT	pH	Acidity	Alkalinity	DO	Chloride	TH	Ca hardness	Mg hardness	PO ₄ ³⁻	NO ₃ ⁻	TS
WT	1	0.31	-0.37	0.52	-0.97**	0.21	-0.58	-0.62	-0.33	-0.28	0.33	0.01
pH	-	1	-0.10	0.63	-0.36	0.66	0.04	-0.05	0.08	-0.26	-0.09	-0.20
Acidity	-	-	1	0.14	0.46	0.27	0.59	-0.06	0.73	0.19	-0.22	0.29
Alkalinity	-	-	-	1	-0.59	0.77	0.08	-0.21	0.22	-0.51	-0.34	0.07
DO	-	-	-	-	1	-0.28	0.52	0.46	0.34	0.41	-0.19	0.02
Chloride	-	-	-	-	-	1	0.56	0.06	0.62	-0.61	-0.62	0.003
TH	-	-	-	-	-	-	1	0.52	0.86*	-0.34	-0.82*	-0.009
Ca hardness	-	-	-	-	-	-	-	1	0.03	-0.46	-0.62	-0.19
Mg hardness	-	-	-	-	-	-	-	-	1	-0.13	-0.59	0.10
PO ₄ ³⁻	-	-	-	-	-	-	-	-	-	1	0.61	0.22
NO ₃ ⁻	-	-	-	-	-	-	-	-	-	-	1	-0.17
TS	-	-	-	-	-	-	-	-	-	-	-	1

WT = Water Temperature, DO = Dissolve Oxygen, TH = Total Hardness, TS = Total Solids

Dissolved Oxygen (DO) is the most important parameter for assessment of water quality, primary production and pollution status of water. It is directly affecting survival and distribution of flora and fauna of an ecosystem. In the present study period dissolved oxygen values ranged from 3.45 mg/l (May) to 9.21 mg/l (January). Similar results were reported of some water ponds of Ayodhya¹⁷. The DO showed inverse relation with water temperature. During May may be due to high temperature, high metabolic rate of aquatic organism, DO was low.

Chloride values were found ranging from 83.49 mg/l (September) to 155.06 mg/l (May). The higher concentration of chloride in May may be due to low level of water, increased temperature, mixing of sewage in the pond and lower in September due to dilution of pond with rain water. The chloride concentration showed positive relation with water temperature. The higher concentration of chloride in fresh water indicates an index of pollution due to higher organic waste of animal origin. A chloride concentration above 60 mg/l indicates heavy pollution¹⁸. According to the above statement the pond water was polluted.

Total hardness was ranged from 88 mg/l (September) to 220 mg/l (October). Total hardness showed significant monthly variation. Water hardness up to 60 mg/l consider as soft water, from 61-121 mg/l as moderately hard water, from 121-180 mg/l as hard water and above 180 mg/l as very hard water¹⁹. The average value was found in the present investigation is in the

range of 121-180 mg/l, which fall in the category of hard water. It is not useful for drinking purpose.

Calcium is found abundantly in all natural water. The main source of calcium is leaching of rocks. Calcium hardness was found ranging from 56 mg/l (July) to 136 mg/l (November). The higher concentration of calcium may be due to inflowing sewage from surrounding areas. Magnesium hardness was ranged from 8 mg/l (September) to 136 mg/l (March). It showed significant positive correlation with total hardness.

Phosphate is essential for the growth of phytoplankton and zooplankton and important nutrient for maintaining of the fertility of water body. Phosphate ranged from 0.21 mg/l (May, November) to 0.42 mg/l (February, July). The higher concentration of phosphate may be due to presence of detergents in sewage waste dumped in the pond²⁰ and washing clothes, cleaning of the utensils at the pond¹⁴. The parameter did not show definite monthly variation.

Nitrate concentration was found ranged between 1.26 mg/l (April, May) to 4.22 mg/l (July). The highest value was in monsoon and lowest in summer. Similar result was reported of a minor reservoir of Andhra Pradesh²¹. During monsoon may be due to surface run off and domestic sewage specially washing activities, the nitrate values were high.

Total solids ranged from 400 mg/l (November) to 1000 mg/l (April). The ranged showed that it was within the permissible

limits. The concentration of total solids was constantly increased in May to August.

Conclusion

The present investigation revealed that the pond water was hard and alkaline in nature. It also showed high values of chloride and total hardness. All the parameters were within permissible limits for potable water standards of WHO¹³ except water temperature and pH. The chloride concentration showed that the pond was polluted. Water temperature showed high significant negative correlation with dissolved oxygen. Phosphate showed negative correlation with most of all parameters except Acidity and DO. It has lowest concentration of all the ions studied. Only total hardness showed significant monthly variation among all the parameters. Magnesium hardness showed significant positive correlation with total hardness. Nitrate showed significant negative correlation with total hardness.

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