



## Physico-Chemical status of Danteshwar pond of Vadodara City, Gujarat India and its Environmental Implications

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### Abstract

The present study is the investigation of physico-chemical status of Danteshwar pond of Vadodara city. The water quality parameters selected for the study were dissolved oxygen, pH, chloride, total hardness, nitrates and phosphates. The sampling duration was from February, 2010 to April, 2010. Samples were collected from four pre-decided points from the pond. Standard methods were used to analyze all the water samples collected from the pond. The results of the analysis showed that the parameters were within the permissible limits for drinking water standards as directed by BIS (Bureau of Indian Standards) as well as American Public Health Association. However, concentration of some of the parameters was found to be high which may cause a potential threat and interfere with the normal growth, development and reproduction of aquatic organisms leading to their death and ultimately eradication of life from that pond which in turn may to disappearance of the pond itself.

**Keywords:** BIS, American Public Health Association, the parameters, aquatic organisms

### Introduction

Comprising over 70% of the Earth's surface, water is undoubtedly the most precious natural resource that exists on our planet and which is of fundamental importance. It is utilized for irrigational purposes, industrial as well as domestic consumption<sup>1,2</sup>. Earth's environment is degraded due to man's economic exploitation of natural resources<sup>3</sup>. Even though we recognize importance of water; we disregard it by polluting our rivers, lakes, ponds and oceans. In addition to innocent organisms dying off, our drinking water has become greatly affected as is our ability to use water for various purposes. In the developing world over 1 billion people still lack access to clean drinking water, 2.5 billion do not have access to adequate sanitation services and over 3 million death each year are traced to water borne diseases (mostly in children under 5 years age)<sup>4</sup>.

There are number of sources of pollution including sewage and fertilizers containing nutrients such as nitrates and phosphates. In excess levels, nutrients over stimulate the growth of aquatic plants and algae<sup>5</sup>. Excessive growth of these consequently clog our waterways, use up dissolved oxygen as they decompose, and block light penetration to deeper waters. This, in turn, poses a threat to aquatic organisms by depletion of dissolved oxygen levels. When aerobic bacteria and Protozoans in the water break down the deposits of organic material, they begin to use up the oxygen dissolved in the water. Various fishes and bottom-dwelling animals cannot survive when level of dissolved oxygen drops below 2.0 – 5.0 ppm. When this occurs, mass mortality of organisms occurs, these continue to deposited at the bottom and

shallower the pond depth; ultimately leading to disappearance of the pond.

To develop a better understanding of the status of the water in such a habitat Danteshwar pond of Vadodara city, Gujarat was selected and analysis of the physico-chemical characteristics of the water was carried out.

### Material and Methods

**Danteshwar Pond:** The Danteshwar Pond is an urban pond located in the Vadodara City with natural boundaries (figure 1). Half of the periphery of the pond has modification in its natural state. For example at South and East of the pond there is a residential cum commercial area as can be seen in the image. These boundaries are assumed to be under constant pressure of the human activities. Some parts of the periphery of the pond is having natural boundary covered with vegetation. The common human activities at the pond were observed to be washing of cloths and bathing of animals, washing of vegetables and disposal of waste from nearby shops and households. The dimensions of the pond were recorded to be as follows:  
Perimeter: 749.91 m Area: 29,998 m<sup>2</sup>

The samples of water from the pond were collected from pre-decided points at the periphery of the lake to reduce biasness. All the samples were collected in the morning time between 7:00 to 8:00 a.m. The physico-chemical parameters were analyzed using the standard methods<sup>6</sup>. The following table - 1 shows the methods adopted for analysis of water quality parameters for the collected water samples.



**Figure-1**  
 Sampling points at Danteshwar pond of Vadodara City (Image source: Google Earth)

**Table-1**  
 Represents list of methods and parameters studied

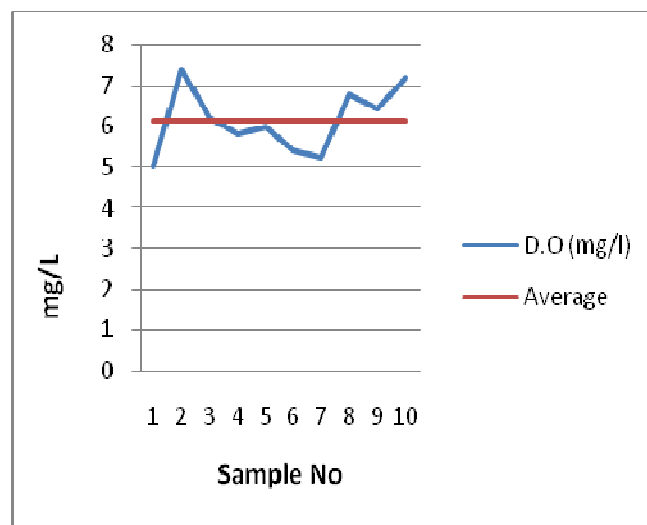
| Parameter studied | Method used                                      |
|-------------------|--|
| Dissolved Oxygen  | Alkaline azide - Titrimetric                     |
| Ph                | pH probe   |
| Chloride Total    | Titrimetric                                      |
| Hardness          | Titrimetric Method – Erichrome black T indicator |
| Nitrate           | Colorimetric                                     |
| Phosphate         | Colorimetric                                     |

### Results and Discussion

The primary results of the analysis showed that the dissolved oxygen levels of the water sample were between 5.2 mg/l to 7.4 mg/l with average value of 6.14 mg/l. Value of pH ranged between 8.20 to 8.88 and average of 8.42. In the case of chloride and total hardness the values ranged between 118.11 mg/l – 142.14 mg/l (average – 131.12 mg/l) and 206 mg/l – 228 mg/l (average – 216 mg/l) respectively. The nutrients analyzed i.e. phosphate and nitrates ranged between the values of 0.714 mg/l to 0.924 mg/l and 1.73 mg/l – 2.15 mg/l with average values of 0.79 mg/l and 1.86 mg/l respectively.

The dissolved oxygen plays an important role in defining the fate of the living organisms (figure 2a). The dissolved oxygen enrichment of a pond may be due to surface diffusion of atmospheric oxygen but the photosynthetic activity also plays a major role in increasing the levels of dissolved oxygen in the pond. In the present study the dissolved oxygen levels were found to be ranging between 5.0 – 7.4 mg/l with an average value of 6.14 mg/l. For continuous optimum levels of Dissolved oxygen equilibrium is required amongst various trophic levels

of the system. When this equilibrium is broken, it may cause disruption in the natural stability of the system. Though the photosynthetic plants are important for the higher levels of dissolved oxygen in the water, their (especially algae) excessive growth may cover the surface of the pond leading to decreased surface diffusion of gases ultimately causing depletion in the oxygen levels resulting into the death of organisms which cannot sustain lowered levels of oxygen. Bacteria that decompose dead aquatic organisms consume oxygen indirectly decreasing the levels of dissolved oxygen in water<sup>7</sup>. Total phosphate content in water should not exceed a range of 0.05 mg/l to 0.1 mg/l, depending upon whether the water sources discharge directly into a lake or reservoir<sup>7,8</sup>.



**Figure-2(a)**  
 Dissolved Oxygen

The pH of the water ranged from 8.20 – 8.88 (figure 2b) with an average value of 8.42 which says that during the whole sampling period the pH was found to be more than 7.0 which means the water was alkaline throughout the study duration. Though the average pH was within the permissible standards, at four instances it was above the permissible limits having the values of 8.51, 8.74, 8.61 and 8.88. The last three values of the pH were found by the end of the April Month of the study duration where the average ambient air temperature was 30°C<sup>9</sup>. Apart from the drinking purposes, the pH also plays an important role in defining the fate of the aquatic organism. Most of the aquatic life requires a pH range of 6.5 – 8.0. If the pH increases or decreases far from these values it may affect metabolism, growth and reproduction of the organisms and even death in extreme cases. Moreover, at lower pH, the toxic compounds and other materials present in the sediments at the bottom of the pond may be liberated and ultimately make their path to the food web of the pond ecosystem causing deterioration of the quality of biotic environment of the pond as well. The chloride levels of the water sample were observed to be ranging within 118.11 mg/l – 142.14 mg/l (average – 131.12 mg/l) (figure 2c). Chlorides are associated with many physiological functions of aquatic plants and animals, however if the levels of chloride becomes increased it might be having negative impact on growth, development and reproduction of aquatic organisms on a long term exposure. The values of Total Hardness kept on fluctuating during the whole study period with minimum value of 205 mg/l and 227 mg/l respectively (figure 2d). The permissible level for drinking water is 300 mg/l so in this case the total hardness so further increase in the hardness may lead to unwanted impact on human health as well the health of other aquatic organisms. Moreover, increased level of Hardness may also lead to corrosion of metals used in private water supply systems.

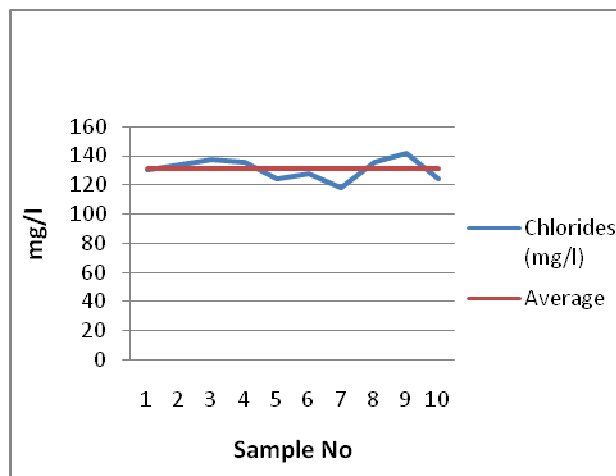


Figure-2(c)  
 Chlorides

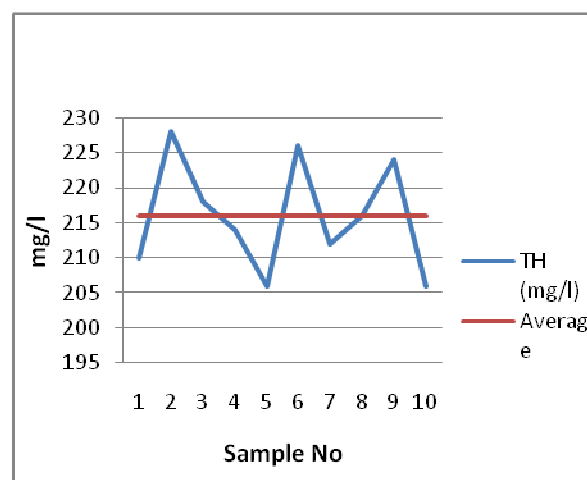


Figure-2(d)  
 Total Hardness

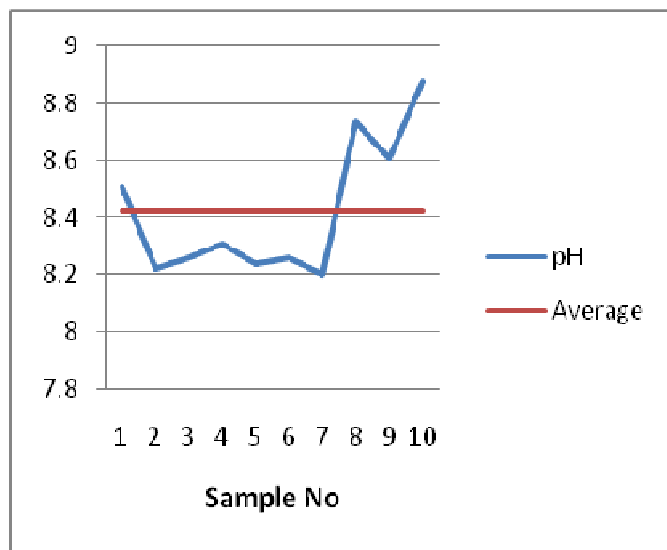


Figure-2(b)  
 pH

In the present study, values of nitrates were found to be ranging between 1.73 mg/l - 2.15 mg/l (figure 2e). Many of the freshwater animals such as invertebrates<sup>10</sup> (*E. toletanus*, *E. echinosetosus*, *Cheumatopsyche pettiti*, *Hydropsyche occidentalis*), fishes (*Oncorhynchus mykiss*, *Oncorhynchus tshawytscha*, *Salmo clarki*), and amphibians (*Pseudacris triseriata*, *Rana pipiens*, *Rana temporaria*, *Bufo bufo*) etc. showed a higher sensitivity towards elevated concentration of nitrates in the freshwater environment<sup>11</sup>. A maximum level of 2 mg NO<sub>3</sub>-N/l would be appropriate for protecting the most sensitive freshwater species. It is suggested that, though the permissible nitrate concentration in the drinking water is 10 mg/l<sup>6</sup>, some fish and invertebrate larvae may be affected after a long exposure of these high concentrations of nitrates<sup>11</sup>. This could be the probable impact of continuously increasing concentration of nitrates in the Danteshwar Pond<sup>11</sup>.

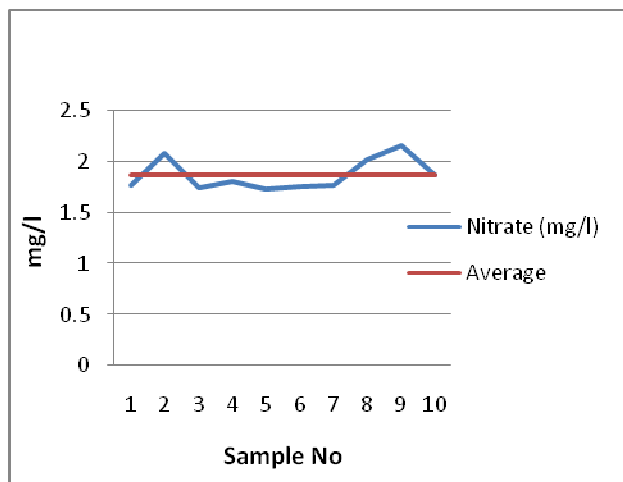


Figure-2(e)  
 Nitrate

Some scientists have categorized trophic status of a wetland according to phosphorus concentration<sup>8</sup>. Lakes with phosphorus concentrations below 0.010 mg/l are classified as oligotrophic, phosphorus concentrations between 0.010 and 0.020 mg/l are indicative of meso trophic wetland, and eutrophic wetland have phosphorus concentrations exceeding 0.020 mg/l<sup>9</sup>. In the present study the concentration of the phosphate – phosphorous in the water was found to be 0.79 mg/l on an average (figure 2f). This value is sufficiently high to convert the pond into a eutrophicated pond. The problem with excessive growth of aquatic plant is a major issue with respect to maintenance of the water quality for drinking purposes<sup>12</sup>. With such high concentration of phosphates in the surface water there is faster growth of aquatic plants.

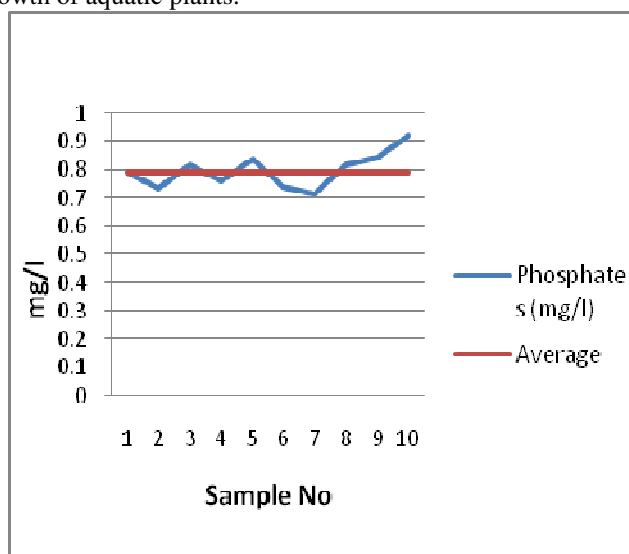


Figure-2(f)  
 Phosphate

Figure-2(a-f)

Graphical representation of water quality parameters

## Conclusion

The above results and discussion suggest that besides smaller fluctuations from the standard values, the water quality of the Danteshwar pond has not completely deteriorated. If mitigatory steps are taken to control the inflow of pollutants and nutrients then the possibilities of the pond being eutrophicated can be reduced or minimized. Proper waste management practices at the boundaries of the pond can help the pond to regain the status of a healthy water body which can be utilized as a freshwater source by the surrounding community for various purposes.

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