

## The physico-chemical characteristics of water quality of Narayan Talab, Satna (M.P.) India

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### ABSTRACT

Due to sewage, agricultural and industrial wastes, abnoxious emissions and anthropogenic activities, the freshwater bodies around the world are becoming polluted. The water body selected for this study is Narayan Talab of Satna, the District head quarter in Madhya Pradesh, India. The Narayan Talab is one of the important sources of potable water supply for the Satna city. The Talab receives a large amount of domestic wastes, sewage and industrial effluents. It has floating lotus flowers, which are very useful in improving the Talab's water quality. The effluent of water treatment plant of P.H.E. is also connected through this talab bringing some trace metals and chlorides in it. Authors examined physicochemical parameters like pH, dissolved oxygen, biochemical oxygen demand, and chemical oxygen demand to ascertain the water quality of this talab. Chemistry of Sarpat plants as well as chemistry of other chemicals and their effect on water quality is also studied.

**Key words:** Pollution, Narayan talab, water quality parameters.

### INTRODUCTION

Water resources in India have reached a point of crisis due to unplanned urbanization and industrialization (Singh, Pathak, & Singh, 2002). Urban water bodies receiving external pressure from human settlements adversely affect nearby aquatic ecosystems. Urbanization has direct negative impacts on water bodies (Khan, Bhatnagar, & Saxena, 1988). Satna district abounds in minerals like calcium, iron, aluminium and silicon and their concentration in water has been reported to be positive and in some cases touching the alarming limit of W.H.O. Several industries are set up in this region, prominent among them are lime and cement factories contributing inorganic and organic pollutants. Use of detergents by washer men as

well as by washing four wheelers makes the water alkaline in nature. Organic enrichment of the talab through floral offerings, idol immersion, and decomposition of aquatic weeds are also the significant causes of its eutrophication. Enormous growth of Sarpat Plants also cause eutrophication of the Talab. Denting and Painting of four wheelers at its northern bank as well as domestication is also a cause of heavy metals concentration and direct domestic sewage discharge in it.

### Methodology

The samples were collected from a depth of 1ft below the surface using Nansen type water sampler and kept in polythene containers (500 mL) with the addition of 2 mL concentrated HNO<sub>3</sub> at 2 mL in order to preserve the metals and also to avoid

precipitation. The pH of water samples was determined using pH-meter with electronic glass electrode (LI 127 of Elico, India) and conductivity was measured by conductivity-meter (Systronics 304).

For the analysis of total heavy metals (dissolved and suspended), water (200 mL) samples were digested with 5 mL of di-acid mixture ( $\text{HNO}_3$ :  $\text{HClO}_4$  :: 9: 4 ratio) on a hot plate and filtered by Whatman No. 42 filter paper and made up the volume to 50 mL by double distilled water for analysis of heavy metals using atomic absorption spectrophotometer (GBC-902, Australia), APHA (1995).

#### Dissolved oxygen

Dissolved oxygen was fixed instantly on the spot and analyzed immediately as per the Winkler's method with Azide modification (De, 2002).

#### Biochemical oxygen demand (BOD)

BOD was determined as per standard method (De,2002).

#### Chemical oxygen demand (COD)

COD was determined by potassium dichromate open reflux method.

The study area selected is Narayan Talab Satna located in the Satna city, in Madhya Pradesh, India (latitude  $24^\circ 35' \text{ N}$ ,  $80^\circ 50' \text{ E}$ . longitude  $24^\circ 58' \text{ N}$  and  $80^\circ 83' \text{ E}$ ). The Narayan Talab has an area of 3 acres and a catchment area of 36000sq.m.

## RESULTS AND DISCUSSION

### pH

PH ranged from 7.2-7.9 and 7.8-8.0 in the surface layer at stations 1 and 2 respectively (Table1). The USPH (United States Public Health Standards) limits of pH for drinking water are 6.0-8.5 (De, 2002, pp245-252). The values obtained were on the higher side of normal. Higher pH values of surface water were explained on the basis of increased photosynthetic activity of the algal bloom, the carbonates of calcium and magnesium are precipitated from bicarbonates and water becomes more alkaline. pH controls the chemical state of many nutrients including dissolved oxygen, phosphate, nitrate, etc. (Goldmann & Horne, 1983). It regulates most biological processes and biochemical reactions.

### Dissolved Oxygen (DO)

DO concentration of water body in the range of 6.0-9.8 and 6.0-9.6 ppm were obtained in surface layer of the station 1 and station 2. The maximum increase in the DO was recorded during the rainy season as shown in Table 1. The value of DO was found low, mostly at the bottom layer on account of lower production of oxygen and higher consumption of DO by microbial activities (Tamot & Bhatnagar, 1988). DO is one of the most important parameters to study the quality of water. It is required for the metabolism of all aquatic organisms. It acts as an indicator of the magnitude of eutrophication. In natural water resources the concentration of dissolved oxygen depends upon the physical,

**Table 1: Variation in pH and DO concentration at two stations at different functioning intervals (Pre, during, post rainy season)**

Sampling Station	pH			DO(ppm)		
	Pre	During	Post	Pre	During	Post
Station No.1						
0 m Distance	7.9	8.7	7.9	6.4	9.0	10.0.
10 m Distance	7.8	8.7	7.2	6.0	9.8	8.9
20 m Distance	7.8	8.0	8.0	6.8	8.9	8.8
Station No. 2						
0 m Distance	7.8	8.0	8.0	6.4	9.6	6.4
10 m Distance	7.8	8.0	8.0	6.4	8.4	6.0
20 m Distance	8.0	7.9	7.9	6.4	8.0	6.4

Table 2: Variation in BOD, COD, iron, zinc and lead concentration at the two stations at Pre, during and Post Rainy season

Sampling Station	BOD(ppm)			COD(ppm)			Iron(ppm)			Zinc(ppm)			Lead (ppm)			
	Pre	During	Post	Pre	During	Post	Pre	During	Post	Pre	During	Post	Pre	During	Post	
<b>Station No. 1</b>																
0 m Distance	11.0	11.8	12.0	44.0	50.0	28.0	1.87	1.72	1.79	1.65	0.55	0.56	0.022	0.021	0.033	
10 m Distance	12.0	12.2	12.8	45	56.0	20.0	1.58	1.83	1.79	1.84	0.74	0.62	0.015	0.026	0.023	
20 m Distance	13.0	13.0	14.0	64.0	68.0	44.0	1.58	1.83	1.79	1.84	0.74	0.62	0.015	0.026	0.023	
<b>Station No.2</b>																
0 m Distance	12.0	16.6	16.0	38.0	46.0	32.0	1.58	1.83	1.79	1.84	0.74	0.62	0.015	0.026	0.023	
10 m Distance	12.0	16.4	12.0	40.0	42.0	36.0	1.58	1.83	1.79	1.84	0.74	0.62	0.015	0.026	0.023	
20 m Distance	16.0	16.2	28.2	44.0	48.0	36.0	1.58	1.83	1.79	1.84	0.74	0.62	0.015	0.026	0.023	

chemical and biological activities prevailing in the water body.

### Biochemical Oxygen Demand (BOD)

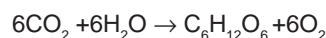
A range of 11.0 -14.0 and 16.0-28.2 ppm were obtained at stations 1 and 2 respectively (Table 2). The minimum value of BOD was recorded at the surface layer during the functioning period of the aeration units. BOD indicates the presence of microbial activities and dead organic matter on which microbes can feed. BOD is directly linked with decomposition of dead organic matter present in the talab & hence the higher values of BOD can be directly related with pollution status of the lake (WQM, 1999). An inverse relationship was found between the dissolved oxygen concentration and biological oxygen demand values (Cosgun, Yurteri, Mirat, & Gurolet, 1987).

### Chemical Oxygen Demand (COD)

COD indicates the pollution level of a water body as it is related to the organic matter present in the talab (1999). COD concentrations in the range of 20-68 and 32-48 ppm were obtained in the surface layer of stations 1 and 2 respectively (Table 2).

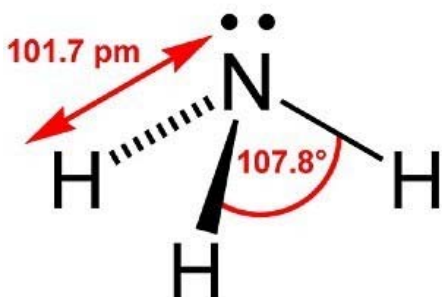
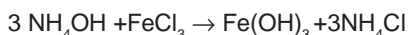
The botanical name of sarpat plant is *Acorus gramineus* which is an evergreen perennial growing plant of height 0.5m to 1.5m. The plant has antispasmodic, digestive and diuretic activity. This plant can influence the pH of the water. During the hours of daylight, plants produce nutrients directly from carbon dioxide dissolved in the water and the energy obtained from sunlight, a process known as photosynthesis.

As a consequence of photosynthesis the plants utilize carbon dioxide in the day time and remove this from the water causing alkaline carbonates and bicarbonates to predominate in the water and the pH to rise. The pH of the water can fluctuate quite dramatically through a 24 hour period.

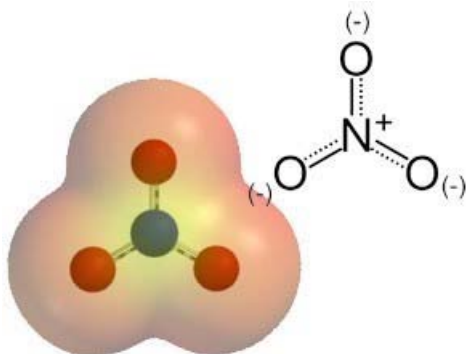


Ammonia originated from the dead and decaying plant material in the pond or from uneaten food remains dissolved in water as ammonium hydroxide and causes precipitation of metals in water therefore metallic concentration in water

increases in the form of suspended solids. Some soluble metal complexes are also formed. Oxidation of water by Sarpat plant increases complex forming ability of water.



Nitrate is the final product from the breakdown of ammonia which is a potent plant fertilizer and can contribute to the growth of Sarpat plant. Higher concentration of nitrate in water causes cancer to human. The higher the pH and water temperature the greater percentage of the ammonia which exists in its harmful free form. Concentration



of iron as per Indian and WHO standards are 1 ppm but concentration of iron in this Talab is more than these limits. Concentration of lead is within the limit otherwise it is toxic. It is a general protoplasmic poison. Lead inactivates delta-aminolevulinic acid and obstructs its conversion to porphobilinogen and retards heme synthesis. Heavy metals also oxidize organic substances causing decrease in DO value of water.



### CONCLUSION

The sewage from domestication and decomposition of Sarpat Plants are the main causes of increase value of BOD & COD. Heavy metals like iron, zinc & lead are accompanied due to denting & painting of four wheelers on its northern Bank. Iron is also prevailing due to laterite found in the earth crust of this region. Alkalinity in water is mostly due to use of detergents by washermen as well as by the washing of four wheelers in the Narayan Talab. Chloride concentration is also possible due to sewage from PHE treated water. Eutrophication of the Narayan Talab is happening rapidly due to binding of clay & soil by abundantly growing Sarpat Plants and dissolution of soil and dust by washing four wheelers in the Narayan Talab. Therefore washing of four wheelers in the talab should be banned. The growth of Sarpat Plants should be stopped by cutting them from the root, which will prevent Eutrophication of the Narayan Talab. Municipal wastages dumped near the pond contains plenty of dead and decayed organic substances and several inorganic chemicals which are the major sources of ammonia and nitrate contamination in water of Narayan talab.

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