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STUDIES ON PHYSICO-CHEMICAL PARAMETERS OF PURLE POND WATER OF SHIVAMOGGA, KARNATAKA (INDIA)

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ABSTRACT

Purle pond of Shivamogga is one of the important sources of water supply to agricultural areas receives domestic waste water almost throughout the year and exhibits abundance of phytoplankton population. An year long study was conducted to measure various physico-chemical parameters like temperature, turbidity, conductivity, hydrogen ion concentration, free carbon dioxide, dissolved oxygen, BOD, alkalinity, hardness, presence of various radicals etc., The turbidity of pond water was found to be highest during June-July and lowest in the month of November. BOD was highest in the month of July while lowest in December. The study revealed that there is greater degree of pollution in the studied pond and hence, preventive measures are required to avoid further deterioration of the pond water quality. The estimated water quality parameters were compared with the WHO and IS standards.

Key words: Purle pond, Physico-chemical parameters, Algal bloom.

INTRODUCTION

Purle pond is annual water body as it receives the water from Tunga canal and waste water from Shivamogga township. The total area of the pond is 55 hectares of which water spreads over an area of 43 hectares with average depth of 6 feet. This pond water is used for domestic purposes like washing of clothes, vehicles, domestic animals etc. and also for fisciculture. There are many ponds in the Shivamogga city of Karnataka. Purle pond is amongst the few larger ponds of the city. This is surrounded by dense human population.

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The people mainly belongs to lower and middle class and standard of their living is either low or moderate.

The physico-chemical characteristics of pond water have direct impact on prevailing organisms as well as human being using such water[1]. A preview of available literature has revealed that there is no scientific study carried out with respect to ecological characteristics of this pond. The basis of selection of purle pond was that its water is used by a larger population and it receives adequate waste water and periodic flooding from plains.

EXPERIMENTAL

The study was conducted during the period from January 2008 to December 2008. During the study period, the surface water samples were collected in clean plastic cans between 9.00 AM to 10.00 AM, once in a month from three different stations. Later the data was pooled together and represented as monthly data of the pond. Water temperature was recorded on the spot. The samples for dissolved oxygen were fixed immediately on the field itself. The remaining parameters were analyzed as per the methods described in standard method[2]. The WHO and IS standards for drinking water quantity were used for comparison.

RESULTS AND DISCUSSION

The results of physico-chemical characteristics of pond water indicate that the water is highly polluted. The obtained values have been summarized in the Table 1.

The pond water temperature is largely influenced by local climatic conditions. Values of water temperature ranged from 19.40^{o}C to 31.10^{o}C. The minimum value was recorded in January and maximum in May. The temperature difference might be either due to difference between the collection times or due to the geographical difference in the locations[3]. The value of turbidity ranged from 46.00 NTU to 80.30 NTU. The colloidal material which exerts turbidity provides adsorption site for chemicals that may causes undesirable taste for biological organisms that may be harmful. In natural water bodies, turbidity may impart a brown color to water[4]. Higher values of turbidity were recorded in the months of summer. It is probably due to mixing of sewage water and high rate of evaporation.

Conductivity is an index to represent the total concentration of soluble salts. The conductivity values were found to vary from 0.73 to 1.45 mmho. cm^{-1}. The higher values of conductivity was observed in April due to increase in the concentration of minerals and organic matter.

Table 1: Physico-chemical characteristics of polluted pond water of Purle, Shivamogga (Karnataka)

Parameters	Months : 2008											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1. Physical characteristics												
Temperature (^{o}C)	19.40	21.50	27.00	30.20	31.10	28.50	29.60	25.40	25.10	22.00	21.30	22.00
Turbidity (N.T.U.)	46.10	49.20	62.00	65.30	75.00	80.30	79.60	58.00	49.80	51.00	46.00	48.30
Conductivity (mmho.cm^{-1})	0.93	1.21	1.39	1.45	1.34	1.32	1.23	0.82	0.73	0.81	0.89	0.78
2. Chemical characteristics												
pH	9.41	8.86	8.73	8.70	8.50	8.35	8.95	8.80	8.40	8.40	8.60	8.72
Free CO_2 (mg.L^{-1})	323.63	206.12	430.70	810.25	1250.2	1200.5	670.35	415.50	392.10	115.0	112.0	74.75
DO (mg.L^{-1})	6.02	6.14	6.09	4.23	4.89	8.53	5.63	6.03	5.04	4.88	5.92	7.02
BOD (mg.L^{-1})	31.80	40.0	37.10	39.60	43.0	42.10	44.10	32.30	35.90	36.30	40.20	32.15
Chloride (mg.L^{-1})	82.45	86.80	90.10	100.30	104.0	102.30	87.15	67.50	85.0	92.15	100.15	75.40
Alkalinity (mg.L^{-1}) ($CaCO_3$)												
a. Phenolpthalein alkalinity	13.80	12.60	16.00	14.80	18.20	15.20	12.70	18.10	13.30	12.50	14.40	13.20

Cont...

Parameters	Months : 2008											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
b. Methyl orange alkalinity	254.10	225.0	230.10	230.20	260.10	225.10	198.0	190.0	200.0	230.0	205.0	190.0
c. Total alkalinity	269.90	237.60	246.10	245.0	278.30	240.30	210.70	207.0	213.30	242.50	219.40	203.20
Hardness ($mg.L^{-1}$)												
a. Calcium hardness	133.0	130.10	141.20	145.25	150.0	139.30	130.35	125.0	143.80	142.0	147.2	152.25
b. Magnesium hardness	7.49	8.22	6.30	9.02	19.65	17.30	12.10	7.40	9.90	11.30	9.80	6.80
c. Total hardness	165.20	174.0	164.10	185.0	230.10	173.0	142.45	140.30	160.30	170.0	165.30	173.50
Nitrate-N ($mg.L^{-1}$)	2.31	2.09	1.80	1.82	1.79	1.71	1.69	1.63	1.68	1.74	1.79	1.61
Nitrite-N ($mg.L^{-1}$)	0.19	0.21	0.23	0.24	0.22	0.20	0.23	0.21	0.20	0.21	0.22	0.24
Phosphate ($mg.L^{-1}$)												
a. Organic phosphate	0.40	0.35	0.30	0.36	0.32	0.37	0.31	0.32	0.35	0.35	0.34	0.35
b. Total phosphate	1.32	1.20	1.10	1.30	1.39	1.23	1.31	1.29	1.30	1.28	1.27	1.15
c. Total orthophosphate	0.60	0.57	0.37	0.48	0.56	0.43	0.39	0.42	0.43	0.45	0.41	0.43
d. Acid hydrolyzable phosphate	0.42	0.38	0.36	0.42	0.51	0.49	0.43	0.42	0.44	0.46	0.38	0.39

Measurement of hydrogen ion concentration is represented as pH. It does not measure total acidity or alkalinity. pH represented very little variation as it ranged from 8.40 to 9.41. The pH is an important parameter in a water body since aquatic organisms are well adapted to specific pH range and do not withstand abrupt changes in it[5]. Carbon dioxide is added to aquatic system as it is directly mixed from atmosphere. The decomposition of organic matter from aquatic ecosystem also adds CO_2 to pond[6]. Free carbon dioxide value varied from 74.75 to 1250.20 mg.L^{-1}. Minimum value was observed in the month of December while maximum in May. Dissolved oxygen plays an important role in maintaining the presence and distribution of aquatic organisms. Dissolved oxygen ranged from 4.23 to 7.02 mg.L^{-1}. The minimum value was recorded in the month of April and maximum in December. It might be due to higher water temperature and greater consumption of oxygen in the summer month April as compared to December[7].

BOD is the measure of degradable organic matter present in water. The BOD and other microbial activities are generally increased by the introduction of sewage[8]. BOD values ranged from 31.80 to 44.10 mg.L^{-1}. The minimum value of BOD was noticed in the month of January while maximum in July. Higher values of BOD indicate the higher consumption of oxygen and higher population load in the pond water. The chlorides control the salinity of water and osmotic stress on biotic communities[1]. The most important sources of chlorides in the fresh water is the discharge domestic and industrial sewage. The concentration of chlorides is thus the indicator of pollution[3]. The chloride values ranged from 78.40 to 104.00 mg.L^{-1}. The minimum value was recorded in the month of December and maximum in May. High chloride content indicates deterioration of water quality usually linked with sewage load[9].

Alkalinity in the water samples is primarily a function of carbonate, bicarbonate and hydroxide contents. The fluctuation in the monthly values of phenolphthalein, methyl orange and carbonate alkalinity was almost similar. High alkalinity may be due to contamination by leaching process through surface water. The minimum values were recorded in the month of December while maximum in May. Total hardness of water is not a pollution parameter but indicates water quality mainly in terms of Ca^{2+} and Mg^{2+} content. Total hardness values observed are 140.30 to 230.10 mg.L^{-1}. Calcium and magnesium concentrations are observed to be in the range of 125.00 to 152.25 mg.L^{-1} and 6.30 to 19.65 mg.L^{-1}, respectively. Total hardness above 200 mg.L^{-1} is not suitable for domestic use in washing and cleaning.

The values of nitrite exhibited very little variation in the range of 0.19 to 0.24 mg. L^{-1}. The maximum nitrate (2.31 mg.L^{-1}) was observed in the month of January possibly due to higher rate of oxidation and minimum (1.52 mg.L^{-1}) in the month of December. Phosphate is

considered as the most critical single element for biological productivity[10]. Increased concentration of phosphates is taken up by the phytoplankton, which leads to algal blooms. All the forms of phosphate viz. acid hydrolyzable, total and organic phosphate had a maximum value in the month of May and minimum in March. On the other hand, maximum value of total orthophosphate (0.60 $mg.L^{-1}$) was obtained in January and minimum (0.37 $mg.L^{-1}$) in March.

Many studies have been done in our country to assess the quality of pond water but very few of them have studied the assessment of physico-chemical parameters of ponds receiving domestic waste[11]. In general, such characteristics are largely affected by human activities and influx of domestic waste in pond water, which cause a grater degree of eutrophication[12]. The data of physico-chemical parameters under study exhibits that the degree of contamination of the pond water is greater in summer months. The reason is that the rate of evaporation is higher during summer. On the other hand, sewage water is the only source of water input. Due to lack of rain, dilution of pond water does not occur in the months of April and May. In the light of standard of water quality recommended by WHO and IS, the pond water should not be used by human beings especially for drinking and cooking.

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