

Study of Physico-chemical Characteristics of Water Bodies of Burdwan Municipal Area, West Bengal, India

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Received May 17, 2008; revised and accepted April 21, 2009

Abstract: A study has been undertaken to evaluate the physico-chemical parameters (colour, temperature, pH, DO, COD, alkalinity, hardness, sodium, potassium, nitrate-nitrogen, phosphate) in surface water bodies (pond water) in Burdwan municipal area of West Bengal. Water samples collected from Ranisayar, Shyamsayar, Raj College pond, Laldighi, Krishnasayar, Kamalsayar, Gopalsayar, Hatipukur, Gargarghat and Bashbera were analyzed in laboratory. Results reveal that Ranisayar has less dissolved oxygen; COD of Ranisayar, Shyamsayar, Laldighi, Gopalsayar and Bashbera are high. All these ten ponds have high sodium and potassium concentration and the Krishnasayar has the highest phosphate level among these five ponds. Ultimately it is concluded that Ranisayar, Shyamsayar, Laldighi, Gopalsayar and Bashbera are more polluted than remaining five ponds.

Key words: Physico-chemical, COD, municipal area, potassium, Ranisayar, Shyamsayar, phosphate level.

Introduction

Water pollution is a major problem in most part of our world in the present era. It is increasing day by day in rural and urban areas and industrial wastes around industrial and urban centres and the domestic wastes are generally discharged into the natural water bodies. The main groups of pollutants which can affect surface water bodies are organic material, phosphates, heavy metals, detergents, nitrogen, surfactants, chemical fertilizer, insecticides etc.

The surface water bodies should be clean, clear and free from:

- (a) Materials which impart colour, taste, odour and turbidity.
- (b) Any objectionable substance that deposit/floats on the surface.
- (c) Toxic substance.
- (d) Growth promoting substance of undesirable aquatic life.

The temperature should not be raised by 3-5° F by hot waste water while pH and DO should be within the tolerable limit (De, 2002). But the reality is that pond waters constantly are being polluted. Pollution can cause the water quality decline, inhibits the growth of fish, weakens their immune system and often decreases the aquatic plant growth. Polluted water body will be the favourable place for growth of various pathogenic microbes which spread epidemic diseases and ultimately the water pollution produce harmful effects on human.

Limnological studies of lake and reservoirs have been carried out at different times and different places. pH, organic carbon, TSS from the upper 10 cm of soil samples from 72 shrimp ponds were collected and analyzed in Texas (Ritvo et al., 2002). Waste water related issues and their controlling mechanisms were undertaken in Sri Lanka (Bandara, 2003). The evaluation of physico-chemical parameters (pH, temperature, DO, COD, alkalinity, total hardness, free CO₂, Zn concentration etc.) in water bodies in and around Jaipur was measured (Srivastava et al., 2003). In this work, some of the

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physico-chemical analysis of surface water bodies of the Burdwan municipality area has been done to observe the pollution level of different water bodies and to conclude whether the water should be used for aqua-culture or other usage or not. Besides some probable polluting sources have also been identified.

Material and Methods

Burdwan is located in the state of West Bengal and is situated at a distance of 100 km from Kolkata. Representative water samples were collected from ten different ponds i.e, Ranisayar, Shyamsayar, Raj College pond, Laldighi, Krishnasayar, Kamalsayar, Gopalsayar, Hatipukur, Gargarghat and Bashbera. Subsequently the physico-chemical analysis of water was performed in laboratory. The temperature of water sample was measured at the spot using thermometer and the water sample was collected separately in BOD bottles for estimation of DO (Figure 1). Colour of the water samples was greenish and pH of the water samples were measured (Figure 2) following the standard method by digital pH meter. DO, COD, phosphate, sodium, potassium, alkalinity, and hardness of water samples were measured following standard method (APHA, 1998).

Result and Discussion

Table 1 shows the average of ten samples for each parameter. Almost all the experimental ponds water show light green colour and moderate temperature which are very similar to aquaculture division results. In the present study the alkalinity of pond water samples ranges 248-269 mg/L (Figure 3), which is little higher than the standard of 200 mg/L as prescribed in the ISI standard (ISI-10500, 1983). The variation in DO values for different pond have been presented in Figure 1 and the correlation in Table 2 shows that a strong positive correlation exists between alkalinity and phosphate with pH. There is no such strong relationship among other parameters (Table 2). As far as DO is concerned minimum and maximum values were at Ranisayar and Krishnasayar respectively (Figure 1). Again pH value of Gopalsayar was minimum and Krishnasayar was maximum (Figure 2). According to Khan and Ansari (2005), the two parameters pH and DO strongly affect water eutrophication. Figure 4 shows that phosphate value of Krishnasayar was higher than the other nine ponds, although it is situated in the restricted area. It may be due to the application of super phosphate in such water bodies to enhance aquatic plants, which in turn provides food to fish. All the experimental ponds having high COD

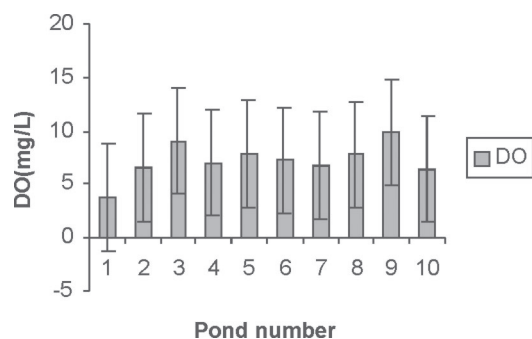
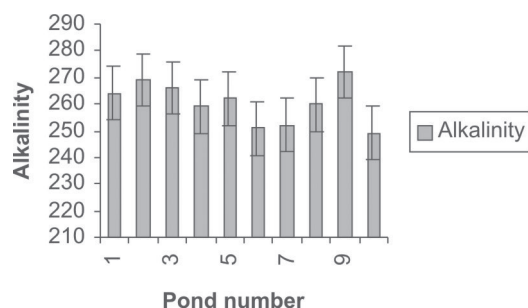
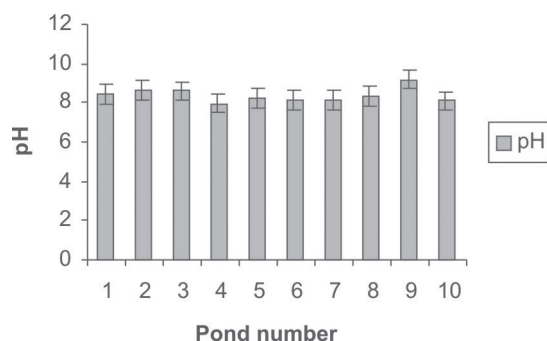
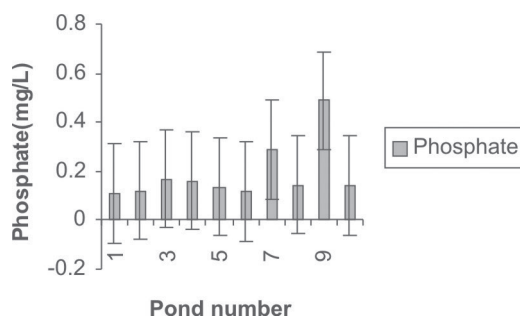
Table 1: Characterization of the pond water and comparison with the standards provided by Aquaculture Division

<i>Parameter→ Ponds↓</i>	<i>Colour</i>	<i>Temperature (°C)</i>	<i>pH</i>	<i>DO*</i>	<i>COD*</i>	<i>Alkalinity</i>	<i>Sodium*</i>	<i>Potassium*</i>	<i>Nitrate- nitrogen*</i>	<i>Phosphate*</i>	<i>Hardness*</i>
(1) Ranisayar	Light green	28.3	8.45	3.738	64	264	75	27	0.034	0.109	150
(2) Kamalsayar	Same	28.0	8.65	6.589	Nil	269	102	25	0.029	0.121	145
(3) Shyamsayar	Same	28.1	8.60	9.078	96	266	72	30	0.021	0.169	105
(4) Gopalsayar	Same	28.3	7.98	7.025	67	248	84	29	0.041	0.159	123
(5) Raj College pond	Same	27.6	8.25	7.869	Nil	262	113	30	0.032	0.135	125
(6) Hatipukur	Same	28.1	8.11	7.230	Nil	251	63	27	0.073	0.117	108
(7) Laldighi	Same	28.0	8.1	6.746	96	252	53	14	0.082	0.287	143
(8) Gargarghat	Same	28.1	8.37	7.815	Nil	260	59	16	0.02	0.144	120
(9) Krishnasayar	Same	28.0	9.20	9.837	Nil	272	53	35	0.027	0.488	122
(10) Bashbera	Same	27.9	8.09	6.463	71	249	71	22	0.038	0.141	123
Aquaculture Division	Clear water with greenish hue	25-35	6.7-8.5	05-10	<50	0.5-10	0.1-3.0	30-180
Sem(±)	—	0.201	0.356	2.046	10.597	8.731	18.806	6.591	0.02	0.368	13.926
CD(5%)	—	0.647	1.137	6.538	33.864	27.901	60.097	21.062	0.06	1.176	44.501
CV(5%)	—	1.757	7.134	19.759	8.262	12.714	5.821	10.067	35.673	32.442	2.952

*(Unit—mg/L)

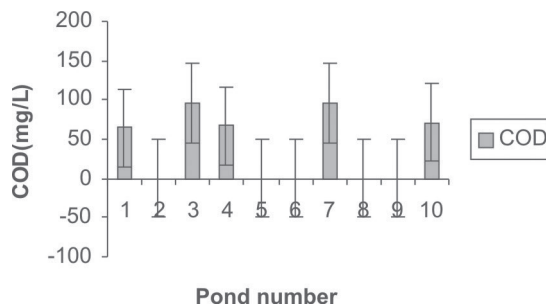
Table 2: Correlations between pH, Temp., DO, COD, alkalinity, sodium, potassium, nitrate-nitrogen, phosphate and hardness

	<i>pH</i>	<i>Temp.</i>	<i>DO</i>	<i>COD</i>	<i>Alkalinity</i>	<i>Sodium</i>	<i>Potassium</i>	<i>Nitrate-N₂</i>	<i>Phosphate</i>	<i>Hardness</i>
Temp.	-0.036									
DO	0.456	-0.352								
COD	-0.344	0.366	-0.258							
Alkalinity	0.911	-0.134	0.299	-0.370						
Sodium	-0.139	-0.412	-0.179	-0.243	0.160					
Potassium	0.497	-0.025	0.342	-0.235	0.442	0.311				
Nitrate-N ₂	-0.538	0.037	-0.245	0.229	-0.624	-0.325	-0.389			
Phosphate	0.626	-0.092	0.575	-0.050	0.344	-0.521	0.244	0.38		
Hardness	0.25	0.085	-0.690	0.099	0.159	0.201	-0.311	0.122	-0.029	

**Figure 1: DO value of different ponds.****Figure 3: Alkalinity of different ponds.****Figure 2: pH value of different ponds.****Figure 4: Phosphate of different ponds.**

value (Figure 5) result from significant domestic sewage discharged and waste dumping and there is one pond like Shyamsayar which is very nearer to the Burdwan Hospital showing highest COD value. This is due to the fact that huge amount of medical wastes are frequently dumped near the said pond.

Figure 6 indicates the variation of sodium, potassium and hardness in water of different experimental ponds and it is clear that all the ponds showed higher hardness compared to the sodium and potassium. This is quite possible because hardness is due to presence of different cations and anions other than sodium and potassium.

**Figure 5: COD value of different ponds.**

Although the variation of sodium and potassium is also significant because fish require electrolytes for their metabolic processes, and because these pond waters are treated by Mahua neem cake, pond salt etc. by the fishermen or pond owners. Again from Figure 7, it was revealed that only two ponds Hatipukur and Lal dighi has high nitrate nitrogen. The nitrate nitrogen is one of the most oxidisable forms of nitrogen and is an essential plant nutrient. Due to its higher mobility in water and utilization by plants it is also regulated by waste loading, through agricultural runoff (Jha et al., 2001).

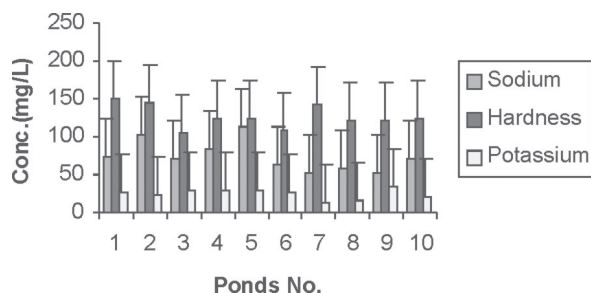


Figure 6: Sodium, potassium and hardness of different ponds.

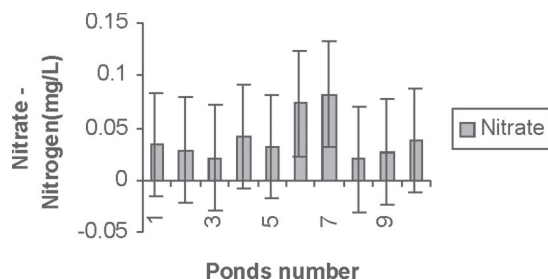


Figure 7: Nitrate-nitrogen of different ponds.

Conclusion

From the above discussion, it can be concluded that all these ten ponds are more or less polluted. If these conditions prevail for long duration, the water will become unsuitable for aquaculture/fish culture and for human use also, gradually day by day. The condition of Ranisayar is most worse as its DO level is very low than the others as well as the tolerable limits. To maintain the quality of water bodies, there should be arrangement so that no domestic waste water or municipal effluents are

allowed to enter directly to the pond through drainage system and produce cumulative effect. Some simple processes or treatment can be applied for the effluent before its contact with the surface water body to reduce the waste burden. The hazardous waste must be disposed off properly, and on-site treatment may also be applied which will vary from case to case depending on the pond condition and on the chemical form of the pollutants.

Acknowledgement

Authors are thankful to Dr A.R. Ghosh, Reader of the Department of Environmental Science and Dr R.N. Saha, Lecturer of the Department of Chemistry, NIT Durgapur, for their fruitful help, active guidance and constant good wishes during the tenure of the project work.

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