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STUDIES ON THE WATER QUALITY OF A WATER BODY AT ASANSOL TOWN, WEST BENGAL

Pinaki Ranjan Chatterjee and M. Raziuddin*
Department of Zoology, Kabi Nazrul College, Murarai-731 219, Dist. Birbhum, W. B., India
*P.G. Department of Zoology, V. B. University, Hazaribag, Jharkhand, India

ABSTRACT

The present study was intended to calculate Water Quality Index (WQI) of a particular surface Pamputola water body in Asansol Town, West Bengal in order to ascertain the quality of water assessed for public consumption, recreation and other purposes. Investigation has been based on different physicochemical parameters namely pH, TDS, TSS, TA, TH, chloride, DO and BOD for which no earlier reports are available on this water body.

INTRODUCTION

The large water body, common called Pamputola waterbody is 10000 sq. m in area and surrounded by dense residential colony, hospital, nursing homes, recreational park and a stadium. Discharges of domestic and hospital effluents from the surroundings are continuously mixing up with the water body. Review of literature reveals that number of attempts have been made to assess the pollution load of Damodar river at Asansol town but no study so far has been conducted to assess the pollution load of this water body. Keeping in view the necessity of restoring the water quality of the waterbody, the present study aims to calculate the Water Quality Index (WQI) in order to assess the suitability of its water for human use.

MATERIALS AND METHODS

Water samples were collected twice every month during morning hours between 8 a.m. and 10 a.m. pH and dissolved oxygen were monitored at the sampling spot while total dissolved solids, total suspended solids, total alkalinity, total hardness, chlorides and BOD were analysed in the laboratory as per standard procedures of APHA (1995) and Trivedy & Goel (1986).

Water Quality Index (WQI): Water Quality Index, indicating the water quality in terms of index number, offers a useful representation of overall quality of water for public or for any intended use as well as in the pollution abatement programs and in water quality management. Horton (1965) defined Water Quality Index (WQI) as a reflection of composite influence of individual quality characteristics on the overall quality of water. For calculation of WQI, selection of parameters has great importance. Since, selection of many parameters widen the quality index, and importance of various parameters depends on the intended use, eight physico-chemical parameters namely pH, TDS, TSS, total alkalinity, total hardness, chloride, DO and BOD were used to calculate WQI, which are popularly used for its calculation.

The following steps of evaluation of WQI have been used from the point of view of the suitability of surface water for human consumption, and it is calculated by weighted arithmetic index method (Brown et al. 1972).

Calculation of subindex or quality rating (q_n): Let there be *n* water quality parameters and quality

rating or subindex (q_n) corresponding to n^{th} parameter is a number reflecting the relative value of this parameter in the polluted water with respect to its standard permissible value. The q_n is calculated using the following expression.

$q_n = 100\ [(Vn\text{-}Vio)/(Sn\text{-}Vio)]$

Where,

q_n = Quality rating for the n^{th} water quality parameter.
Vn = Estimated value of the n^{th} parameter at a given sampling station.
Sn = Standard permissible value of the n^{th} parameter.
Vio = Ideal value of n^{th} parameter in pure water.
i.e., 7.0 for pH, 14.6 mg/L for DO and 0 for all other parameters.

pH calculation through water quality rating evaluation: Ideal value of pH is 7.0 where 8.5 is the permissible value of water (i.e., polluted water), therefore, quality for pH is calculated from the following relation.

$q_{pH} = 100\ [(V_{pH} - 7.0)/(8.5 - 7.0)]$

Where V_{pH} = Observed value of pH

DO calculation through the water quality rating equation: Ideal value (V_{DO}) of dissolved oxygen is 14.6 mg/L and standard permissible value for drinking water is 5mg/L, therefore, quality for DO is calculated from the following relation.

$q_{DO} = 100\ [(V_{DO} - 14.6)/(5 - 14.6)]$

Calculation of unit weight: Unit weight was calculated by a value inversely proportional to the recommended standard value (Sn) of the corresponding parameter.

$$Wn = \frac{K}{Sn}$$

Where, Wn = Unit weight for the n^{th} parameters, Sn = Standard value for the n^{th} parameter, K = Constant for proportionality

The overall Water Quality Index was calculated by aggregating the quality rating (q_n) with the unit weight linearly.

$WQI = \sum q_n Wn / \sum Wn$

RESULTS AND DISCUSSION

The results of the study are depicted in Tables 1, 2, 3 and 4. The pH value of water indicates as an alkaline nature of waterbody. It is varied between 7.74 and 7.65. The recommended values of it by ISI is 6.5-8.5, and by ICMR 7-8.5. TDS values are much above the prescribed limit of WHO i.e., 100 mg/L., whereas TSS values of different seasons varied from 32.99-106.87 mg/L. Total alkalinity values were within 207.0 to 359.25 mg/L. Alkalinity itself is not harmful to human beings but desirable limit of 100 mg/L is always required for domestic supply of water. Hardness values were recorded as 85.5-145.7 mg/L during different seasons from winter to monsoon period. Higher values of hardness were observed during summer, which may be due to low water level and high rate of decomposition and evaporation thus concentrating the salts. Chloride concentration results in salty taste of water. Some times high concentration of it is responsible for laxative effect in human beings. The concentration of chloride varied between 70.13 and 145.7 mg/L, which was below the prescribe

Table 1: Water quality rating for drinking purposes.

WQI level	Water quality rating
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very poor
> 100	Unfit for drinking

limit of WHO. Dissolved oxygen varied from 1.90 to 3.99 mg/L indicating as unfit for human consumption and cause of the fish mortality in the water. Depletion of DO is enhanced by high concentration of organic matter of the water body (Rana & Palharya 1988). BOD values were in the range of 27.56 to 32.73 mg/L, which are much above the prescribed limit indicating polluted nature of the water.

Table 2: Drinking water standards recommended by Agencies and unit weights.

No.	Parameters	Standards (Sn)	Recommended agency	Unit weight (Wn)
1	pH	7.0 to 8.5	ICMR	0.2190
2	Total dissolved solids	500	ICMR	0.0037
3	Total suspended solids	500	WHO	0.0037
4	Total alkalinity	120	ICMR	0.0155
5	Total hardness	300	ICMR	0.0062
6	Chlorides	250	ICMR	0.0074
7	Dissolved Oxygen	5.00	ICMR	0.3723
8	Bio-chemical oxygen	5.00	ICMR	0.3723

Table 3: Calculation of WQI in winter season of the said water body.

No	Parameters	Observed values	Standard values (Sn)	Unit weight (Wn)	Quality rating$_n$	Wnq$_n$
1	pH	7.74	7 to 8.5	0.2190	49.33	10.8032
2	TDS	389.26	500	0.0037	77.85	0.2896
3	TSS	41.38	500	0.0037	8.27	0.0307
4	TA	252.5	120	0.0155	210.41	3.261
5	TH	109.65	300	0.0062	36.55	0.226
6	Chlorides	73.55	250	0.0074	29.42	0.2177
7	DO	3.99	5.0	0.3723	110.52	41.1465
8	BOD	32.73	5.0	0.3723	654.6	243.707
All observed values except in pH are in mg/L				$\Sigma Wn = 1.0001$	$\Sigma q_n = 1176.95$	$\Sigma Wnq_n = 299.68$

$$WQI = \frac{\Sigma Wnq_n}{\Sigma Wn} = \frac{299.68}{1.0001} = 299.65$$

Table 4: Observed values of physico-chemical parameters and WQI of different seasons of the water body.

	Post Winter	Summer	Post Summer	Monsoon	Post Monsoon
pH	7.50	7.56	7.65	7.74	7.64
TDS	356	413.95	440.35	347.35	266.05
TSS	39.20	32.99	34.60	106.87	71.02
TA	274.96	325.5	207	359.25	213.05
TH	85.5	145.7	133	121.0	102.5
Chlorides	74.63	81.01	79.61	60.23	70.13
DO	2.40	2.42	1.90	3.00	3.31
BOD	27.56	28.94	32.42	31.57	31.60
ΣWnq_n	263.83	275.95	303.64	296.25	291.82
WQI	263.80	275.92	303.61	296.22	291.79

Quality rating of the water is established from WQI as it is established from different physico-chemical parameters in different seasons of the water body. The present results are much above 100 indicating the water as unfit for drinking and other human use. The value is at peak in post summer (303.61). Other seasons also denote its value nearer to this, which indicates severe deterioration of water quality for human use.

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