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ASSESSMENT OF WATER QUALITY PARAMETERS OF THE RIVER BRAHMANI AT ROURKELA

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ABSTRACT

Various Physico-chemical parameters such as D.O., alkalinity, hardness, turbidity and BOD were studied on the samples drawn from the river, " Koel", "Shankha" and " Brahmani" selecting strategic points, almost quarterly over a period of one year in 2002. The quality of water was assessd by estimating dissolved metals such as Ca, Mg, Fe, Pb, Cd and Cr using standard methods and calibrated apparatus. It was observed that dilution during rainy season decreases the metal concentration level to a considerable extent. However the enrichment of these metals by bio-magnification and bio-accumulation in edible components produced in water is accepted to produce a remarkable effect on the water of the river " Brahamani" which is of deep public concern.

INTRODUCTION

Investigations have been made on inumerable water bodies from various sources of our country. The river "Brahmani" in the Stale of Orissa is not an exception. The Steel City Rourkela is on the Howrah- Mumbai railway line. It latitude is 22^0 -12′ N of equator and longitude is 85^0 east of meridian. It is at an altitude of *219* meters above the sea level. The river Brahmani emerges at Vedvyas as the confluence of two rivers namely "Shankha"' and "Koel". Due to location of Rourkela Steel Plant. Fertilizer Plant, Captive Power Plant, Heavy Engineering Works. Refractory Units, Cement Plants, expolsive plants, distillery units, sponge iron plants and above all 300 small scale industries in the vicinity of Rourkela and due to discharge of effluents from these industries, sewage disposal of steel city, the said river gets polluted to a great

extent. The pollution is alarming and creats furore among the inhabitants on its bank and has endangered the aquatic life. Therefore it was decided to study the water quality parameters of the said river along with the heavy metal pollutants by collecting quarterly water sample from strategic points over a period of one year.

MATERIAL AND METHOD

Study area

The water samples for physico-chemical analyses were carried out in the middle of January, April, August and November 2002 from littoral and limonitic zones of the river " Koel" at Bankia, sector 14. Rourkela (Sampling point- 1, S_1) and simultaneously samples were collected at Vedvyas Bridge on river " Shankha" (Sampling point- 2, S_2) Panposh Confluence (Sampling point- 3, S_3) and village Vidual, Jalda "C" Blcok, situated at a distance of 5 km down stream from Tarkera Waste Disposal Pond (Sampling Point- 4, S_4).

Experiment

The samples were collected in plastic containers in triplicate and were kept in ice box and the physico-chemical parameters were determined on the same day by standard methods as outlined in APHA[1]. BOD was measured at an interval of 5 days at 20^0C. The pH of the samples were measured using pH meter of " Elico" make and the turbidity was measured by Nephelo Turbidity Meter of "Systronics" make model 131. Hardness was determined titrometrically using EDTA. Water Quality Index, WQI was calculated using the weighed arithmetic mean formula (not shown). For determination fo dissolved metals, the water samples were filtered through a suitable filter pape evaporated to almost dryness and digested with conc. HNO_3 and $HClO_4$. The metal ions present in the digested solutions were estimated atomic absorption spectrophotometrically (AAS). The experimental results have been tabulated in **Table-1 and 2**.

RESULTS AND DISCUSSION

pH : The pH values fluctuated between 7.2 to 8.7. According to Klein (1973), the acceptable pH value should not exceed 8.3. However, the pH values of the samples are well within the ICMR standards (7.0-8.5).

D.O. : The obtained D.O. values varied from 6.8 to 8.3 which is co-related to the temperature and the other nutrients like phosphate, nitrate, silicate etc. The decrease in D.O. in S-4 mainly due to the acidic and organic discharges.

Total Alkalinity : Alkalinity is defined as the quantity of ions in water that will react to neutralize Hydrogen ions. the BIS recommends the alkalinity to be within 50-200 mg/L. The alkalinity figures of the examined samples were within the standard values. Alkaline nature of water is harmful to human beings. The alkalinity also may be due to process of leaching through surface

Table - 1 Physico-chemical Quality

	S1				S2				S3				S4			
	Jan	April	Aug	Nov	Jan	April	Aug	Nov	Jan	April	Aug	Nov	Jan	April	Aug	Nov
1. pH	8.3	8.5	8.6	8.3	8.5	8.6	8.5	8.7	8.1	8.4	7.9	8.0	7.2	7.5	8.0	7.8
2. DOppm	8.3	7.6	7.5	8.4	8.2	7.5	8.3	8.6	8.0	7.3	8.2	8.1	6.8	6.6	7.3	7.5
3. Total alkalinity ppm of CaCO3	62	80	56	60	64	78	56	58	62	76	52	66	58	76	54	58
4. Total Hardness ppm of CaCO3	110	112	120	84	120	126	1128	29	115	118	124	121	130	132	116	120
5. Turbidity (NTU)	8.2	10.2	212	19.2	9.0	9.8	198	21.0	9.5	10.6	216	20.6	7.8	9.6	156	8.2
6. B.O.D. ppm	5.6	7.2	7.0	6.8	6.1	7.4	6.8	6.5	6.5	7.0	6.6	5.8	5.1	5.8	5.4	5.3

Table - 2 Distribution of dissolved metals

Ca (ppm)	12	10	12	08	22	25	28	26	15	14	12	12	32	34	28	30
Mg (ppm)	08	06	06	05	20	18	15	18	14	12	12	10	16	18	15	16
Fe (ppm)	0.7	0.6	0.8	0.3	0.2	0.5	0.7	0.5	0.6	0.5	0.9	0.6	0.8	0.7	0.9	0.8
Pb (ppb)	72	68	56	44	71	65	55	38	66	65	58	42	85	92	86	88
Cd (ppb)	08	ND	04	ND	06	02	01	ND	03	04	ND	02	ND	04	02	02
Cr (ppb)	18	16	15	12	22	ND	02	03	12	10	24	06	25	32	38	42

water during rainy season. The alkalinity is also produced by the action of water on limestone in presence of CO_2.

$$CaCO_3 + H_2O + CO_2 = Ca(HCO_3)_2$$

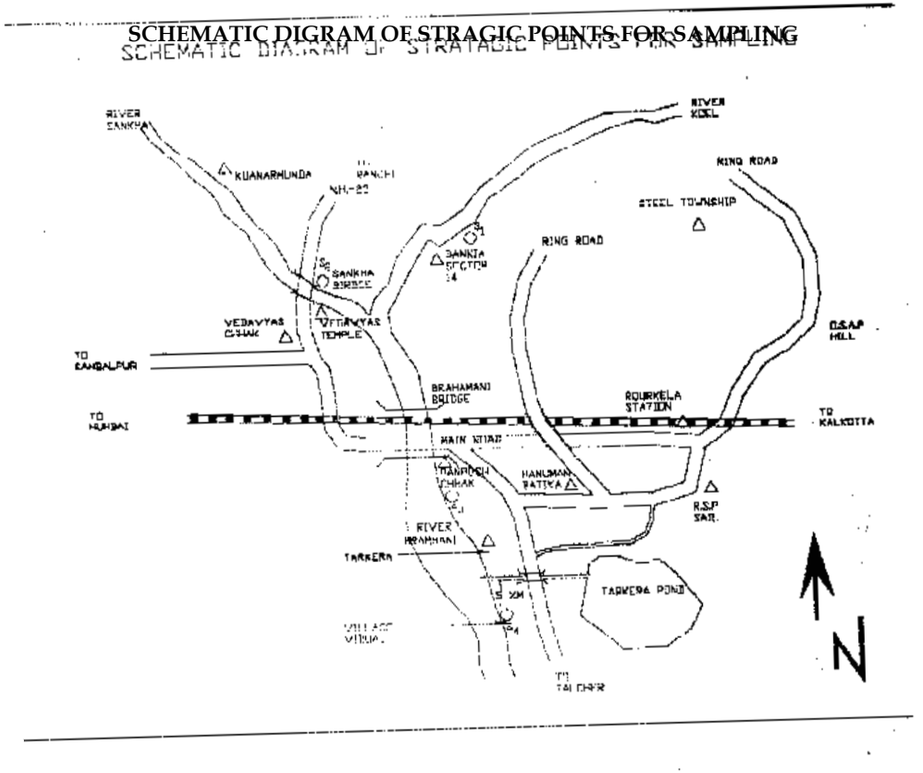
Insoluble Soluble

Total Hardness : The BIS has specified the total hardness to be within 500 mg/L of $CaCO_3$. The higher value of hardness in S2 is due to dissolution of limestone, natural accumulation of salts from contact soil and geological formation. Though Fe^{+3} contributes towards the hardness of water, its ionic concentration in the natural water is generally negligible. The hardness is due to the formation of bicarbonate as followes:

$$MCO_3 + CO_2 + H_2O = M(HCO_3)_2, \text{ where M= Ca, Mg, Sr.}$$

Besdies, sulphates, chlorides, silicates etc, of Ca, Mg, Al and those of alkali metals add to the hardness of water[4].

Turbidity : The turbidity is mainly due to the dispersion of suspended particles and the BIS specifies it to be within 10 for potable water. The abnormal values of turbidity are due to discharge of industrial effluents and sewage disposal. Besides the dispersion of inorganic solids such as clay, silt and other soil constituents add to the magnitude of turbidity[5].



B.O.D. : The BOD values varied from 5.3 to 6.2 mg/L. The higher value of BOD in summer is due to thermal effect and less volume of water.

Dissolved Metals : The calcium content in the samles ranges between 8 to 30 mg/L. The minimum value of Ca is observed in winter, while the maximum value is in rainy season. Similarly the Mg conent varied between 05 to 20 mg/L. The higher content of Ca and Mg is due to dissolution of sedimentary rock strata.

The dissolution of heavy metals in river water is reflected in **Table-2**, which reveals that these are well within the permissible limit and in some samples it is quite low, and nondetectable. The higher values in S4 are due to the effect of industrial effluents.

CONCLUSION

- The seasonal change does not bring any significant alteration in the pH values.
- There is a considerable decrease in D.O. (S_4) due to contamination from effluent discharge of industries and sewage disposal.
- Higher observed values of alkalinity might be due to large-scale use of its bank as open-air latrine by people of that area and consequent washing of the excreta.
- Total hardness varied between 110-132 mg/L of $CaCO_3$. The higher values of hardness may be due to the facts explained earlier and also due to large qnantity of sewage disposal including discharge of detergents.
- The abnormal behaviour of turbidity is due to addition of soil constituents, industrial effluents and sewage disposal.
- The higher values of BOD is mostly due to thermal effect while the lower value is due to presence of organic materials present in disposed sewage and excess use of detergents.
- The estimated data of dissolved metals are well within the prescribed limit, but the increase in heavy metal concentration in S_4 is due to mixing of industrial effluents.

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