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Physico-Chemical Studies on the Pollution Potential of River Kosi at Rampur (India)

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Abstract: Water of River Kosi in stretch of 35 Kms at Rampur was studied for pollution by determining various water quality parameters, for all three seasons viz. winter, summer and rainy season. The river is subjected to severe domestic and industrial pollution at Kashipur (U.A). This polluted water is carried down stream to Rampur (U.P.). The pH range is 7.3 to 7.9.The organic pollution is mild as indicated by DO (6.2-7.5 mg/l) and BOD (5.0-6.0 mg/l). But the highest value of COD ranging between 25.0 mg/l to as high as 40.0 mg/l, indicates industrial pollution. To monitor the water quality samples from six stations were collected monthly. In this paper the results of one year study are presented.

Key words: River pollution · Water quality · BOD · COD · DO

INTRODUCTION

Water pollution is an acute problem in all the major rivers of India [1-4]. In the wake of increasing urbanization and industrialization, the pollution potential of river Kosi is gaining momentum day by day. The river flows three kilometers, west of Rampur town. The survey of river revealed that villages and towns which fall in the way of river, dump waste water and toxic wastes in the river. This has caused serve pollution in the river to the extent that its water is no more palpable and is posing threat to the survival of aquatic flora and fauna. The construction of dam at Lalpur aggravate the pollution situation.

It is, therefore, desirable to monitor the pollution level over the stretch between village Pranpur and Kishanpur (District Rampur) by collecting and analyzing the water samples from different places with a view to study the physical, chemical and biological characteristics and to investigate the factors responsible for causing pollution. The study can also help in formulating remedial measures.

MATERIALS AND METHODS

Midstream surface water samples were collected for analysis from six sampling stations. The samples were collected in wide mouthed polythene bottles and stored in ice box for further analysis after determining temperature, pH and electrical conductivity. The samples were analysed for following physico-chemical and biological parameters viz., temperature, pH, total solids, electrical conductivity, turbidity (Nephelometric Method), hardness (EDTA Titrimetric Method), dissolved oxygen (Winkler Method with Azide Modification), biochemical oxygen demand (5 days incubation method), chemical oxygen demand (by dichromate titration method), alkalinity, chloride and MPN of F. coliforms [5,6].

RESULTS AND DISCUSSION

Results of physico chemical and biological analysis are given in Table 1.

Temperature: Temperature was recorded to ±0.1°C accuracy using a mercury thermometer, immediately after collecting the sample. Table 1 shows average winter, summer and rainy season temperatures of the river water, which vary from 20.1°C to 18.8°C, 34.6°C to 33.4°C and 31.5°C to 30.5°C respectively.

The variation is mainly related with the temperature of atmosphere and weather conditions [1,2,7]. Higher temperature during summer was due to greater heating [3]

pH: The pH ranges from 7.7 to 7.9 in winter, 7.3 to 7.8 in summer, 7.3 to 7.8 in rainy season. In general the pH values are higher in winter than other seasons. The variation can be due to the exposure of river water to

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Table 1: Mean Values of Physico-Chemical and Biological parameters of River Kosi at Rampur showing seasonal variations

	Temperature			pH			Total solids			Conductivity		
	W	S	R	W	S	R	W	S	R	W	S	R
Station 1	19.9	33.4	31.5	7.9	7.8	7.45	426	433	405	522	525	466
Station 2	19.2	34.6	31.4	7.9	7.5	7.8	358	378	399	488	500	455
Station 3	18.8	34.3	31.5	7.8	7.6	7.3	368	381	385	495	506	441
Station 4	19.7	34	30.9	7.7	7.5	7.5	365	387	386	493	514	445
Station 5	20.1	33.5	30.7	7.9	7.4	7.6	325	351	366	461	482	421
Station 6	18.9	33.4	30.5	7.8	7.3	7.5	341	347	372	479	485	430
	Turbidity			Hardness			Chloride			Alkalinity		
	W	S	R	W	S	R	W	S	R	W	S	R
Station 1	39	43	81	221	227	220	23.5	20.1	20.0	200	163	130
Station 2	28	35	79	173	191	189	13.6	11.8	12.6	196	151	91
Station 3	31	38	77	208	199	208	20.5	18.7	18.7	198	160	115
Station 4	32	41	75	205	209	199	25.3	21.0	18.8	195	158	111
Station 5	25	34	73	189	188	184	21.4	19.0	18.1	157	131	91
Station 6	29	36	74	211	207	205	23.8	20.0	18.2	197	153	98
	D.O			B.O.D.			C.O.D.			MPN		
	W	S	R	W	S	R	W	S	R	W	S	R
Station 1	7.4	7.2	6.7	5.8	5.4	5.8	38.0	36.0	37.0	206	237	290
Station 2	7.3	6.9	6.1	5.0	5.3	5.5	25.0	27.0	30.0	190	206	235
Station 3	7.5	7.0	6.8	5.8	5.3	5.9	34.0	34.7	35.0	136	141	186
Station 4	6.7	6.8	6.3	5.9	5.7	5.8	39.0	33.0	36.0	121	134	190
Station 5	6.6	6.6	6.2	6.0	5.5	5.9	36.0	32.8	33.5	115	126	179
Station 6	6.5	6.4	6.3	6.0	5.5	6.0	40.0	36.0	36.5	114	129	189

atmosphere, biological activities and temperature changes [2].

Turbidity: The drinking water limit for turbidity as prescribed by World Health Organization is 2.5 NTU. The turbidity values in samples varied from 25 to 39 NTU in winter, 34 to 43 NTU in summer and 73 to 81 NTU in rainy season. The water at station-1 is most turbid throughout the study period due to low discharge of water from Lalpur dam. The probability of presence of pathogenic organisms is also increased in turbid water[5].

Total Solids: The total solids (TS) determined in these studies ranged between 325 to 426 mg/l in winter, 347 to 433 mg/l in summer 366 to 405 mg/l in rainy season. Total solids analysis has great implications in the control of biological and physical waste water treatment processes [8,9]. The largest amount of total solids adds to the highest turbidity and electrical conductivity. Similar results were also obtain by Bahadur and Chandra [1] for river Ramganga at Bareilly.

Electrical Conductivity: In present observations the electrical conductivity (EC) varies from station 1 to 6, 522 to 479 µmho/cm in winter, 525 to 485 µmho/cm in summer and 466 to 430 µmho/cm in rainy season as shown in Table 1. High Electrical conductivity indicates a larger quantity of dissolved mineral salts[10], thereby making it sour and unsuitable for drinking [5,8]. Similar observation were also reported by Srivastava and Shina [4] for river ganga at Phaphamau (Allahabad).

Total Hardness: In present study the observed values range from 173 to 221 mg/l in winter 188 to 227 mg/L in summer and 184 to 220 mg/l in rainy season. Although hard water has no known effect on health but is unsuitable for domestic uses. It also forms heat-insulating scales in the boilers reducing their efficiency. Therefore, the water of river Kosi is unsuitable for industrial uses [7,8]. These observations are in agreement with those obtained by Bahadur and Chandra [1] and Pande and Sharma [3].

Dissolved Oxygen: In liquid wastes, dissolved oxygen is the factor which determines whether the biological changes are brought about by aerobic or anaerobic organism. It reflects the physical and biological processes prevailing in the water. The oxygen present in water can be dissolved from air or produced by photosynthetic organisms. The D.O. varies from 7.4 to 6.5 mg/l in winter, 7.2 to 6.4 mg/l in summer and 6.7 to 6.3 mg/l in rainy season for station 1 to 6. These values indicate relatively mild organic pollution. Game fish needs at least 5 mg/l dissolved oxygen therefore the water of river Kosi can be

used for fish culture. These results also agree with those of Bhargava [2], Pande and Sharma [3].

Biochemical Oxygen Demand: Types of micro-organism, pH, presence of toxins, some reduced mineral matter and nitrification process are the important factors influencing the B.O.D. tests. The aim of B.O.D. test is determine the amount of bio-chemically oxidisable carbonaceous matter[5,8]. The biochemical oxygen demand observations for the three seasons i.e. winter, summer and rainy season vary from 5.0 to 6.0 mg/l 5.3 to 5.7 mg/l and 5.8 to 6.0 mg/l, respectively. Like D.O. it also indicates presence of organic pollution which can be attributed to the non-point sources scattered over the entire study zone.

Chemical Oxygen Demand: Chemical oxygen is the amount of oxygen consumed during the chemical oxidation of organic matter using a strong oxidizing agents like acidified potassium dichromate. This gives valuable information about the pollution potential of industrial effluents and domestic sewage[5]. In present study the values vary from 25 to 40 mg/l in winter 27 to 36 mg/l in summer and 30 to 37 mg/l in rainy season. The highest values of COD indicates that most of the pollution in study zone in caused by industrial effluents discharged by industrial units like pulp and paper mill, sugar factory etc. upstream [8]. Similar results were also reported by Pande and Sharma [3].

Alkalinity: It is the quantitative capacity of water sample to neutralize a strong acid to a designated pH [5,8]. In the present study observed values range from 157 to 200 mg/l in winter 131 to 163 mg/l in summer and 91 to 130 mg/l in rainy season. Higher values (Table 1) can be attributed to the industrial effluents discharged upstream, as in winter sugar factory runs at the highest capacity. Increase dilution may be responsible for relative lower values in rainy seasons [1].

Chloride: This is the most common inorganic anion present in water. Man and animals excrete high quantities of chloride, therefore, it indicate sewage contamination[11]. In present study the value range from 13.6 to 25.3 mg/l in winter, 11.8 to 21 mg/l in summer and 12.6 to 20 mg/l in rainy season. The lowest relatively values in rainy season can be attributed to the increase dilution by rains water. The results agree with those obtained by Pande and Sharma [3] for Ramganga at Moradabad.

MPN of Coliform: The coliform group of bacteria has been the principal indicator for the suitability of water for domestic use [5]. In the present study, MPN count is the highest at station 1 in all three seasons. In general the values are maximum in rainy season and minimum in winter season. The highest relative values in rainy season can be attributed to the favorable conditions of temperature and nutrients [11,3].

CONCLUSION

Due to high alkalinity river water is not suitable for agriculture. The highest values in winter may be attributed to increase industrial discharge from sugar mill situated in north. C.O.D. is much higher than B.O.D., it indicates that most of the pollution in Kosi ,in the study zone, is caused by industrial discharge. The main sources of organic pollution are non-point sources like agricultural run-off, cattle-dropping.

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