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RESEARCH ARTICLE

Evaluation of water quality: Physico – chemical characteristics of Ganga and Yamuna river at Allahabad

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SUMMARY : Rivers are especially at high risk of contamination by different contaminants from anthropogenic sources including heavy metals since change of the sediment regime often occurs. The present study was carried out to study the changes in physiochemical parameters of the water samples of Ganga and Yamuna River in Allahabad region. Water samples under investigations were collected from the different sites of Allahabad and following parameters were investigated such as water temperature, pH, DO (mg/l), BOD (mg/l), COD (mg/l) and TDS (mg/l), chloride (mg/l), total alkalinity (mg/l), total hardness (mg/l), calcium (mg/l), magnesium (mg/l), turbidity (mg/l) and conductivity (μScm^{-1}). Analysis of observation reveal variation in the value of temperature from 21^0C to 24^0C, pH of river ranged from a minimum 7.8 and 8.3, D.O ranged from 4.5 to5.8 (mg/l), BOD ranged from 11.0 to 16 (mg/l), COD ranged from 8 to 21.6 (mg/l), TDS ranged from 359 to 455 (mg/l), chloride ranged from 5.7 to 6.8 (mg/l), total alkalinity ranged from 25 to 26.6 (mg/l), conductivity ranged from 480 to 573 μScm^{-1}, total hardness ranged from 212 to 246 (mg/l), calcium ranged from 110 to150 (mg/l), magnesium varied from 72 to 136 (mg/l), turbidity ranged from 11 to 18.5 (mg/l). All the physicochemical parameters for pre monsoon, monsoon and post monsoon seasons are within the highest desirable or maximum permissible limit set by WHO except turbidity which was high while NO^{3-}, Cl^{-1} and F^- are less than the values prescribed by WHO.

Key Words :
Physico-chemical parameters, Rivers, Anthropogenic, Water quality

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Ganga river is life line of Allahabad and its water is used for domestic and agriculture purposes. Therefore, effective maintenance of water quality is required through appropriate measurements. The river Ganga is a part and parcel of everyday life in the city and thousands of people bath daily in the river Ganga and Yamuna. The largest tributary of river Ganga has been one of the most prominent and important rivers of India. The river Yamuna, draining the southern slopes of the Himalaya in its upper reaches, is the largest tributary of the Ganga (Negi, 1991). Pressure on the river is increasing is enormously due to ever increasing population, industrial and urban growth in the river basins. Today, over 29 cities, 70 towns and thousands of villages extend along the Ganga banks. Nearly all of their sewage - over 1.3 billion liters per day - goes directly into the river, along with thousands of animal carcasses, mainly cattle (Bharadwaj *et al.*,2010). Domestic and industrial wastewater constitute as a constant polluting source, whereas surface runoff is a seasonal phenomena mainly controlled by climate (Singh *et al.,* 2004). Municipal sewage constitutes 80 per cent by volume of the total waste dumped into the Ganga and industries contribute about 15 per cent. The majority of the Ganga pollution is organic waste, sewage, trash, food and human and animal remains. Over the past century, city populations along the Ganga have grown at a tremendous rate, while waste-control infrastructure has remained relatively unchanged due to abundance of toxic effects in the

environment of highly industrialized and urbanized areas. The pollutants, which do not remain in water column or solution, could be absorbed rapidly by particulate matters and thereby they also could escape any detection by water monitoring schemes (Mehrotra, 1990).

EXPERIMENTAL METHODOLOGY

The laboratory analyses of samples were done using standard methods. Titrimetric method was used for the determination of total alkalinity. Complexometric method was used for determining chloride content, whereas EDTA titrimetric method was used for total hardness analysis. Sampling and analysis of the river water was conducted at all the four sites (at 4 subsites each) fortnightly for three years. Standard methods for the examination of water and waste water (APHA, 2005) was followed for the analysis of pH, Total alkalinity, Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Dissolved oxygen (DO) and Total dissolved solid (TDS) of water were made according to standard procedure (EPA 1979; APHA, 1999).

EXPERIMENTAL FINDINGS AND DISCUSSION

The pH was observed as 6.8 to 8.2 which showed that the present water samples are slightly alkaline in pre-monsoon

Table 1: Water analysis of sample 1: Sangam

Sr. No.	Parameters	Units	Drinking water WHO standard		Experimental values
			HDL	MPL	
1.	Temperature	^{0}C	----	-----	21
2.	Turbidity	NTU	5	10	12.5
3.	Calcium	mg/l	75	200	140
4.	Magnesium	mg/l	30	150	92
5.	pH value	----	6.5 to 8.5	No relaxation	8.2
6.	Total hardness(as $CaCO_3$)	mg/l	300	600	232
7.	DO	mg/l	2	6	4.5
8.	BOD	mg/l	3	6	16
9.	COD	mg/l	3	No relaxation	16.6
10.	TDS	mg/l	500	2000	359
11.	Chloride	mg/l	250	1000	5.7
12.	Total alkalinity	mg/l	200	600	26.5
13.	EC	μ mohs/ cm	250	750	550

HDL: Highest Desirable Limit, MPL: Maximum Permissible Limit

Table 2: Water analysis of sample 2: Sarswati ghat

Sr. No.	Parameters	Units	Drinking water WHO standard		Experimental values
			HDL	MPL	
1.	Temperature	^{0}C	----	-----	24
2.	Turbidity	NTU	5	10	11
3.	Calcium	mg/l	75	200	150
4.	Magnesium	mg/l	30	150	72
5.	pH value	-	6.5 to 8.5	No relaxation	7.8
6.	Total hardness(as $CaCO_3$)	mg/l	300	600	222
7.	DO	mg/l	2	6	4.1
8.	BOD	mg/l	3	6	11.6
9.	COD	mg/l	3	No relaxation	20.1
10.	TDS	mg/l	500	2000	359
11.	Chloride	mg/l	250	1000	6.8
12.	Total alkalinity	mg/l	200	600	26.7
13.	EC	μmohs/cm	250	750	874

HDL: Highest Desirable Limit, MPL: Maximum Permissible Limit

season. These values are within maximum permissible limit prescribed by WHO (*www.lenntech.com/drinking-water-standards.htm*). Other parameters were concluded as follows like temperature of both the rivers came as 21^0C - 28^0C, Turbidity came as 11 - 18.5 NTU, Chloride came to the range of 5.7 - 6.8 mg/l, Total Dissolved Solids ranged from 359 - 455 mg/l, Presence of Ca^{2+} came as 110 – 155 mg/l, Total Alkanity ranged from 25.5 - 26.7 mg/l, presence of Mg^{2+} ranged from 72 - 136 mg/ , Biological Oxygen Demand came as 3.6 - 11.6 mg/l, Chemical Oxygen Demand 11.7 - 21.6 mg/l, Dissolved Oxygen 4.1 - 6 mg/ l, Hardness ranged from 212 - 246 mg/l. All the components were found within the highest desirable or maximum permissible limit set by WHO (Trivedi and Goel, 1986). The observed values of various physico-chemical parameters of water samples were compared with standard values recommended by World Health Organization WHO and are given in Table 1 to 4.

Table 3: Water analysis of sample 3: Arail ghat

Sr. No.	Parameters	Units	Drinking water WHO standard		Experimental values
			HDL	MPL	
1.	Temperature	^{0}C	----	----	28^{0}C
2.	Turbidity	NTU	5	10	17
3.	Calcium	mg/l	75	200	120
4.	Magnesium	mg/l	30	150	82
5.	pH value	-	6.5 to 8.5	No relaxation	7.8
6.	Total hardness(as $CaCO_3$)	mg/l	300	600	212
7.	DO	mg/l	2	6	6
8.	BOD	mg/l	3	6	3.6
9.	COD	mg/l	3	No relaxation	21.6
10.	TDS	mg/l	500	2000	452
11.	Chlorides	mg/l	250	1000	5.8
12.	Total alkalinity	mg/l	200	600	25.5
13.	EC	µmohs/cm	250	750	480

HDL: Highest Desirable Limit, MPL: Maximum Permissible Limit

Table 4: Water analysis of sample 4: near old bridge

S. No.	Parameters	Units	Drinking water WHO standard		Experimental values
			HDL	MPL	
1 .	Temperature	^{0}C	----	-----	22
2 .	Turbidity	NTU	5	10	18.5
3.	Calcium	mg/l	75	200	110
4.	Magnesium	mg/l	30	150	136
5.	pH value	-	6.5 to 8.5	No relaxation	7.6
6.	Total hardness(as $CaCO_3$)	mg/l	300	600	246
7.	DO	mg/l	2	6	6
8.	BOD	mg/l	3	6	3.6
9.	COD	mg/l	3	No relaxation	18.2
10.	TDS	mg/l	500	2000	455
11.	Chlorides	mg/l	250	1000	6.8
12.	Total alkalinity	mg/l	200	600	26.7
13.	EC	µmohs/cm	250	750	573

HDL: Highest Desirable Limit, MPL: Maximum Permissible Limit

Conclusion:

From the present study we conclude that Ganga and Yamuna water is most probably not fit for drinking and its need to be treated. To minimize the contamination of Ganga and Yamuna river water at Allahabad city, the values obtained had their significance level will help in selecting the proper experimental method used for treatment of water.

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