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Assessment of Physicochemical Properties of Yamuna River in Agra City

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Abstract: The present study was carried out to determine the physico-chemical properties of Yamuna River water from nine different sampling sites in Agra City. River water samples were collected from nine locations (viz Runkata, Naire Ghat, Kailash Mandir, Pohiya Ghat, Balkeshwar, Rambagh, Etmad-ud-daula, Hathi Ghat and Tajganj) of Agra City, during the months of March and April, 2011 and River water samples were taken to the laboratory and analyzed. The analysis was done for the parameters like Turbidity, pH, Total Dissolved Solids, Electrical Conductivity, Total Hardness, Total Alkalinity, Chloride, Calcium and Magnesium. pH shows that Yamuna River water is alkaline in nature. Turbidity and Total Dissolved Solids was found above the WHO permissible limits.
Keywords: Yamuna, river, physicochemical, water.

Introduction

Water is the most essential and prime necessity of life. It is an essential requirement for the life supporting activities. Surface water generally available in Rivers, Lakes, Ponds and Dams is used for drinking, irrigation and power supply etc. The usual source of drinking water is from streams, rivers, wells and boreholes which are usually not treated[1]. Quality of water generally refers to the component of water, which is to be present at the optimum level for suitable growth of plants and animals. Aquatic organisms need a healthy environment to live and have adequate nutrients for their growth. The productivity depends on the physicochemical characteristics of the water body. The maximum productivity obtained when the physical and chemical parameters are at optimum level[2].

The Yamuna is the largest tributary river of the Ganges (Ganga) in northern India, originating from the Yamunotri Glacier at a height 6,387 meters on the south western slopes of Banderpooch peaks. The cities of Delhi, Mathura and Agra lie on its banks. Yamuna is one of the most polluted rivers in the world. Agra is situated in western U.P. between 27.11' degree Latitude North and 78.0' degree to 78.2' degree Longitude East. Its Altitude is 169 meters above sea level. The objective of this study is to investigate the physicochemical properties of Yamuna River in Agra City.

Sample Collection

Water samples from selected sites were collected during the months of March and April, 2006. The samples were collected from the surface water of the River in pre-cleaned polyethylene bottles.

Physico-Chemical Analysis

The collected samples were analyzed for major physical and chemical water quality parameter like pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Alkalinity (TA), Total Hardness (TH), Chloride (Cl^-), Calcium (Ca^{++}), Magnesium (Mg^{++}), Sodium (Na^+) and Potassium (K^+). The Chemical analysis was carried out the following the methods by Trivedy and Goel (1986)[3] and standard methods of APHA (1995)[4].

Result and Discussion

The average results of the physicochemical parameters for water samples are presented in **Table-1.**

pH

pH is the scale of intensity of acidity and alkalinity of water and measures the concentration of hydrogen ions. The pH of water samples ranged between 7.3-7.7. The pH of water samples is slightly alkaline and found within the limit prescribed by World Health Organization.

Electrical Conductivity

Conductivity is the measure of capacity of a substance or solution to conduct electrical current through the water. EC values were in the range of 990µmhos/cm to 1285µmhos/cm. High EC values indicating the presence of high amount of dissolved inorganic substances in ionized form.

Total Dissolved Solids

TDS indicates the general nature of salinity of water. Water with high TDS produces scales on cooking vessels and boilers. The TDS values varied from 705 mg/l to 785 mg/l. The TDS values was found within the limits prescribed by IS 10500-91.

Total Alkalinity

Total Alkalinity is the measure of capacity of water to neutralize the acids. Alkalinity increases as the amount of dissolved carbonates and bicarbonates increase[5]. Alkalinity level varied from 175 mg/l to 310 mg/l in the Yamuna River. Total Alkalinity value for all the investigated samples except S1 and S2 were found to be greater than the limit prescribed by IS 10500-91.

Turbidity

The turbidity in water is mainly caused by sand, silt, clay, phytoplankton, microorganism or organic material suspended or dissolver in it. The turbidity values varied between 9.9 NTU to 33.7 NTU. The turbidity values for all the investigated samples were found to be greater than the value prescribed by WHO[6].

Total Hardness

Waters become hard primarily due to excessive presence of bicarbonate, chloride and dissolved sulphate in water primarily[2]. Total Hardness values ranged from 252 mg/l to 304 mg/l and found within the permissible limit of WHO. According to some classification, water having hardness upto 75 ma/l is classified as soft, 76-150 mg/l is moderately soft, 151-300 mg/l as hard and more than 300 mg/l as very hard[11]. On the basis of classification the selected water samples of Yamuna River can be considered as moderately soft except the sample S4.

Chloride

Chloride concentration in water indicates presence of organic waster particularly of animal origin[7]. Chloride concentration varied from 180 mg/l to 218 mg/l. All the samples were found within the permissible limit prescribed by WHO.

Calcium and Magnesium

The sources of Ca and Mg in natural water are various types of rocks, industrial waste and sewage. There is a evidence that hard water plays a role in heart diseases. Higher concentration of Mg makes the water unpalatable and act as laxative to human beings[8]. The calcium concentration was ranged from 72.8 mg/l to 86.4 mg/l and magnesium concentration was ranged between 13.6 mg/l to 24.3 mg/l.

Sodium

The major source of sodium in natural fresh waters is the weathering of various rocks. Many industrial waste and domestic sewage are rich in sodium increase its concentration in natural waters after disposal[9]. The value of sodium was varied between 404.9 mg/l to 524.0 mg/l.

Potassium

In the present investigation, the potassium concentration was ranged between 18.1 mg/l to 23.8 mg/l.

Statistical analysis

Interrelationship studies between different variables are very helpful tools in promoting research and opening new frontiers of knowledge. The study of correlation reduces the range of uncertainty associated with decision making[10]. The correlation co-efficient 'r' was calculated to know the Relationship in between and among the parameters by using the following formula-

$$r = \frac{N\sum(XY) - (\sum X).(\sum Y)}{\sqrt{[N\sum X2 - (\sum X)2][N\sum Y2 - (\sum Y)2]}}$$

Where, X and Y represents two different parameters, N= Number of total observation.

Table-1: Average results of the physicochemical parameters

S. No	Parameter	Sampling Points									WHO (1993)	IS 10500-91
		S1	S2	S3	S4	S5	S6	S7	S8	S9		
1.	pH	7.4	7.3	7.3	7.5	7.5	7.7	7.6	7.5	7.5	-	6.5-8.5
2.	EC	990	1215	1275	1130	1090	1170	1080	1285	1165	250	-
3.	TDS	710	740	783	710	715	785	705	750	770	-	500
4.	Turbidity	20.6	9.9	11.2	14.4	12.0	12.2	15.7	33.7	11.1	Less than 5	10
5.	TA	194	175	300	242	242	290	268	310	272	-	200
6.	TH	260	254	304	266	266	282	252	278	272	150-500	300
7.	Cl^-	180	187	218	194	188	202	180	204	204	250	250
8.	Ca^{2+}	75.2	78.4	81.6	82.4	83.2	80.8	72.8	79.2	86.4	-	75
9.	Mg^{2+}	17.5	14.1	24.3	14.6	18.8	20.7	17.0	19.4	13.6	-	30
10.	Na^+	407.2	409.4	470.0	419.9	419.4	449.9	404.9	524.0	419.9	200	200
11.	K^+	18.9	18.1	21.7	19.1	18.7	21.6	19.1	23.8	19.7	-	-

All parameters are in mg/l except pH, EC and Turbidity. EC in µmhos/cm, Turbidity in NTU

Table-2: Matrix of correlation among water quality parameter

Parameter	pH	EC	TDS	Turb.	TA	TH	Cl^-	Ca^{2+}	Mg^{2+}	Na^+	K^+
pH	1										
EC	-0.240	1									
TDS	0.002	0.697	1								
Turbidity	0.109	0.142	-0.165	1							
TA	0.442	0.528	0.550	0.293	1						
TH	-0.113	0.626	0.781	0.003	0.700	1					
Cl^-	-0.117	0.792	0.853*	-0.009	0.716	0.933*	1				
Ca^{2+}	-0.018	0.356	0.491	-0.332	0.271	0.469	0.614	1			
Mg^{2+}	-0.009	0.336	0.450	0.139	0.576	0.772	0.532	-0.059	1		
Na^+	0.026	0.749	0.519	0.656	0.718	0.670	0.689	0.157	0.582	1	
K^+	0.202	0.671	0.608	0.606	0.824	0.716	0.715	0.121	0.628	0.959*	1

It can be seen from Table-2, the high positively correlated values were found between chloride and total hardness (0.933), Potassium and Sodium (0.959) while the low negatively correlated values were found between Calcium and pH (0.018), Magnesium and pH (-0.009), Chloride and Turbidity (-0.009) and Magnesium and Calcium (-0.059). Total Alkalinity, Sodium and Potassium are positively with all parameters. However pH is partially positively and partially negatively correlated with all parameters.

Conclusion

This study assessed the physicochemical properties of Yamuna River water from nine different locations (viz. Runkata, Naire Ghat, Kailash Mandir, Sikandra, Balkeshwar, Rambagh, Etmad-ud-daula,Hathi Ghat and Tajganj) of Agra city, during the months of March and April 2011. The analysis was carried out by taking certain important parameters like pH, electrical conductivity, total dissolved solids, turbidity, toal alkalinity, total hardness, chloride, calcium, magnesium, sodium and potassium.

In the present investigation, it was found that the maximum parameters were at the level of pollution except few parameters like pH, total hardness and chloride. Thus the study indicated that the Yamuna River in Agra city was highly polluted and unsafe for human use for the sampling time.

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