Physico-chemical Studies of Water of River Yamuna at Mathura

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Physico-chemical characteristics of water of river Yamuna were studied from Jaisinghpura to Kachahari Ghat (a stretch of 6 km.) at Mathura. The duration of study was from April, 2002 to June 2002. Three sampling stations were selected for study The parameters under study were temperature, pH, turbidity, chloride, sulphate, total hardness, total alkalinity, total dissolved solids and metals like Cr, Fe, Cd, Pb, Ni, Mn, Zn and Cu. The concentrations of parameters like turbidity, chloride, sulphate, total hardness, TDS, Cr, Cd, Ni, Mn, Cu and Zn were found beyond the tolerance limits.

Key Words: Mathura, Turbidity, Alkalinity, TDS, Heavy metals.

INTRODUCTION

Due to increasing industrialization, urbanization and other developmental activities, most of our water bodies such as ponds, lakes, streams and rivers have become polluted. Today many rivers receive millions of litres of industrial effluents, sewage, domestic waste, agricultural and land drainage, etc. These effluents cause degradation of water quality[1].

Metallic industries include those which are mainly related with copper, brass, zinc and nickel. Besides these industries, there are a number of unauthorized domestic small scale units working in the narrow streets of the city. All these industries use toxic and non-biodegradable chemicals. All the waste including these chemicals is dropped into the river Yamuna, through a number of drains.

A quantitative study of the physico-chemical condition of river Yamuna at Mathura is quite essential[2,3]. The study of water quality of various rivers in India have shown remarkable pollution level[4–14].

EXPERIMENTAL

Water samples were collected in pre-cleaned polythene containers and preserved according to standard methods[15] at monthly intervals from the selected sampling sites (R_1, R_2 and R_3) between 9 a.m. to 12 a.m. from April 2002 to June 2002 and brought to the laboratory for various physico-chemical analysis. Temperature was measured at the sampling spot by Celsius thermometer. BDH/AR grade reagents, doubly distilled water and borosil glasswares were used

throughout this work. pH and turbidity were measured by digital pH-meter (type-335) and digital nephelo-turbidity meter (type-132) respectively. Chloride was estimated by volumetric titration with $AgNO_3$. Sulphate was estimated by UV-Vis spectrophotometer (type-11). Total hardness was determined by volumetric titration (EDTA method). Alkalinity was determined by volumetric titration. TDS was estimated by digital TDS meter (METZ-701). Metals were estimated by atomic absorption spectrophotometer (AAS) with a Perkin-Elmer model-2380 instrument using Perkin-Elmer hollow cathode lamp as light source. For digestion and preconcentration of water samples standard methods[16-18] were followed.

RESULTS AND DISCUSSION

Results obtained during the analysis have been given in Tables 1 and 2. The temperature of sampling stations ranged between 28–31.5°C. The pH ranged between 7.5 to 8.6 showing slightly alkaline nature of river water. The higher value of pH is probably due to soap industries. Turbidity is one of the most common forms of pollution. Turbid water interferes with self-purification of streams by reducing photosynthetic activity of aquatic plants. The turbidity ranged between 130 to 170 NTU. The chloride contents ranged between 301 to 360 mg/L. The concentration of chloride was beyond the tolerance limit. High chloride content has deleterious effect on animals as well as on aquatic plants.

The concentration of sulphates ranged between 171 to 332 mg/L. Its concentration at all the sites was beyond the permissible limit. Alkalinity is an important parameter involved in corrosion control. Alkalinity was found to be in the range of 125 to 185 mg/L. Hardness of water is an important parameter in determining the suitability of water for domestic and industrial uses. Total hardness was found in the range of 490 to 539 mg/L. The values of TDS were found in the range of 808 to 945 mg/L.

Chromium was estimated in the range of 0.089 to 0.218 mg/L. Its maximum concentration was estimated at R_3 in the month of June. It is a carcinogenic, tetratogenic and mutagenic element. The values of Fe varied between 0.0352 to 0.0640 mg/L. Its maximum concentration was estimated at R_3 in the month of June. Cadmium, lead and nickel were reported in the range of 0.061 to 0.081 mg/L, 0.058 to 0.095 mg/L and 0.179 to 0.339 mg/L respectively. These metals are carcinogenic in nature. Manganese was reported in the range of 0.095 to 0.114 mg/L. Its maximum concentration was estimated at R_3 in the month of June. The concentrations of zinc and copper were reported to be 4.428 to 5.792 mg/L and 1.609 to 1.813 mg/L.

Conclusions

The parameters like turbidity, chloride, sulphate, total hardness, TDS and the concentration of metals like Cr, Cd, Ni and Cu were found beyond the permissible limit. The concentration of Mn at R_2 and R_3 and the concentration of Zn at R_3 in all the months were beyond permissible limit[19, 20].

The data showed severe pollution in the river which was probably due to sewage, garbage and large number of small and large scale industries working in Mathura city.

TABLE-1

PHYSICO-CHEMICAL PARAMETERS OF YAMUNA RIVER WATER (for the year 2002)

	Temp. (°C)			pH			Turbidity (N.T.U.)			Chloride (mg/L)			Sulphate (mg/L)			Total hardness (mg/L)			Total alkalinity (mg/L)			TDS (mg/L)		
	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3
April	28.0	28.1	28.0	8.6	7.8	7.7	130	132	135	301	300	302	171	285	290	490	498	512	125	132	159	808	845	890
May	28.5	28.6	28.6	8.1	7.9	7.6	145	140	150	318	327	345	185	305	323	510	520	527	140	139	170	840	855	940
June	31.0	31.5	31.4	8.5	7.8	7.5	167	170	172	329	338	360	192	311	332	520	530	539	148	160	185	845	861	945

TABLE-2

METAL CONCENTRATION IN YAMUNA RIVER WATER (for the year 2002)

	Chromium (mg/L)			Iron (mg/L)			Cadmium (mg/L)			Lead (mg/L)			Nickel (mg/L)			Manganese (mg/L)			Zinc (mg/L)			Copper (mg/L)		
	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3
April	0.089	0.139	0.201	0.035	0.041	0.059	0.061	0.068	0.075	0.058	0.077	0.089	0.179	0.255	0.315	0.095	0.102	0.106	4.438	4.580	5.230	1.609	1.779	1.625
May	0.092	0.152	0.212	0.036	0.046	0.062	0.063	0.071	0.078	0.062	0.078	0.091	0.182	0.259	0.319	0.098	0.104	0.109	4.451	4.591	5.629	1.721	1.782	1.762
June	0.109	0.160	0.218	0.035	0.048	0.064	0.066	0.073	0.081	0.067	0.085	0.095	0.211	0.278	0.339	0.099	0.109	0.114	3.481	4.689	5.792	1.762	1.785	1.813

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