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The Physico-Chemical Study of Heavy Metals in Water of Yamuna River

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Abstract

The pollution of water bodies with heavy metals has become a worldwide problem. The concentration of heavy metals- Copper (Cu), Chromium (Cr), Iron (Fe), Lead (Pb), Mercury (Hg), Nickel (Ni), and Arsenic (As) in the water of Yamuna River at Agra to Etawah and its adjacent areas, according to their pollution potential in the river water were determined. Perennial sources for the release of the heavy metals in the Yamuna river are- (1) Industrial discharge, (2) House wastes discharge (3) Sewage discharge, etc. Their effect has been carried out on various physiological responses of fishes living in the river ecosystem. The data showed that there was notable variation in the concentration of heavy metal from one sample area to another, which may be due to variation in the quality of sewage and industrial discharge. A river water samples collected from Agra to Etawah was also analyzed for Total hardness which is caused by CaCO_3 along with the potassium and sulfate. It was found that the hardness of water gradually increased from Agra to Etawah.

Keywords- Hazardous, Toxicity, Correlation etc.

Introduction-

As a result of disturbances created by humans on rivers, the pollution levels in river water have significantly increased. Numerous studies^{1,2,3} have been conducted for testing the presence of heavy metals in Yamuna River.

Sharma et al.⁴ carried out an extensive study to assess the physico-chemical characteristics of Yamuna water at Agra. **Bhargava**⁵ conducted a detailed study to find out the water quality index of the Yamuna river.

Mathur and co-workers⁶ have described the pollution of the Ganga river near Varanasi due to seven heavy metals-Cd, Cu, Cr, Ni, Mn, Pb and Zn. **Romani et al.**⁷ have investigated the contents of heavy metals in aquatic environment of Kali River which receives a huge amount of industrial effluents. **Tomar and Upadhyay**⁸ carried out an extensive survey about the current scenario of Pollution in River Yamuna in terms of heavy metals.

Agra stretch of River Yamuna has been under study for quiet sometime. In number of studies for evaluating the water quality of the river have been carried out in the past.

n view of the above mentioned facts the present investigation entitled “The Physico-chemical study of Heavy Metals in water of Yamuna River” from Agra to Etawah with special help of some important physical, chemical and biological parameters was undertaken. After initial survey of Yamuna River we selected some sample points as given below:

Site 1- Agra (Near Taj) (Downstream)

Site 2-Firozabad

Site 3- Bateshwar

Site 4- Etawah (Upstream)

Materials and methods-

Sampling was done in a well-planned manner of Quarterly intervals. Sample from the river was collected in, two liter plastic bottles, in duplicate, one for physico-chemical analysis and other for the analysis of Heavy metals. To establish correlation between various Physico-chemical parameters of different sites including Trash metals present in river water.

The physico-chemical constituents have been carried out following standard methods of Indian standard; 3025, 1964, eleventh reprint, April 1999.

- 1- SO_4^{-2} ; Methods given in part number IS: 3025-1964, eleventh reprint April 1999, page 26.
- 2- Cr; Methods given in part number IS: 3025-1964, eleventh reprint April 1999, page 67.
- 3- Fe; Methods given in part number IS: 3025-1964, eleventh reprint April 1999, page 51.
- 4- Cu; Methods given in part number IS: 3025-1964, eleventh reprint April 1999, page 62.
- 5- Pb; Methods given in part number IS: 3025-1964, eleventh reprint April 1999, page 63
- 6- As; Methods given in part number IS: 3025-1964, eleventh reprint April 1999, page 73
- 7- Ni; By A.A.S. method given part number 3500 APHA(1995) 19th edition Page 3-81, with 232 on wavelength. Air acetylene oxidizing flame and 0.02mg/l detection limit.

Results and Discussions-

The quality parameters apart from indicating the acceptability indicates the level of pollution and state of prevailing environment the extent of pollution indicates the presence of various undesirable organic and inorganic substances. The contribution of heavy metals in this regard assumes great significance. The bio-availability and toxicity of heavy metals will depend on their chemical form. The metal species in the water to a large extent were determined by the presence of various organic and other

quality parameters. The average maximum and minimum values of various heavy metals are presented in table 1. We have taken data of only 1 year, 2019; the detailed data is given in tables. The metals like Pb, Hg, Cr, Co, Fe, Ni, Cu, As, have been identified as the most hazardous pollutant, owing to their tendency to accumulate in food chain through which they ultimately reach the human system⁹. We have found accumulation of certain heavy metals in harmful concentration in sites of River Yamuna.

1-Chromium: The concentration of chromium in Yamuna river water at site 1, site2, site3, site4 were 0.02,0.04,0.052,0.014 mg/L respectively.

2-Iron: The concentration of Iron in Yamuna river water at site 1,site2,site3,site 4 were 0.36,0.42,0.27,0.54 mg/L respectively.

3-Nickel:The concentration of Nickel in Yamuna river water at site 1,site2,site3,site 4 were 0.013,0.019,0.012,0.002mg/L respectively.

4- Copper:The concentration of Copper in Yamuna river water at site 1, site2, site3, site 4 were 0.011,0.017,0.026 ,0.029mg/L respectively.

5-Lead:The concentration of Lead in Yamuna river water at site 1,site2,site3,site 4 were 0.089,0.065,0.076,0.044mg/L respectively.

6-Arsenic:The concentration of Arsenic in Yamuna river water at site 1,site2,site3,site 4 were 0.003,0.011,0.022,0.005mg/L respectively.

Table 1: Physico-chemical characteristic and heavy metal concentration(Unit- mg/L) in Yamuna River Water .

Duration A in 2019

Sample	pH	DO	Fe	Cd	Cr	Ni	Cu	Pb	As
Site 1	7.6	3.24	0.36	0.08	0.02	0.013	0.011	0.089	0.003
Site 2	7.8	4.56	0.42	0.06	0.04	0.019	0.017	0.065	0.011
Site3	7.3	5.2	0.27	0.15	0.052	0.012	0.026	0.076	0.022
Site 4	7.9	4.82	0.54	0.32	0.014	0.002	0.029	0.044	0.005

Table 2: Physico-chemical characteristic and heavy metal concentration(Unit- mg/L) in Yamuna River Water .

Duration B in 2019

Sample	pH	DO	Fe	Cd	Cr	Ni	Cu	Pb	As
Site 1	7.1	4.74	0.15	0.004	0.16	0.009	0.062	0.029	N.D.
Site 2	7.6.	7.2	0.12	0.009	0.03	N.D.	0.011	0.038	0.004
Site3	7.3	6.88	0.18	0.046	0.018	0.017	0.02	0.060	0.002
Site 4	7.7	4.15	0.26	0.068	0.009	0.013	0.009	0.007	N.D.

Table 3: Physico-chemical characteristic and heavy metal concentration (Unit- mg/L) in Yamuna River Water .

Duration C in 2019

Sample	pH	DO	Fe	Cd	Cr	Ni	Cu	Pb	As
Site 1	6.8	6.76	0.15	0.075	0.062	0.008	0.060	0.034	0.001
Site 2	7.6	5.2	0.20	0.032	0.084	0.021	0.030	0.033	0.016
Site3	8.2	6.82	0.35	0.001	0.023	0.003	0.014	0.082	0.001
Site 4	7.3	7.22	0.66	N.D.	0.025	0.004	0.031	0.062	0.003

Table 4: Physico-chemical characteristic and heavy metal concentration(Unit- mg/L) in Yamuna River Water .

Duration D in 2019

Sample	pH	DO	Fe	Cd	Cr	Ni	Cu	Pb	As
Site 1	6.9	4.11	0.32	0.014	0.007	0.01	0.20	0.16	0.002
Site 2	7.3	6.9	0.30	0.020	0.009	N.D.	0.10	0.08	0.03
Site3	8.2	5.2	0.81	0.090	0.018	0.02	0.12	0.03	0.001
Site 4	7.6	6.5	0.80	0.066	0.002	0.01	N.D.	0.04	N.D.

Conclusion-

In the evaluation of water toxicity of the river with regard to the heavy metals dispersion, prime importance is given to the dissolved metal concentration. Like the total metal concentration, dissolved concentration of the metals is also found to get reduced in downstream, due to dilution by uncontaminated surface water, sorption, sedimentation processes and bioaccumulation. Toxic zones in the river as regards to the metal description have been evaluated. The water toxicity with regard to total metal load depends upon the other factors such as hardness and DO levels of the water.

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