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RESEARCH ARTICLE

Effect of heavy metals on aquatic life in Gangan River at Moradabad, Uttar Pradesh, India

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Abstract

Moradabad is brass city of India. A number of brass industries are situated near Gangan River and are continuously discharging their effluents into the river. In this paper an effort is made to analyse the effect of industrial effluents on the aquatic life. After the detailed analysis of results it was revealed that among the three metals chromium, copper and nickel, chromium is most toxic. It also observed that the toxicity effect increases in mixed solvent system as compared to individual metal because survival rate is very low in mixed solvent. The study also indicates that toxicity is high at the point of metal discharge and it will decrease continuously when we move faraway from discharge point. As all the above metals are present in industrial waste in Moradabad and are continuously accumulating in Gangan River, they have pollute the river water severely and have severe toxic effect on aquatic life in the river

INTRODUCTION

Due to industrialization, the number of factories and population has increased rapidly. Heavy metals widely used in various industries and considered as common water pollutants. Sewage and industrial disposal has greatly increased the addition of heavy metals in the aquatic ecosystems. When the amount of heavy metals in a medium, reach to more than a certain limit, it becomes toxic[1].The toxic effects of heavy metals have been reviewed, including their bioaccumulation by several workers [2-3]. The pollution of the aquatic environment with heavy metals has become a worldwide problem during recent years, because they are indestructible and most of them have toxic effects on organisms.

Heavy metals have the tendency to accumulate in various organs of aquatic organisms, especially fish. Heavy metals also have toxic effects even at places away from the source of pollution as they have the ability of biological accumulation [4]. That is why knowledge regarding the toxicity of heavy metals to aquatic organisms is of paramount importance [5]. This problem has become more complex because of the non-degradability of the inorganic pollutants .Metal ions of high toxicity cause deleterious impact on fish [6-7]. Hexavalent chromium is mobile in the environment and is acutely toxic, mutagenic, teratogenic and carcinogenic to aquatic organisms [8]. Copper (Cu) and Zinc (Zn) that are often present in industrial wastewaters are hazardous to the aquatic ecosystem. The effects of metals on aquatic organisms have been the subject of numerous investigations [9-11].

Moradabad city in Uttar Pradesh, India is famous for Brass Metal Handicrafts not only in India but also in abroad since ancient times. This city is situated in western U.P. between 28°-21´ to 28°-16´ Latitude North and 78°- 4´ to 79 Longitude East. Presently it is an Industrial and Commercial city. Ram Ganga River flows in the north east and Gangan River is there in south west of the city. The brass industry in Moradabad is regularly discharging the effluents into the river Gangan. River Gangan receives almost all the domestic and industrial effluents of Moradabad city. The water of river Gangan is highly polluted by direct contamination of sewage and industrial effluents. The quality of water in Gangan River is highly deteriorated as copper, chromium & nickel compounds are the main constituent of effluent of brass industry [Fig. 1-2].

Pollution of the aquatic environment with heavy metals has become a serious health concern in recent years. Increased discharge of heavy metals into natural aquatic ecosystems can expose aquatic organisms to unnaturally high levels of these metals. Among aquatic organisms, fish cannot escape from the detrimental effects of these pollutants. The fish as a bio-indicator species plays an increasingly important role in the monitoring of water pollution. Fishes are very good biosensors of aquatic contaminants .The sudden death of a fish indicate heavy pollution. Elements like arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc exhibit toxicity effects on aquatic organisms [12]. Several species of fishes are thriving in such water bodies hence their conservation is essential.

The river water has also rendered unsafe for fishes as well as for domestic consumption, irrigation, and other needs particularly consumption by cattle and other domestic animals. This attracted a lot of attention as another aquatic ecosystem may get damaged and have the same fate as the reservoir.

So, in the present work we have identified the presence of Heavy metals in the industrial effluents of river Gangan. To assess the toxic effect of industrial effluent on aquatic life a toxicity assessment has done using fishes.

MATERIALS AND METHODS

The samples collected at two different sites.

Site-1: This site is just below the Gangan Bridge at NH -24 Delhi roads. At the site there is a large drainage (Nala) in which domestic discharge and near by industries are discharging their effluents directly into the Gangan river. The samples of effluents collected before mixing into the river.

Site- 2: This site is nearly 2 Km from site 1.At this site sample of river water mixed with industrial effluent and domestic discharge are collected.

Sampling sites are shown in Fig. 3. All the samples are collected using standard procedure of sampling [13]. All the samples tested for the concentration of Cr, Cu and Ni using Atomic Absorption spectrophotometer .Site wise concentration of different metals are presented in table 1.

The toxicity test on these samples were conducted using fishes. Fishes were acclimatized to the laboratory conditions for one week using diluents water prepared in the laboratory [14]. The fish fed daily with a commercial food (crude lipid 8.0%, crude protein 30%, carbohydrate 46%, ash 8.5% and moisture 8%) . The D.O. of the diluents water kept between 4.5-5.0 mg/lit [15]. The pH, COD, alkalinity, Conductivity, hardness of the diluents water kept almost same as that of fresh river water. Different solution of effluent sample were prepared with diluents water (100%, 50%, 25%, 10%) and were taken separately in 5 lit capacity glass beaker and 6 acclimatized fishes were put in each beakers. The test conducted for 96 hrs continuously.

RESULTS AND DISCUSSION

The results obtained from all the experiments are presented in Table 2. As all the 6 fishes were transferred in the beakers containing Cr, Cu and Ni solution has concentration 100%, all the fishes died immediately in the Cr solution. Even in case of 10% concentration of metal sample of Cr, no fish survived after 48 hrs. It shows that the Cr is more toxic in comparison to Cu and Ni.

In the present experiment it is observed that in case of 50% concentration of metal in Cr ,Cu and Ni solution each , all the fishes died in 12 hr. duration in case of Cr ,while there is 83% and 50 % survival in case of Cu and Ni respectively even after 96 hr.

Similarly in case of 25% concentration of metal in Cr ,Cu and Ni solution each , all the fishes died in 48 hr. duration in case of Cr ,while there is 100% and 67 % survival in case of Cu and Ni respectively even after 96 hr.

Same results are obtained in case of 10% concentration of metal in Cr ,Cu and Ni solution each , all the fishes died in 48 hr. duration in case of Cr ,while there is 100% and 83 % survival in case of Cu and Ni respectively even after 96 hr.

Thus we see that Ni is more toxic than Cu and Cr is more toxic than Ni and Cu.

When all the three metal effluents mixed in 1:1:1 ,there was no survival of fish at 100% concentration and 50% survival at 50% concentration after transfer of the fishes in effluents immediately. There was also no survival in case

of 25% concentration & 10% concentration after 48 hrs of transfer of the fishes to the effluent. Thus, the toxicity of the heavy metals has increased several times.

When the fishes are kept in river water with effluents as collected from site 2, the survival rate is found 83% and 67% in 48 hr. and 96 hr. respectively. As all the above metals are present in industrial effluents and are continuously accumulating in Gagan river water, polluting the river severely and having toxic effect on aquatic life of river.

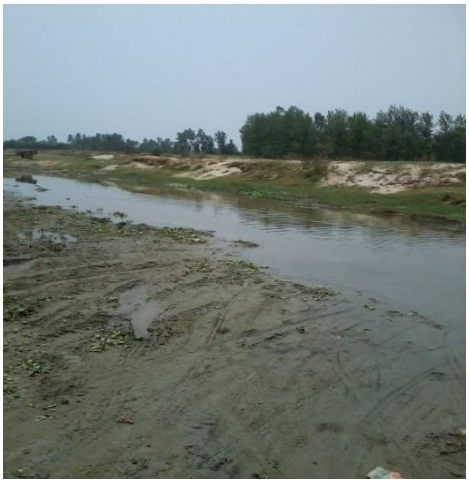

Fig. 1 : River Gangan at Moradabad

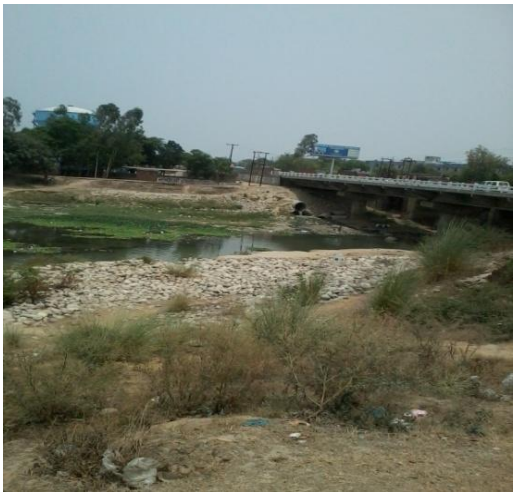

Fig. 2 : Effluent mixing in river from industry

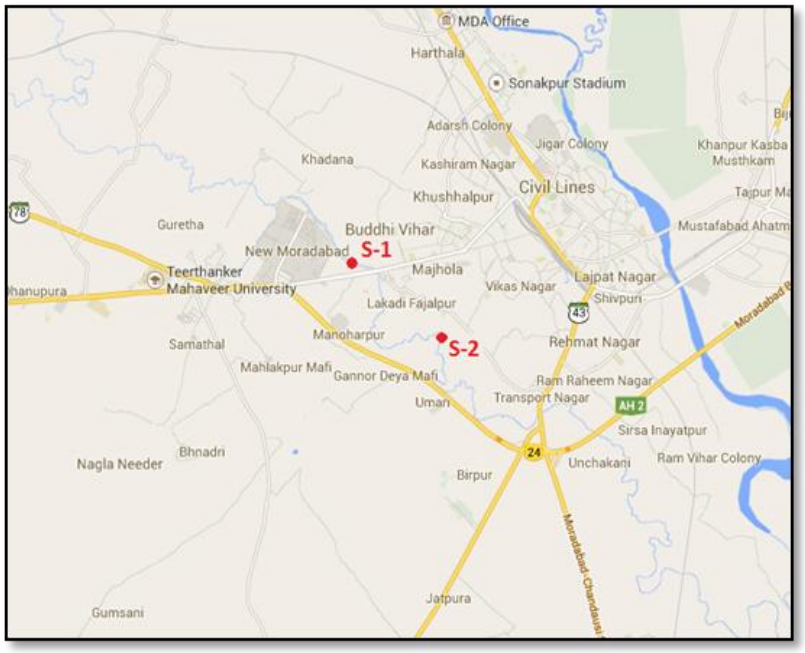

Fig. 3: Map of sampling site

Table 1: Site wise concentration of Cr, Cu and Ni **metals in industrial effluents mixing in Gangan river (mg/lit)**

Trace Metal	**At The Discharging Source** (Concentration in mg/l) Site S1	**After Mixing In River** (Concentration in mg/l) Site S2
Chromium	2.082	1.492
Copper	3.248	2.19
Nickel	1.03	0.39

Table 2: Survival rates of fishes at various concentrations

S.N.	**Solution**	**Concentration %**	**No. of Fish survived at different time interval**				
			0 Hr.	**12 Hr.**	**24 Hr.**	**48 Hr.**	**96 Hr.**
1.	**Diluents water**	**100**	**	**	**	**	**
2.	**Chromium** 2.082 mg/lit	**100**	**None**				
		50	**5**	**None**			
		25	**	**5**	**3**	**None**	
		10	**	**	**4**	**None**	
3.	**Copper** 3.248 mg/lit	**100**	**	**	**	**	**5**
		50	**	**	**	**	**5**
		25	**	**	**	**	**
		10	**	**	**	**	**
4.	**Nickel** 1.03 mg/lit	**100**	**	**	**4**	**3**	**None**
		50	**	**	**5**	**5**	**3**
		25	**	**	**	**4**	**4**
		10	**	**	**	**	**5**
5.	**All the metals combined (1:1:1)**	**100**	**None**				
		50	**3**	**None**			
		25	**	**4**	**2**	**None**	
		10	**	**	**4**	**None**	
6.	**River water with effluent**		**	**	**	**	**4**

****All survived**

CONCLUSIONS

It is clear from the above investigation that among three metals Cr is more toxic but When all the three metal effluents mixed in 1:1:1 ratio the toxicity of other two metals (Ni & Cu) have increased several times . As all the above metals are present in industrial waste in Moradabad and continuously accumulating in Gangan River, they have polluted the river water severely and have severe toxic effect on aquatic life in the river. It is also observed on the river site that some industries are discharging their effluents on some particular day and a number of fishes found dead on the bank of the Gangan River. The fishes in the Gangan River are not fit for eating also. Thus there is an acute need of doing something seriously by the authorities to save the river Gangan. So government should intact laws which will ensure that industries make use of standard waste treatment plants for the treatment of their wastes before they are being discharged into water bodies. Industries should also be concerned about the environment and they should discharge their effluents by treating it properly as per the norms. Some monitoring programs should also be launched from time to time in order to check water quality status, and to restore it for the welfare of society and to protect the natural environment.

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