Nature Environment and Pollution Technology © Technoscience Publications	Vol. 6	No. 4	pp. 609-613	2007

STUDIES ON PHYSICO-CHEMICAL CHARACTERISTICS AND HEAVY METALS IN KELO RIVER ALONG CITY STRETCH IN RAIGARH, CHATTISGARH

Brajesh K. Shrivastava and Masood Alam
Environmental Chemistry Division, Department of Applied Sciences and Humanities, Faculty of Engineering & Technology, Jamia Millia Islamia, New Delhi-110 025, India

ABSTRACT

The present investigation was undertaken to study the limnology of Kelo river at five locations in Raigarh and the effect of domestic sewage and industrial effluents on the physico-chemical conditions of the river water.In the stretch of river under study, it was found that the water quality in premonsoon near old palace ghat is above maximum permissible limit for some heavy metals. However, water quality at same sampling points was found above maximum desirable limit but below maximum permissible limit in postmonsoon season. It was found that drains are adversely affecting quality of river water along the stretch of study as the waste is discharged into Kelo river without pretreatment. Irrigation water and surface run-off water from the surrounding farm lands also affect river water quality at some locations.

INTRODUCTION

Kelo river is an important tributary of Mahanadi. It is about 95 km long which finally merges into Mahanadi. Demand for adequate water supply in Raigarh district in Chattisgarh has steadily increased and is likely to increase further with rapid growth of population and industrial activities. The Raigarh city dwellers have been largely dependant on Kelo river for drinking water as it passes through the midway of city. Kelo river has served a major source of drinking water for city dwellers for years but sudden surge in population and industrial activities during last 10 years in Raigarh district have put severe pressure on Kelo river. Though there are many studies on river water pollution in various parts of India (Sinha 2004, Sharma & Pande 1999, Singh 1999, Aher et al. 2002), no study on the quality of Kelo river is available, hence the present study has been undertaken.

MATERIALS AND METHODS

Samples were collected from April 2005 to March 2006 with necessary precautions from different sections of the river at five sampling locations. The water samples were pretreated as per specifications and analyzed by standard methods (APHA, AWWA, WPCF 1985). The study starts from old Palace Ghat to area near jute mill covering about 2.5 km length. The stretch covers the critical zones of heavy pollution where various city drains and outlets from the factories fall into the river.

All chemicals used for the purpose of study were of analytical grade. Double distilled water was used for preparing reagents. All glasswares and other containers were thoroughly cleaned by soacking in detergents followed by chromic acid solution and then with distilled water several times. All samples were analysed in triplicate.

The samples were analysed for the physico-vhemical parameters as per BIS/Standard methods guidelines within stipulated time (APHA, AWWA, WPCF 1985). pH and TDS were determined using pH and TDS meter. Colour was measured using visual comparison method using standard

solution of potassium chloroplatinate in nessler cylinders of 100 mL capacity. Turbidity was measured by Nephelometer. Alkalinity, chloride, calcium and magnesium were determined titrimetrically. Iron, manganese, nitrate, nitrite, sulphate and aluminium were determined using spectrophotometer.

Metal ion concentration was determined by flame atomic absorption spectrometer using Perkin-Elmer Atomic Absorption Spectrophotometer (Model 3110) using air-acetylin flame (Nafde et al. 1998). Arsenic concentration in samples (acidified in the field to 1 % (v/v) HCl) were determined by hydride-generation-flame atomic absorption spectrometry. Using sodium borohydride, arsenic ions were reduced to arsenic hydride, transferred to a heated quartz cuvette with the aid of a current of inert gas, decomposed thermally, and the absorption of the atoms was measured in the beam of an atomic absorption spectrometer (Dhopte et al. 1999**).**

RESULTS AND DISCUSSION

Physico-chemical parameters of Kelo river at five sampling sites in premonsoon and postmonsoon seasons are presented in Table 1 and Table 2. The values have been compared with BIS specifications for drinking water (BIS 1991**)**. BIS has specified two types of limits for drinking water quality. These are :maximum desirable limit and maximum permissible limit in absence of suitable alternative sources.

The observed physico-chemical parameter values in sampling station-I were 6.9 and 7.1 for pH, 485 and 327 mg/L for TDS, 78 and 66 mg/L for chloride, 78 and 58 mg/L for alkalinity, 25 and 23 mg/L for calcium, 26 and 16 mg/L for magnesium, 2.4 and 0.4 mg/L for nitrate, and 5.6 and 18.8 mg/L for sulphate in premonsoon and postmonsoon seasons. For some heavy metal parameters water quality, however, at sampling station-I (near old palace ghat) in premonsoon is above maximum permissible limits. The values of iron, chromium, cobalt and nickel have been found to be 1.7 mg/L, 1.2 mg/L, 0.55 mg/L and 0.68 mg/L respectively. This might be due to effluent discharge from Nalwa sponge iron plant which is located within one km from Kelo river at Taraimal village. The effluents discharge seems to have concentrated along the stretch due to low water availability throughout the summer. In postmonsoon season, river water quality at sampling station-I was comparatively better. The values of iron and chromium were 0.65 mg/L and 0.03 mg/L respectively while cobalt and nickel were below the detection limits. The effluents are diluted in monsoon season when rainfall and surface run-off water reduce the heavy metal contents considerably.

Water quality starts deteriorating after sampling station-I. There are two drains which fall into Kelo river near sampling station-II. The drains carry domestic, municipal, agricultural and industrial effluents. Many parameters were found to be above specifications (either max. desirable limit or max. permissible limit) at sampling station-II due to untreated water from drains. pH was 8.9 in premonsoon, and 8.4 in postmonsoon season which is higher than specified limit of 6.5 -8.5. TDS were 2180 mg/L (above max. permissible limit of 2000 mg/L) in premonsoon season and 1420 mg/L in postmonsoon season. High values of chloride, nitrate and alkalinity indicate domestic and municipal pollution, while presence of heavy metals above specifications indicate that industrial effluents are also being discharged. BIS has not specified BOD and COD as drinking water quality parameters but these are considered useful indicators of water pollution nowadays**.** The higher is the value of BOD or COD, the higher is pollution. Maximum values of BOD and COD were found as 210 mg/L and 388 mg/L respectively.

Water quality at sampling stations-III and IV indicates significant reduction in pollution probably due to dilution. The effect is more pronounced in postmonsoon season as the volume of water

Table 1.Physico-chemical & heavy metal analysis of Kelo river water at five locations.

		(pre monsoon season)				
S.N.	Parameters	Sampling Locations				
		SPI	SP II	SP III	SP IV	SP V
1	pH	6.9	8.9	8.2	7.4	8.2
2	TDS	485	2180	1538	972	1730
3	Ca (as Ca)	25	131	104	100	115
4	Mg (as Mg)	19	119	83	65	81
5	Colour	agreeable	not agreeable	not agreeable	not agreeable	not agreeable
6	Odour	acceptable	unacceptable	unacceptable	unacceptable	unacceptable
7	Taste	agreeable	N.A.*	N.A.*	N.A.*	N.A.*
8	Turbidity	8	132	88	54	94
9	Cl^-	78	1097	476	317	990
10	NO_3^-	2.4	72.6	32.6	18.2	48.5
11	NO_2^-	BDL	0.14	0.006	0.01	0.12
12	SO_4^-	5.6	70	67.8	52	94.6
13	Alkalinity	56	412	369	227	266
14	DO	5.9	3.2	4.4	5.6	4.4
15	Oil & grease	BDL	2.2	0.6	0.05	1.2
16	Phenolic compound	BDL	0.24	0.05	BDL	0.04
17	Fluoride	0.42	1.6	1.2	0.24	1.2
18	BOD	4.8	168	107	132	210
19	COD	18.6	310	290	180	388
20	Fe	1.7	6.6	5.1	2.2	4.2
21	Mn	0.05	1.4	0.6	0.01	1.4
22	Cu	0.02	1.8	0.6	0.4	0.96
23	Cr	1.2	5.2	1.8	1.5	2.92
24	Pb	BDL	3.8	1.2	0.86	1.6
25	Zn	3.8	18.6	8.2	15.8	17.5
26	Al	0.01	0.84	0.25	0.16	0.52
27	Co	0.55	2.8	0.84	0.8	1.6
28	Ni	0.68	3.4	1.2	1.2	1.8
29	As	BDL	0.22	0.14	BDL	0.02
			* Not analysed due to coloured water			
			BDL = Below Detection Limit			

increases. Dissolved oxygen was present in sufficient quantity at sampling station-I (5.9 mg/L) in premonsson and 7.1 mg/L in postmonsoon, but after mixing with domestic and industrial wastes at sampling station-II, its content was depleted. It has been reported that solubility of dissolved oxygen in freshwater at 1 atm pressure ranges from 14.6 mg/L at 0°C to 7 mg/L at 25°C. At sampling stations-III and IV, there is significant increase in dissolved oxygen indicating reduction in pollution.

Analysis of water at sampling station-V indicates quality of water very much similar to sampling station-II. Again, there is an increase in all values compared to values at stations-III and IV. TDS, nitrate, nitrite, phenolic compounds, oil/grease and heavy metals like iron, cobalt, nickel and chromium were either above desirable limit or maximum permissible limits in both the seasons. The higher values of TDS suggest the presence of ionic species as pollutants. Exceptionally high value of alkalinity indicates the pollution due to sewage discharge into the river. Elevated values of chloride and nitrate indicate domestic and agricultural pollution. Although, when compared to the quality at

Table 2.Physico-chemical & heavy metal analysis of Kelo river water at five locations).

		(post monsoon period)				
S.N.	Parameters	Sampling Locations				
		SPI	SP II	SP III	SP IV	SP V
1	pH	7.1	8.4	7.5	7.2	7.2
2	TDS	327	1420	1160	623	1230
3	Ca(as Ca)	23	123	82	40	115
4	Mg(as Mg)	16	72	75	18	81
5	Colour	agreeable	not agreeable	not agreeable	not agreeable	not agreeeable
6	Odour	acceptable	unacceptable	unacceptable	acceptable	unacceptable
7	Taste	agreeable	N.A.*	N.A.*	N.A.*	N.A.*
8	Turbidity	12	132	88	54.6	94
9	Cl^-	66	590	346	206	990
10	NO_3^-	0.4	60.2	26	8.2	48.5
11	NO_2^-	BDL	0.04	0.08	BDL	0.42
12	SO_4^-	18.8	46	181	36	94.6
13	Alkalinity	58	328	227	170	266
14	DO	7.1	5.2	5.5	5.5	4.5
15	Mineral oil	BDL	0.42	0.08	0.01	BDL
16	Fluoride	0.26	0.82	0.45	0.08	1.2
17	BOD	0.8	138	102	40	110
18	COD	4.8	282	268	184	245
19	Fe	0.65	3.2	0.08	0.08	1.8
20	Mn	BDL	0.12	0.01	BDL	0.26
21	Cu	0.02	1.8	0.6	0.4	0.96
22	Cr	0.03	1.2	0.06	0.02	0.28
23	Pb	BDL	0.12	0.01	BDL	0.02
24	Zn	2.8	4.8	2.2	1.5	2.2
25	Al	0.01	0.84	0.25	0.16	0.52
26	Co	BDL	2.8	0.84	0.8	1.6
27	Ni	BDL	3.4	1.2	0.06	1.8
28	As	BDL	0.04	BDL	BDL	BDL
			* Not Analysed due to coloured water			
			BDL= Below Detection Limit			

sampling station-II, the values are low, but the quality of river water at this point is still unacceptable for drinking purpose. Adverse effects of heavy metals are well documented (Obodo 2001, Govil et al. 1998, Totawat et al. 1994, Gaete et al. 2000). Heavy metals can cause biochemical effects such as inhibition of enzymes, metabolic disorders, genetic damage, hypertension and even cancer.

CONCLUSION

It is evident that the river water is polluted due to effluent discharge and drains carrying polluted water. There is an urgent need for efficient drain management. Drain water should not be allowed to discharged directly into the river without pretreatment. Industrial effluents should not also be allowed to discharged in surface water without meeting Pollution Control Board norms.River water quality monitoring needs to be undertaken at regular interval to save this hilly river from further deterioration in quality especially at locations where peoples are largely dependant on river water. Too much application of pesticides in agrarian land also needs to be discouraged as irrigation water/

surface run-off water from the surrounding farm lands alongwith nitrate fertilizer also leads to deterioration of Kelo river water quality at some locations.

REFERENCES

APHA, AWWA, WPCF 1985. Standard Methods for the Examination of Water and Wastewater, 16th Edition, American Public Health Association, Washington DC.

Aher, H.R., Zinjad, D.G., Gunjal P.S. and Kuchekar, S.R. 2002. Impact of human activities on the quality of water in Pravara river and Pravara left bank canal.Chemical & Environmental Research, 11(1& 2): 101-104.

BIS 1991. Indian Standard for drinking water specification, IS 10500, Bureau of Indian Standards, New Delhi.

Dhopte, S.M., Muthal, P.L., Pandya, G.H. and Kondawar, V.K. 1999. Development of simple hydride generation technique for the atomic absorption determination of arsenic in environmental samples. Journal of IAEM, 26 (3): 150.

Gaete, H., Larrain, A., Bay-Schmith, E., Baeza, J. and Rodriquez, J. 2002. Ecotoxicological assessment of the pulp mill effluent, Biobio river basin, Chile. Bull. of Environmental Contamination & Toxicology, 65: 183-189.

Govil, P.K., Rao, Ganeshwar. and Krishna, A.K. 1998. Arsenic contamination in Patancheru industrial area, Medak district, Andhra Pradesh. Environmental Geochemistry, 1(1): 5-9.

Nafde, A. S., Kondawar, V.K. and Hasan, M.Z. 1998. Precision and accuracy control in the determination of heavy metals in sediment and water by Atomic Absorption Spectrophotometry. Journal of Indian Association for Environmental Management, 25(2): 83.

Obodo, G.A. 2001. Toxic metal in River Niger and its tributaries. Journal of Indian Association for Environmental Management, 28(3): 147-151.

Sinha, D. K. 2004. Level of some heavy metals in waters from Sai river at Rae Bareli, India for the premonsoon period and after the onset of monsoon. Pollution Research, 23(1): 113-116.

Sharma, S.D. and Pande, K.S. 1999. Pollution studies of River Ramganga at Moradabad: Determination of toxic substances. Chemical and Environmental Research, 8(1&2): 117-129.

Singh, B.N. and Rai Seema 1999. Physico-chemical studies of River Ganga at Varanasi. Journal of Environment & Pollution 6 (1).

Singh, Omkar., Rai, S. P. and Kumar, Vijay. 2002. Ground water quality assessment for irrigation in Jammu and Kathua districts, J & K. Jounal of Applied Hydrology, 15(2&3): 9-19.

Totawat, K., Upadhyay, R.N. and Chauhan, S.C. 1994. Effect of zinc smelter effluent on water, land and vegetation. Indian Journal of Environmental Health, 36(4): 237-247.