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STUDIES OF PHYSICO-CHEMICAL CHARACTERISTICS OF RIVER BETWA (M.P)

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Abstract: *The physico-chemical characteristics of water such as water temperature, Secchi transparency, pH, Dissolved Oxygen, Free CO_2, Total Alkalinity, Total hardness, Ammonical nitrogen were studied in Betwa River.. water temperature varied from 18.60^{o}C to 33.64 ^{0}C , Secchi transparency varied from 98 cm to 30.50cm, pH varied from 6.47 to 8.60, Dissolved Oxygen oxygen ranged from 4.53 mg/l to 8.10 mg/l, Free CO_2 ranged from 1.06 mg/l to 3.92 mg/l, Total Alkalinity ranged from 115mg/l to 235 mg/l, Total hardness varied from ranged from 184 mg/l to 393 mg/l and Ammonical nitrogen ranged from 0.40 mg/Ll to 1.12mg/l. The results obtained during the present study show that the physico-chemical nature of water of the river Betwa has been affected and the concentration of some of the constituents has crossed the permissible limit as recommended by WHO.*

Key Words: *physico-chemical characteristics, permissible limit, WHO.*

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INTRODUCTION:

Based on the discoveries of our satellites, it appears that water is a unique substance in our discovered universe. The presence of water on earth is in itself unique, for the planet earth has few natural liquids. Rivers are waterways of strategic importance across the world, providing main water resources for domestic, industrial, and agricultural purposes [1]. The maintenance of healthy aquatic ecosystem is depended on the physico-chemical properties and biological diversity. A regular monitoring of water bodies with required number of parameters with reference to the quality of water not only prevents the outbreak of diseases and occurrence of hazards but checks the water from further deterioration.

Betwa River or Vetravati is an important tributary of river "Yamuna", which in turn is a tributary of the river Ganga. It originates from southern part of Bhopal Plateau near Jhirri village and joins river Yamuna at Ghatampur near Hamirpur in Uttar Pradesh .The river Betwa plays a significant role in the human life of the villages located in Mandideep, Bhojpur and Raisen areas. It has become polluted at some places of Mandideep due to industrial activities and the confluence of sewage, domestic wastes and industrial effluents of many big and small enterprises with various types of organic compounds and heavy metals detrimental to human health and aquatic organisms. Urban areas, farms, factories and individual households – all contribute to the contamination of this river. The pollution affects the ecology of the river and carries undesirable vegetation and organisms. Moreover, the river has religious importance and its water is widely used for drinking, agricultural and power generation purposes. The water quality in the stretch of the river Betwa extending from its origin near Mandideep industrial area up to Bhojpur remains poor because of the regular inflow of domestic waste of the Bhopal city through the Kaliyasot river and industrial/domestic waters from Mandideep. The quality of the Betwa river water improves after Bhojpur due to the confluence of some smaller rivers like Ricahan, Dawar etc. flowing from the forest area located in the central part of the district. The average quality in the north-western part of the district, i.e. towards Vidisha District falls under a medium category with some patches of low quality attributed to the industrial/domestic contamination from isolated large Industries and scattered settlements [2]. Due to increased human population, industrialization, use of fertilizers in agriculture and man-made activity. The natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to water quality and depletion of aquatic biota. A powerful monitoring program is needed to provide reliable information about the current water quality. Therefore, keeping the same in view the present study was taken into consideration in which an attempt was made to access the water quality of River Betwa and it is believed that this study would be helpful in formulating control strategy in near future.

MATERIALS AND METHODS:

The water samples from the sampling sites were collected in 2 litre clean, marked, new plastic bottles, thoroughly washed with distilled water followed by washing with sample water. The water samples from four sites of the River Betwa were collected on monthly basis and were analyzed for detection of concentration of inorganic substances followed by standard methods [3, 4]. pH of the water was determined by electrometric method using a laboratory pH meter, before taking the readings the Ph meter was calibrated by using buffer solution of pH 4 and Ph 9.2. Temperature was recorded by using a mercury filled thermometer. The thermometer was shaded from the direct sun light while taking the readings and the results were expressed as oC. Secchi transparency was measured by the use of secchi disc having a diameter of 20 cm and alternate white and black quadrates. The disc was lowered in the water and the depth at which it disappears was noted. The disc was then raised slowly and the depth at which reappeared was noted .The average of these two measurement was considered as the limit of visibility. Conductivity was determined by electrometric method using a laboratory conductivity meter. The alkanity was examined by using phenolphthalein indicator. Dissolved oxygen was determined by iodometric azide modification method. While free Carbon dioxide was estimated by tetrameter method. The total hardness was determined by EDTA-titration method using Erichrome black T indicator. While Ammonical Nitrogen was estimated by Direct Nesslerisation method.

RESULTS:

The results obtained during the present study show that the physico-chemical nature of water of the river Betwa has been affected and the concentration of some of the constituents has crossed the permissible limit as recommended by WHO. Betwa River ranged from 6.47 to 8.60.The lowest value of PH was observed in sampling station no.1 in the month of March 2012 while the highest value of PH was seen in the sampling station no.4 in the month of Nov. 2012. Secchi Transparency reading of Betwa river ranged between 30.50cm to 98 cm. The lowest value of Secchi Transparency was observed in the sampling station no. 4 in the month of March 2012 and the highest value of Secchi transparency was observed in the sampling station no. 3 in the month Dec. 2013. The free CO_2 in various sampling stations in Betwa river ranged from 1.06 mg/L to 3.92 mg/L at sampling station no.4 in the month of Oct. 2012 and at sampling station no.1 in the month of May. 2013. The maximum water temperature was recorded 33.64 ^{0}C in the month of May 2013 in the sampling station

no.2 while the lowest temperature was observed 18.60°C in the month of December 2012 in the sampling station no.3. The total alkalinity value of Betwa river ranged from 115mg/L to 235 mg/L. The lowest value of total alkalinity was observed in the sampling station no.2 in the month of Oct. 2012 and the highest value of total alkalinity was observed in sampling station no.3 in the month of Oct. . The value of dissolved oxygen ranged from 4.53 mg/L to 8.10 mg/L. The lowest value of dissolved oxygen was observed in the sampling station no.1 in the month of may while the highest value of dissolved oxygen was seen in the sampling station no.4 in the month of sept.2012. Total hardness of Betwa river was observed to be of hard type as the total hardness ranged from 184 mg/L to 393 mg/L. The lowest value of total hardness was observed in the sampling station no.3 in the month of August.2012 and highest in the sampling station no.2 in the month of June . The ammonia nitrogen in Betwa river ranged from 0.40 mg/L to 1.12. The highest concentration was recorded in sampling station no.1 in the month of July and the lowest concentration of ammonia nitrogen was observed in sampling station no.4 in the month of Dec.

DISCUSSION:

The results obtained during the present study show that the physico-chemical nature of water of the river Betwa has been affected and the concentration of some of the constituents has crossed the permissible limit as recommended by WHO. At all the study sites the maximum water temperature was recorded 33.64 ^{0}C in the month of May in the sampling station no.2 while the lowest temperature was observed 18.60°C in the month of December in the sampling station no.3. Overall the temperature was high in summer and low in winter on an average. Water tempereature varied according to the climatic condition of the region i.e, low temperature during winter and high during summer. Secchi transparency indicates intensity of light penetration through the water columns. In the present study, transparency reading in various sampling stations in Betwa river ranged from 30.50 cm-98cm.The highest transparency of water was found at sampling station no.3 in the month of Dec. and the lowest transparency was found at sampling station no.4 in the month of March . Low values of transparency observed in the station 4 were due to the accumulation of suspended matter (silt, clay, industrial effluents and organic matter) into the Betwa river from nearby agricultural areas drained by rain and other anthropogenic activities. While the high values of transparency at station 3 were due to the absence of agricultural runoff and flood water as well as gradual settling of suspended particles. The pH was found within the range of 6.47 to 8.60.During the course of study water was both acidic and alkaline at different sampling stations. The water was mostly acidic at station 1 and station 2. The reduction in the pH at station 1 and station 2 as compared to station 3 and 4 of Betwa river could have been due to the discharged industrial effluents, agricultural practices, domestic pollution , cremation etc.

Alkalinity is an indirect measure of the concentration of anions in water. Alkalinity in natural water is formed due to dissolution of carbon dioxide in water. In the present study total alkalinity in Betwa river was noticed in the range of 115 mg/L to 235 mg/L . Total alkalinity was comparatively higher in station 3 and least in station 2. In the waters where total alkalinity is high, bicarbonate system prevails and the pH range is usually on the alkaline side [5]. It was also observed that the free CO_2 ranged from 1.06 mg/L -3.92 mg/L in all selected sampling stations. The overall increasing trend of free CO_2 at first two stations i.e. upstream in contrast of other two stations i,e downstream of Betwa river could be due to the addition of some carbon rich substances like industrial effluents which are rich in aromatic hydrocarbons and various kinds of heavy metals. Irrespective of these, agricultural run-offs, tanneries effluents, urbanization etc are solely responsible for deposition of carbon compounds in these areas. Thus results in the increase of CO_2 concentration in Betwa river particularly at upstream areas. It was also observed that the total hardness ranged from 184 mg/L – 393 mg/L .The least value was found in the sampling station no.3 in the month of August and the highest value was found in the sampling station no.2 in the month of June. Hardness in water is due to carbonates and bicarbonates of magnesium and calcium. According to Barrett [6] and Verma [7] hard waters are more productive than soft waters. Chapman and Donald [8], observed that hardness increases due to the presence of toxicant. In the present study dissolved oxygen concentration ranged from 4.53 mg/L to 8.10 mg/L in all selected sampling stations. Minimum DO was recorded in station 1 and maximum in station 4. The low value of DO in first two stations was due to effluent discharges from various industries, domestic pollution ,cultivation of crops and other anthropogenic activities which results in the contamination of Betwa river and thus causes depletion of DO in these stations which is below the level recommended of WHO. Emingor [9], suggested that the industries were releasing some organic substances that were high oxygen demanding wastes. It was also observed that the ammonical nitrogen was found in the range of 0.40 mg/L-1.12 mg/L . The lowest value was observed in the sampling station no.4 while the highest value was found at the sampling station no.1. Ammonical nitrogen is naturally present in surface water, ground water and domestic sewage. Ammonia generally arises from aerobic and anaerobic decomposition of nitrogenous organic matter. Irrespective of it, ammonical nitrogen will depend on the temperature and pH of river because at high temperature and pH, a good number

of ammonium ions are converted into ammonia gas, thus enhancing the toxicity of ammonia.

CONCLUSION:

From the present study it is clear that the water quality of River Betwa has been degraded qualitatively and the concentration of some constituents has passed the permissible limits and this could pose a great threat to the all kinds of life directly or indirectly therefore steps must be taken to protect this divine gift of nature and the present study is a step towards the same.

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Table 1: Physico-Chemical Properties of Water at Different Sites of River Betwa

Parameters	**Sampling Stations**							
	i		ii		iii		iv	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max
pH	6.42	7.52	6.48	7.79	7.83	8.48	7.20	8.60
Secchi Transparency	49.60	91.08	48.00	96.50	41.00	98.00	30.50	82.10
Free Co_2	2.52	3.92	1.93	3.61	2.81	3.89	1.06	2.89
Water temp.	19.10	33.07	19.10	33.64	18.60	33.60	18.62	32.20
Total alkalinity	118.03	221.34	115	207	122	235	129	228
Dissolved O_2	4.53	5.92	5.09	5.84	5.71	7.27	6.46	8.10
Total hardness	197	391	225	393	184	359	190	335
Ammonia N_2	0.59	1.12	0.46	0.93	0.41	0.94	0.40	0.87

Graphical Representation of Different Water Parameters