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PHYSICO-CHEMICAL ANALYSIS OF THE MUHURI RIVER, TRIPURA, NORTHEAST INDIA

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ABSTRACT

Healthy and clean water is the soul of our life. But surface water is usually subjected to changes due to human interventions. Muhuri is one of the major important rivers of Tripura, located in the southern part of this state. The river receives large quantities of untreated sewage from households; agricultural runoff consists of lots of pesticides, fertilizers, sediments; oil and waste materials from the constructional areas. These activities are one of the most important causes for the degradation of water quality, which can create threat for public health. Thus the present study aims to assess the physico-chemical characteristics of the Muhuri River at different sites. The result indicates that some parameters of the river water have extended beyond the permissible limit.

KEYWORDS :*Muhuri River, Water quality, Physico-Chemical Parameters.*

INTRODUCTION

River is an important natural source of fresh water for mankind. This surface water body is subjected to pollution comprising of organic and inorganic constituents. The problem of water quality deterioration is mainly due to human activities such as disposal of animal dead bodies, discharge of industrial and sewage wastes and agricultural runoff which are the major causes of ecological damage and pose serious health hazards (Meitei et al., 2004a). Increase in population, urbanisation and industrialization in the past century have resulted in increased domestic and industrial effluent being discharged into the aquatic system (Ajmal et al., 1988). The river collects large amount of human pollutants like domestic waste, municipal sewage from the municipality, agricultural run-off containing pesticides and waste materials from construction sites which consequently disturb normal water quality of the river. Hence the researcher is intended to investigate the physico- chemical parameters of water of the Muhuri River. Chakraborty et al. (1959), Dey et al. (2005), Das (2005), Chavan et al. (2009), Shivayogimath et al. (2012) and Mahakalkar et al. (2013) have measured the physic-chemical parameters and analysed the water quality status of different rivers of India.

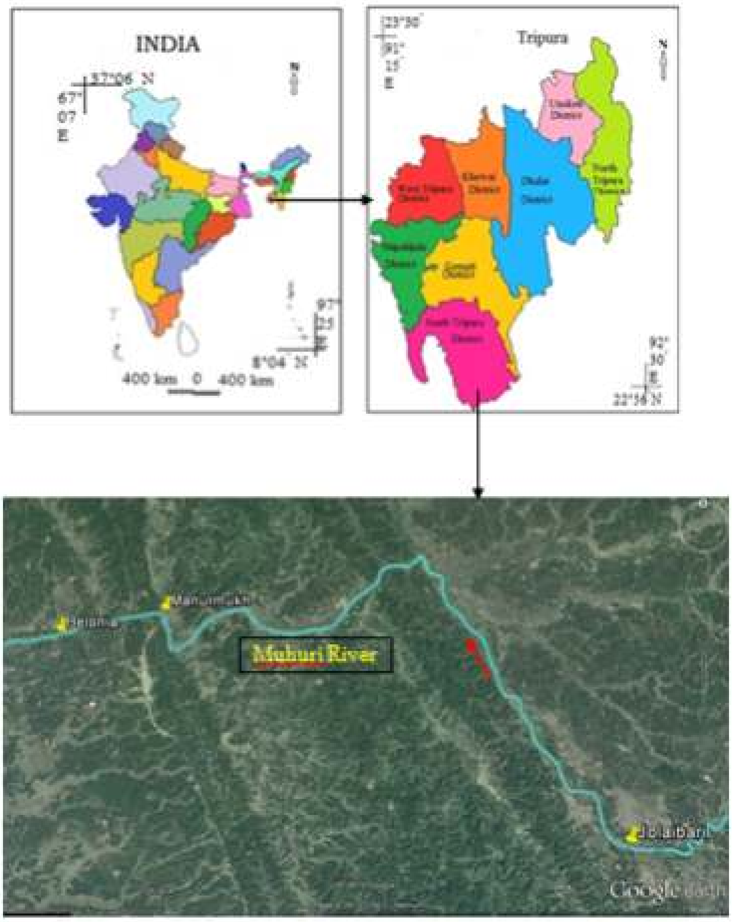

Fig.1: Location Map of the study area highlighting the three sampling sites on the Muhuri River, South Tripura.

2. OBJECTIVE: The water quality of the Muhuri River is gradually deteriorating due to human interventions. Therefore, the objective of the study is to analyse water quality status of the Muhuri River at Jolaibari, Manurmukh and Belonia.

3. MATERIALS AND METHODS:

The River Muhuri is contaminated with waste water and domestic sewage from the households. Various constructional works are going on in the Muhuri River for last few years which affect river water by addition of cement, oil, waste water etc. In order to test the water quality three sites were selected namely, Jolaibari (Cropland), Manurmukh (Brick kiln + Construction) and Belonia (Vegetable Market) on the basis of sources of contamination (Fig.1). The water samples were collected on 18th March, 2015 in between 10.00 am to 2.00 pm. Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Chloride, Hardness, Calcium, Magnesium, Alkalinity, Total Dissolved Load, Total Suspended Solid were analysed according to Standard Method (American Public Health Association [APHA] 1998). Conductivity, pH and Turbidity were analyzed by portable devices.

3.1 Dissolved Oxygen (DO): Dissolved Oxygen defined as the level of free, non-compound oxygen present in water or other liquids. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water. Oxygen is generally reduced in the water due to respiration of biota, decomposition of organic matter, rise in temperature, oxygen demanding wastes and inorganic reductant such as hydrogen sulphide, ammonia, nitrites, ferrous iron, etc (Sahu et al., 2000). Dissolved oxygen content of the water samples was measured by using Winkler's Method (Modified Azide Method). The sample was collected in 300 ml bottle and DO was fixed on site by using 1 ml each of Manganus sulphate (MnSO4) and sodium azide. The precipitate formed was dissolved in laboratory by using sulphuric acid and titrated with sodium thiosulphate using starch as an indicator. The end point of titration was blue to straw pale colour.

3.2 Biological Oxygen Demand (BOD): Biological Oxygen Demand is the quantity of oxygen demand used by microorganisms in the oxidation of organic matter. However, plant growth and decay may be unnaturally accelerated when abundant nutrients and sunlight are overlaid due to human influence. Urban runoff carries domestics waste and garbage disposed from market areas, which increase oxygen demand. After collection of water the BOD bottle was kept in the BOD incubator for idle condition of bacterial growth in the water. The BOD was measured after 3days.

3.3 Chemical Oxygen Demand (COD): Chemical Oxygen Demand (COD) is the measure of capacity to consume oxygen of water during the decomposition of organic matter and the oxidation of inorganic chemicals such as ammonia and nitrite. COD measurements are commonly made on samples of waste waters or of natural waters contaminated by domestic or industrial wastes. Chemical oxygen demand is measured by the Spectrophotometric method. In COD cell, 0.3 ml COD-A and 2.5 ml of COD-B solution were taken and 3 ml of sample solution was added. A blank solution was prepared using the same process. Then the cell was put into the Thermoreactor. After complete digestion, the concentration of COD in Spectrophotometer was directly measured.

3.4 Chloride: Chlorides content are measured by Argentometric titration.

3.5 Hardness: The total hardness of the water samples was determined by EDTA titration method where 10 ml of well mixed sample was mixed with 1-2 ml basic buffer solution and a pinch of Eriochrome black-T indicator. The contents were then titrated with 0.01M EDTA till wine red solution changes to blue.

3.6 Calcium: The calcium hardness of the water samples was determined by EDTA titration method. Here also 10 samples were mixed with 2 ml sodium hydroxide solution and a pinch of Murrexide indicator. The contents were then titrated against EDTA solution till pink colour solution changes to violet.

3.7 Magnesium: Magnesium contents were found out by using the formula:

Magnesium = (Total Hardness – Calcium Hardness) ×0.243

3.8 Alkalinity: Alkalinity contents were determined by titramatric method where 25 ml well mixed sample was mixed with 1-2 drops of Methyl orange indicator and titrated against 0.02 N sulphuric acids (H_2SO_4) till orange colour changes to deep orange.

3.9 Total Suspended Solid: Suspended sediment concentration (SSC) and Total Suspended Solids (TSS) are predominantly used to quantify concentrations of suspended solid-phase material in surface waters (Gray et al., 2000). Total suspended solid was estimated by Gravimetric method. 25 ml samples were taken in the dish for the suspended solid measurement. After that the dish was evaporated to dryness in an oven at 100^0 C temperatures. The dish was then taken in the desiccators to cool down; after that the weight of the dish was measured to analyse the total suspended solid.

3.10 Total Dissolved Solid: Total Dissolved load was also estimated by Gravimetric method.

4. RESULTS AND DISCUSSION:

Different aspects of water and waste water have been studied to know the physic-chemical characteristics of the Muhuri River water. The analytical results of the samples have been tabulated as follows:

Table I: Analytical Results of Water Samples (Mean ± SD) collected from different locations of the Muhuri River, South Tripura

Sl. No.	Parameters	Jolaibari	Manurmukh	Belonia	Standard Scale(APHA Guideline)
1	DO (mg/l)	4.37±0.02	6.28±0.04	5.28±0.03	6
2	BOD (mg/l)	2.16±0.01	0.87±0.01	0.67±0.03	3
3	COD (mg/l)	38±1.41	9.55±0.64	12.5±0.70	-
4	Chloride (mg/l)	18.36±0.15	22.73±0.04	13.63±0.01	250
5	Total hardness (mg/l)	55.56±0.03	46.32±0.01	64.81±0.03	300
6	Calcium (mg/l)	27.81±0.01	37.08±0.04	37.06±0.007	80.1
7	Magnesium (mg/l)	6.67±0.01	2.25±0.03	6.65±0.01	24.28
8	Alkanity (mg/l)	73.3±0.07	91.60±2.83	114.65±0.01	-
9	Total Dissolved Solid (mg/l)	122±1.41	144±2.83	112.5±2.12	500
10	Total Suspended Solid (mg/l)	24.5±2.12	40±2.83	32±1.41	-
11	pH	6.63±0.04	7.17±0.04	7.23±0.11	6.5-8.5
12	Conductivity	4.37±0.02	5.63±0.04	7.55±0.07	-
13	Turbidity (NTU)	10.55±0.06	10.41±0.04	10.1±0.07	-

Courtesy: Tripura State Pollution Control Board (TSPCB).

4.1 DO: Dissolved oxygen in natural and waste water depends on the physical, chemical and biological activities in the water body. Dissolved oxygen contents are varied in all locations of the study area of Muhuri River. The APHA guideline suggested the standard of DO as 6 mg/l. The concentration of DO in water sample collected from the Muhuri River at Jolaibari, Manurmukh and Belonia was found about

4.37 mg/l, 6.28mg/l and 5.28mg/l respectively (Table 1). The study indicates that at Jolaibari and Belonia site the river water is deficient in DO which pose adverse effect on aquatic ecosystem. The water quality in downstream is comparatively more affected than the upstream which is due to the addition of domestic sewages, bank side abuses of people, surface runoff and agricultural tail water from the surrounding agricultural area.

4.2 BOD (BOD 3 DAYS): The biochemical oxygen demand is of great importance in water quality assessment (Hannan et al., 1972 and Hatchinson et al., 1947). BOD 3 days indicates low values at three different sites of the Muhuri River. The BOD concentration at three spots is 2.16 mg/l at Jolaibari, 0.87 mg/l at Manurmukh and 0.67 mg/l at Belonia (Table1). The BOD concentration is high at Jolaibari, while at the other two areas the BOD concentration is acceptable.

4.3 COD: The COD concentration at three sites was not the same. The high concentration was at Jolaibari area (38 mg/l). The relatively higher value of COD levels at Jolaibari site could be mainly attributed to the agricultural runoff from the surrounding agricultural land to the river. In Manurmukh and Belonia sites the concentrations were more or less low i.e. 9 mg/l and 11mg/l respectively.

4.4 pH: pH is an important parameter which is important in evaluating the acid-base balance of water (Sharma et al., 2011). The pH is directly dependent on the amount of CO_2 present and inversely proportional to the activity of photosynthesis (Pandit et al., 2001). The pH value of water at sewage discharge points were usually lower than that of the river water, also reports similar results in case of the River Muhuri. The APHA Guideline's limit of pH for surface water ranges from 6.5--8.5. The pH value in three sites of my study area found to be within the range of 6.60 to 7.30 which were within the permissible limit (Table 1).

4.5 Chloride: Sediments, sewage and constructional work effluents are the main sources of chloride in the river water. The APHA Guidelines suggested the standard of chloride as 250 mg/l. In my study area chloride contents were not similar in three sites. Its content in river water is 18.18 mg/l at Jolaibari, 22.72 mg/l at Manurmukh and 13.63 mg/l at Belonia site. Its highest value is observed at Manurmukh, while lowest value at Belonia.

4.6 Total Hardness: The total hardness contents of Muhuri River water varied from 55.55 mg/l to 64.81 mg/l, it was within the standard limit (300mg/l). The highest value was ascertained at Belonia site (64.81mg/l), whereas the lowest value is at Manurmukh. The concentration was high at Belonia because this site was highly polluted by addition of vegetable market wastes.

4.7 Calcium Hardness: Calcium is an important micronutrient in an aquatic environment. Hardness of the river water is of considerable significance in connection with the discharge of the sewage and industrial effluents containing pollution, as indicated by variations in the concentration of the hardness of the water (Rai et al., 1974). The concentrations of Ca Hardness in Muhuri River's water sample were within the standard limit (APHA 80.10 mg/l). It was found to be in the range of 25mg/l to 40 mg/l. The maximum value was observed at Belonia and minimum value at Jolaibari site.

4.8 Magnesium Hardness: Magnesium as co-factor for various enzymatic transformations within the cell especially in the trans-phosphorylation in algal, fungal and bacterial cell (WHO Recommendation

1984). The concentration of Mg Hardness in Muhuri River water sample was found to be in the range of 2 mg/l and 7 mg/l. It is found that the values of magnesium of the water samples of the Muhuri River were within the standard limit (APHA: 24.28 mg/l). The maximum value of magnesium was found to be 6.75mg/l at Jolaibari and minimum value 2.25 mg/l at Manurmukh site.

4.9 Alkalinity: Alkalinity measures the buffering capacity of water and content of CO2 in its various forms are involved in this carbonate-bicarbonate carbonic acid buffering system (Tali et al., 2012).The total alkalinity value of 60.0 mg/l or more indicates hard water. The total alkalinity in my study areas fluctuate. It is within the range of 73 mg/l to 115mg/l. The concentration was highest (114.5mg/l) at Belonia and lowest at Jolaibari site (73.28 mg/l).

4.10 Total Suspended Solid: The value of Total Suspended Solid ranges from 24mg/l to 40 mg/l at different sites. The values were highest at Manurmukh (40mg/l), lowest at Jolaibari (24mg/l) and medium concentration was observed at Belonia (32mg/l).

4.11 Total Dissolved solid: Total dissolved solid of the three sites was within the permissible limit. The concentrations were varied in different sites. In contrast to total suspended solid, fluctuations in total dissolved solids showed a narrow variation at different sites of the Muhuri River. The maximum and minimum values of total dissolved solids were 144 mg/l and 112 mg/l at Manurmukh and Belonia respectively.

4.12 Conductivity: EC measurement is an excellent indicator of TDS, which is a measure of salinity that affects the taste of potable water (Unnisa et al., 2004). The conductivity of water was low at every site in the study area. The concentration was within the range of 4.37 – 7.55 µmho/ cm.

4.13 Turbidity: Turbidity of water is an important parameter which influences the penetration of sunlight. Turbidity shows wide amplitude of variation at all the study points. The turbidity values of Muhuri River water sample were within the range of 10 NTU to 11NTU. The minimum value observed was 10.1 NTU and maximum was 10.55 NTU (Table 1).

5. CONCLUSION:

This paper provides an informative data and helps to understand the contamination of water of the River Muhuri through mixing of waste water and the influences on the ecology of the river. In the present study it was found that physico-chemical characteristics of the river water was within the permissible limit of APHA Guideline except one parameter i.e. DO. Only at Jolaibari and Belonia sites, due to local anthropogenic activities, agricultural runoff and market wastes, the dissolved oxygen concentration were low. The study concluded that due to discharge of untreated sewage into the Muhuri River, the water quality of the Muhuri River has been more or less deteriorated and the quality of potable water is gradually deteriorating.

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