Physicochemical Analysis of Mymensingh Municipality Sewage Water and Old Brahmaputra River water

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Abstract

The study was conducted to investigate the physicochemical properties of the Old Brahmaputra River and Sewage water in Mymensingh Municipality. To perform the study fifty samples were collected from five different stations from the river and surrounding sewage discharge points. The samples were analyzed to determine pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Lead (Pb) and Cadmium (Cd). The mean value of pH was 7.1 and 6.8 for river and sewage water samples, respectively. Mean EC value was 183 µS/cm and 589.18 µS/cm for river and sewage samples, respectively signifies that EC of all samples were within the acceptable range. 66.32 ppm and 260.36 ppm were the mean TDS value for river and sewage samples, respectively indicates no harm to aquatic lives and irrigation water use. Mean DO and BOD values for river water samples were 4.21 mg/L and 6.02 mg/L, respectively. 3.08 mg/L and 9.98 mg/L were the mean DO and BOD values for sewage water samples, respectively implies that river water is usable for irrigation but sewage water is unfit for it. Mean Pb concentration for river and sewage water samples was 0.428 ppm and 0.467 ppm, respectively.

Key words: Old Brahmaputra River**,** Physicochemical properties, Water quality

Introduction

Old Brahmaputra River originates from the left bank of the Brahmaputra to the north of Bahadurabad. It falls into the Meghna at Bhairab Bazar passes by Jamalpur and Mymensingh towns. Old Brahmaputra river has a considerable impact on economy of Mymensingh city. Mymensingh city is densely populated and at present there is no proper waste treatment plant. Domestic waste, municipal waste disposal is mainly based on direct discharge through sewerage to Old Brahmaputra river. Surface water is the most important resource throughout the world, specially the country like Bangladesh, where a majority of the population depends on it largely. Water is essential not only for survival of human beings, but also for animals, plants and all other living things (Razo *et al*., 2004). River water is highly susceptible to contamination from various sources of pollutants comes through sewerage. Low pH (between 2-3), high conductivity, high concentration of sulphates, iron and toxic heavy metals, low dissolved oxygen (DO) and high biological oxygen demand (BOD) are some of the physico-chemical and biological parameters which characterize the degradation of water quality (Akcil and Koldas, 2006).

In Bangladesh, water resources are being polluted for many reasons. Water resources are polluted by municipal waste and industrial effluents containing trace metals and pathogens. Trace metals like Cu, Zn, Mn, Fe, Ni, Cd, Cr, Co, Pb etc. are usually present in water at low concentration, but enhanced concentration of these metals have found as a result of human activities. Some research results also confirmed that those trace metals have carcinogenic or toxic effects on human beings and environment (Trichopoulos, 2001). Trace metals have toxic properties, leading to adverse effects on human and ecosystem health even in small doses. In Bangladesh, there is a progressive increase in industrial wastes and due to the rapid industrialization such waste products have been causing severe contamination to the air, water and soils, thus polluting the environment. About 80% of the diseases in developing countries are related to contaminated water and the resulting death toll in as much as 10 million per year (Anonymous, 2004).

The water quality of a water body largely depends on the interactions of various physicochemical factors (Momtaz *et al.*, 2010). Water quality assessments are experimental works about physicochemical parameters to determine the quality of water resources and reach in a decision on whether a water body is well suited or not its designated uses such as aquatic life, fishing and drinking water (Rahman *et al*., 2005). To evaluate the quality of river water for the purpose of irrigation, health, domestic and fisheries, we need to identify the physiochemical characteristics that are important for respective field, and their acceptable levels of concentrations. Under such circumstances the present study was conducted to evaluate water quality of Old Brahmaputra river in Mymensingh municipality.

Materials And Methods

The study area located at the Sadarupazila, Mymensingh. Old Brahmaputra river is linked with several sewerage as the municipality wastewater meet the river after 2 or 3 km distance. The study was carried out in drains or channels and surrounding river water bodies from five different discharge points at Boishakhi Chottor area of BAU campus, Kewatkhali Railway Colony area, Mymensingh Zero Point area, Circuit House area and Uttara Police Line area. Thirty samples were collected for pH, EC, TDS, DO and BOD determination and twenty samples were collected and analyzed for heavy metal determination. Three replications were made when samples were collected from each sampling point for physicochemical analysis and two replications were made for heavy metal analysis. The 250 ml plastic bottles (total 50 in number) were cleaned and washed with detergent solution and treated with 5% nitric acid (HNO_3) over night. Each bottle was rinsed three times with the appropriate amount of sample before final sample collection. The water samples were immediately transported to the laboratory for physicochemical analysis.

pH was assessed with a digital pH meter (HACH SensIon^{TM}+EC5, USA) and EC (Electric conductivity) was measured with the help of EC meter (HACH SensIon^{TM}+EC5, USA) following the method as outlined by Singh *et al.* (1999). Total dissolved solids (TDS) were determined by digital TDS meter (model-HM digital, Germany). DO was determined by digital DO meter (YSI, Model 58, USA). BOD test was carried out by means of difference of DO level in water samples before and after incubation. First the DO level of samples was examined using a DO meter (YSI, Model 58, USA) and then the diluted samples (10ml sample + 90ml distilled water) were kept in an incubator at 20ºC for five days. After incubation period, the DO level of the samples was again determined. The BOD was calculated from the difference of dissolved oxygen before and after incubation .Determination of heavy metal concentrations was done by using an atomic absorption spectrophotometer (AAS) (model-UNICAM 969, England). Mono element hollow cathode lamp was used for measurement of each heavy metal of interest.

Data analysis

At the ends of data collection, data were compiled, tabulated and analyzed. MS Excel of Office 2007 version was used for data presentation. Various descriptive statistical measures such as range, mean, standard deviation (SD) etc were used for categorization and describing the variables.

Results and Discussion

pH

In Old Brahmaputra river water there was a slight variation of pH in various sampling stations. pH of the samples ranged from 7.1 to 7.2 for river water samples and 6.7 to 6.9 for sewage water samples. Average pH value was found as 7.1 and 6.8 for river and sewage water, respectively (Table 1). The acceptable range of pH for drinking water is 6.5 to 8.5; recreational water is 6.0 to 9.5; industrial water is 6.0 to 9.5; livestock water is 5.5 to 9.0 (ADB, 1994). The study found that the pH values of all sampling sites were within the standard limit. Hossain (1998) conducted a study on the hydrographic parameters of the river Old Brahmaputra and found that pH of the river water was 6.55-7.71.

EC and TDS

The electrical conductivity (EC) is the total concentration of soluble salts in the sample. In this study, EC of the river water samples ranged from 159.1 to 227.6 µS/cm with an average value 183 µS/cm (Table 1). EC of the sewage water samples ranged from 456.4 to 982.7 µS/cm with an average value 589.18 µS/cm (Table 1). The acceptable range of EC for recreational water 500 εS/cm, for irrigation water 750 εS/cm and for fishing water is 800 to 1000 εS/cm (ADB, 1994). On the basis of measured EC, river water samples not exceeded the acceptable range of recreational and irrigation water quality and sewage water is not suitable for recreational purpose but can be used as irrigation source after proper treatment. The amount of total dissolved solids (TDS) of river water samples were within the limit of 56.7-85.3 ppm with the average value of 66.32 ppm (Table 1). TDS of sewage samples were also within the limit of 198.3-448.3 ppm with the average value of 260.36 ppm (Table 1). Acceptable TDS value for irrigation water is less than 1000 mg/l, but 1000 to 2000 mg/l also permissible for irrigation purpose and for aquaculture required standard of TDS ranges between 500 to 1200 mg/l (Bauder *et al.*, 2005).

DO and BOD

DO value for sewage water samples ranged between 1.8 to 4.2 mg/L with an average 3.08 mg/L (Table 1) and DO values ranged between 2.97 to 5.2 mg/L for river water samples with an average 4.21 mg/L (Table 1). According to the environmental quality standard (EQS), DO prescribed as 6.0 mg/L for drinking purpose, 4.0 to 6.0 mg/L for fish and livestock and

5.0mg/L for industrial application. Comparing with standard values, it is clear that sewerage water is clearly unfit for industrial application, fish and livestock rearing but river water is suitable for fisheries and livestock rearing, industrial application but unfit for drinking purposes. BOD directly affects the amount of dissolved oxygen in rivers and streams. In this study BOD values varied between 5.7 to 6.7 ppm with an average 6.02 ppm in river water and 9.3 to 11.3 ppm in sewerage water with an average 9.98 ppm (Table1**).** The permissible limit for BOD for drinking water is 0.2 ppm, recreational water is 3 ppm, fish culture is 6 ppm and irrigation is 10 ppm in Bangladesh standard (ECR, 1997). Hossain (1988) observed higher values of BOD in the disposal zone due to consumption of oxygen for the oxidation of large amount of wastes discharged from the municipal sewerage and surface runoff. In this study it is found that river water is suitable to use as aesthetic purposes, fisheries and irrigation purposes but sewerage water is unfit for aesthetic purposes, harmful for fisheries and not suitable for irrigation purposes.

Table 1. pH, EC, TDS, DO, BOD of river and sewage water samples

Location	pH		EC (µS/cm)		TDS (ppm)		DO (mg/L)		BOD (mg/L)	
	R	S	R	S	R	S	R	S	R	S
Uttara Police Line area	7.1	6.7	192.7	982.7	70.3	448.3	3.2	2.5	5.7	10
Circuit House area	7.1	6.9	172.6	456.4	60.3	198.3	4.9	2.7	6	10
Zero Point area	7.1	6.8	163.0	470.2	59	201.3	2.97	1.8	6.7	9.3
Kewatkhali Railway Colony area	7.2	6.8	159.1	527.7	56.7	239.3	4.8	4.2	6	11.3
Boishakhi Chottor area	7.1	6.9	227.6	508.9	85.3	214.6	5.2	4.2	5.7	9.3
Average	7.1	6.8	183	589.18	66.32	260.36	4.21	3.08	6.02	9.98
Range	7.1-7.2	6.7-6.9	159.1-227.6	456.4-982.7	56.7-85.3	198.3-448.3	2.97-5.2	1.8-4.2	5.7-6.7	9.3-11.3
SD	±0.045	±0.084	±28.12	±221.85	±11.82	±106.29	±1.044	±1.08	±0.41	±0.82

Keynote**:** ñRò and ñSò stands for river and sewage water samples, respectively and ñSDò denotes standard deviation.

Lead (Pb) and Cadmium (Cd) concentration in river and sewage water

The Pb and Cd concentration in river and sewage water is presented in Table 2. The maximum and minimum Pb concentration in river water was recorded as 0.4425 ppm and 0.417 ppm, respectively. For sewage water, the maximum and minimum Pb concentration was recorded as 0.493 ppm and 0.448 ppm, respectively. The highest Cd concentration in river and sewage water was recorded as 0.0183 ppm and 0.0151 ppm, respectively. The lowest Cd concentration in river and sewage water samples was found as 0.016 ppm and 0.0138 ppm, respectively. The irrigation standard of Pb and Cd is 0.1 mg/L (GOB, 1997). The results of the study indicated that in all areas the Pb concentration exceeded the standard level and Cd concentration was in permissible limit. Therefore the irrigation by this river and sewage water may be harmful due to excess Pb concentration. A similar observation was reported by Rahman *et al*. (2012), for Turag river water quality. The concentrations of Cd in both surface and ground water samples collected from Tongi industrial area were in traces amount and suitable for all purposes.

Table 2. Pb and Cd concentration in river and sewage water samples

Location	Pb concentration (ppm)		Cd concentration (ppm)	
	River	Sewage	River	Sewage
Uttara Police Line area	0.417	0.448	0.0166	0.0147
Circuit House area	0.4223	0.4742	0.016	0.0147
Zero Point area	0.4425	0.461	0.0183	0.015
Kewatkhali-Railway Colony area	0.4293	0.493	0.0169	0.0151
Boishakhi Chottor area	0.4267	0.461	0.016	0.0138
Average	0.428	0.467	0.0167	0.0147
Range	0.417-0.4425	0.448-0.493	0.016-0.0183	0.0138-0.0151
SD	±0.0096	±0.017	±0.00095	±0.00046

Keynote**:** ñSDò denotes standard deviation.

Conclusions

Bangladesh is a riverine country with a number of important rivers which provides huge potentiality for economic development. The assessed physicochemical parameters indicate that the water quality of sewage water was unfit for commercial, recreational, fisheries and irrigation purposes but river water can be used as livestock rearing, fisheries and irrigation source. Moreover, the present study concludes that the Old Brahmaputra river water within the study area was not suitable for drinking. River water is currently being used for discharging of sewage, boating, fishing and religious ritual activities. Impurities generated from fertilizer and pesticide application, municipality, household waste discharge in the river water through sewerage channels affect the river water quality. It is important that the river water is subjected to continuous monitoring and treatment process if the water is to be used for drinking, agricultural, commercial and domestic purposes.

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