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Investigation of Heavy Metals (Pb, Cd, Cr, Cu, Hg and Fe) of the Turag River in Bangladesh

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Abstract

The study was conducted to assess the concentration level of heavy metals in water of the Turag river during the months from January to March, 2014. The level of Pb, Cd, Cr, Cu, Hg and Fe ranged from 0.002-0.005 ppm, BDL (Below Detection Level)-0.03 ppm, 0.007-0.024 ppm, 0.03-0.15 ppm, BDL (Below Detection Level)-0.00024 and 0.78-6.33 ppm, respectively. The concentration level of heavy metals in water did not exceed the permissible limit except Fe. This result was obtained because of river water is always flowing and metals cannot be accumulated in flowing water. For this reason a little amount of analyzed heavy metals were traced in water samples. But heavy metals have toxic properties, leading to adverse effects on human and ecosystem health even in small doses. So, the Turag river water is not safe for using different purposes and steps should be undertaken to improve the water quality of the river.

Key words: Turag River, Heavy metals, BDL (Below detection level)

Introduction

Water pollution is a common environmental problem. It has been suggested that water pollution is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily. In addition to the acute problems of water pollution in developing countries, industrialized countries continue to struggle with pollution problems as well (Balkis, 2012). As Bangladesh is a riverine country situated in the funnel shaped coast of the Bay of Bengal (Azad, 2009), river pollution is one of the main talked about topics here regarding the environmental issues of urban Dhaka. Since the birth of Bangladesh, due to rapid and unplanned urbanization and industrialization precisely in Dhaka, the rivers in the capital including the Turag have been experiencing a number of complicated problems including that of pollution (Hossain, 2011). The river water is already polluted by various heavy metals discharging from industrial waste waters (Staniskiene, 2006). Heavy metal pollution is a serious and widespread environmental problem due to their toxicity. Heavy metals enter the environment through various natural methods and human activities, and can accumulate in fish and other organisms. The main threats to human health from heavy metals are associated with exposure to lead (Pb), cadmium (Cd), mercury (Hg) and arsenic (As) (Jarup, 2003). Heavy metals have toxic properties, leading to adverse effects on human health and ecosystem even in small doses. Another problem-causing property is their non-degradability: once they enter the environment they will remain there for long time (Mahfuza, 2012). As Turag river is already polluted by various pollutants including heavy metals, the present study aims at investigating the concentration of heavy metals (Pb, Cd, Cr, Cu, Hg and Fe) in the Turag river water.

Materials and Methods

Study area

The study area was adjacent to the Turag river. Three locations were selected for this study and they were Ashulia Bridge (Location 1), Kamarpara (Location 2) and Abdullahpur (Location 3). Water samples were collected in the bottles from 3 locations in January, February and March, 2014. Before sampling, the bottles were cleaned with detergent, rinsed with 10% HNO_3 and then washed with distilled water. After sampling, the samples containing bottles were sealed immediately and marked with necessary information (date, location etc.).

At first 100 ml water sample was taken in a beaker by using a calibrated pipette. Then 4-5 ml concentrated HNO_3 was added in it and the beaker was put on the hot-plate for digestion. After proper digestion the sample was taken in a 100 ml volumetric flask and it was filled with distilled water up to the mark. Then it was filtered with a filter paper (Whatman Qualitative 1) and preserved in a container. This process was followed for each water sample. Then all the samples were analyzed for Pb, Cd, Cr, Cu, Hg and Fe by Atomic Absorption Spectrometer (AAS) (APHA, 1998). The study area is shown in Fig. 1 below and the sampling locations are pointed out with circles in it.

Fig. 1. Map showing the Turag River and the study area

Results and Discussions

Lead (Pb)

The highest value (0.005 ppm) of Pb was observed in location 1 in March and the lowest (0.002 ppm) was observed in location 2 in January, February and March and in location 3 in January and March (Table 1). The standard value of Pb for drinking, irrigation and fishing water are 0.05, 0.1 and 0.05 ppm (ADB, 1994), respectively. Here, all the observed values are lower than the standard level. It indicates lower level of Pb pollution.

Bakali *et al.* (2014) studied that the concentration of Pb in water samples fluctuated between trace to 0.43 ppm for surface water with a mean value of 0.34 ppm in the Turag river water. Rahman *et al.* (2012) studied that the values of Pb ranged from 0.00269 to 0.00589 ppm at Ashulia point in the Turag River. Islam *et al.* (2012) found that the concentrations of Pb were ranged from 0.01-0.09 ppm in the Turag river water. Mahfuja *et al.* (2012) found the average concentration of Pb of the surface water of the Turag River as 0.00093 ppm. Khan *et al.* (2007) studied that the concentration of Pb ranged from 0.000043 to 0.0093 ppm at Ashulia point in the Turag River during the months from July to October. All these values are mostly similar to the present study.

Table 1. Concentrations of heavy metals (ppm) in all water samples

Heavy metals		**Location 1 (Ashulia bridge)**	**Location 2 (Kamarpara)**	**Location 3 (Abdullahpur)**
Lead (Pb)	January	0.003	0.002	0.002
	February	0.003	0.002	0.004
	March	0.005	0.002	0.002
Cadmium (Cd)	January	0.00003	0.00001	0.00003
	February	0.00001	0.000006	Not detectable
	March	0.00002	0.00002	0.03
Chromium (Cr)	January	0.013	0.016	0.007
	February	0.016	0.010	0.010
	March	0.024	0.019	0.010
Copper (Cu)	January	0.05	0.03	0.05
	February	0.06	0.05	0.15
	March	0.09	0.08	0.09
Mercury (Hg)	January	Not Detectable	Not Detectable	Not Detectable
	February	Not Detectable	Not Detectable	Not Detectable
	March	Not Detectable	0.00012	0.00024
Iron (Fe)	January	2.49	2.32	1.32
	February	2.32	0.78	1.89
	March	6.33	2.54	1.92

Cadmium (Cd)

The highest value (0.03 ppm) of Cd was observed in location 3 in March and the other observed values are very low (Table 1). The standard values of Cd for drinking, irrigation and livestock water are 0.005, 0.01 and 0.5 ppm (ADB, 1994), respectively. Here, all the observed values are lower than the standard level except one. It indicates lower level of Cd pollution. According to Bakali *et al.* (2014), the concentrations of Cd in surface water samples collected from Tongi industrial area were traces and suitable for all purposes.

Rahman *et al.* (2012) studied that the values of Cd ranged from 0.000092 to 0.002 ppm at Ashulia point in the Turag River. Khan *et al.* (2007) studied that the concentration of Cd ranged from 0.0000023 to 0.0000043 ppm at Ashulia point in the Turag River during the months from July to October. According to Meghla *et al.* (2013), the mean concentration of Cd in the Turag River water was ranged from 0.09 to 0.13, 0.15 to 0.20 and -0.04 to -0.10 ppm during post-monsoon, pre-monsoon and monsoon season, respectively. All these values are similar to the present study.

Chromium (Cr)

The highest value (0.024 ppm) of Cr was observed in location 1 in March and the lowest (0.007 ppm) was observed in location 3 in January (Table 1). The standard value of Cr for surface water is 0.05 ppm (EPA, 2001). Here, all the observed values are lower than the standard level. It indicates lower level of Cr pollution in water. Mahfuja *et al.* (2012) found the average concentration of Cr of the surface water of the Turag River as 0.017 ppm. This is similar to the present study.

Copper (Cu)

The highest value (0.15 ppm) of Cu was observed in location 3 in February and the lowest (0.03 ppm) was observed in location 2 in January (Table 1). The standard values of Cu for domestic, irrigation and fishing water are 1, 0.2 and 0.4 ppm, (De, 2005; ADB, 1994) respectively. Here, all the observed values are lower than the standard levels. It indicates lower level of Cu pollution.

Bakali *et al.* (2014) studied that the concentration of Cu in surface water samples varied between 0.01 to 0.07 ppm in the Turag River. Islam *et al.* (2012) found that the concentrations of Cu were ranged from 0.05-0.10 ppm in the Turag river water. Mahfuja *et al.* (2012) found the average concentration of Cu of the surface water of the Turag river as 0.017 ppm. Khan *et al.* (2007) studied that the concentration of Cu ranged from 0.028 to 0.043 ppm at Ashulia point in the Turag river during the months from July to October. Meghla *et al.* (2013) studied that the surface water samples from the Turag River contained significant amount of Cu and ranged from 0.01 to 0.02, 0.02 to 0.03 and -0.27 to -0.21 ppm during post-monsoon, pre-monsoon and monsoon season, respectively. All the previous values are mostly similar to the present study.

Mercury (Hg)

Most of the values of Hg were not detectable and only two were detectable (Table 1). But the detected values were much lower than the standard value for domestic water supply. It indicates no or a little Hg pollution.

Rahman *et al.* (2012) studied that the values of Hg ranged from 0.00012 to 0.00145 ppm at Ashulia point in the Turag river. Khan *et al.* (2007) studied that Hg was not detected at ppb level at Ashulia point in the Turag river during the months from July to October. All these results are similar to the present study.

Iron (Fe)

The highest value (6.33 ppm) of Fe was observed in location 1 in March and the lowest (0.78 ppm) was observed in location 2 in February (Table 1). The standard values of Fe for domestic, surface and fishing water are 0.3, 1.0 and 0.1 ppm (De, 2005; Ayers and Westcot, 1976; Meade, 1998), respectively. All the observed values are higher than the standard level for domestic and fishing water and all are higher than the standard level for surface water except one. It indicates higher level of Fe concentration in water.

According to Bakali *et al.* (2014) the collected surface water samples contained Fe from trace to 0.27 ppm with a mean value of 0.11 ppm in the Turag River. Islam *et al.* (2012) found that the concentrations of Fe were ranged from1.40-3.29 ppm in the Turag river water. Mahfuja *et al.* (2012) found the average concentration of Fe of the surface water of the Turag River as 0.442 ppm. Khan *et al.* (2007) studied that the concentration of Fe ranged from 0.1269 to 0.5062 ppm at Ashulia point in the Turag River during the months from July to October. All the previous values are almost similar to the present study and a slight difference occurs due to seasonal variation.

Conclusions

The current status of waste water management in Bangladesh is not satisfactory and most of the wastes water is discharged indiscriminately without maintaining any sort of proper steps which is affecting the water quality critically including heavy metal contamination. This research work was conducted to evaluate heavy metals in water samples collected from 3 locations in adjacent area to the Turag River. About 9 samples of water were collected from three locations. The collected water samples were analyzed for Pb, Cd, Cr, Cu, Hg and Fe. All the parameters were analyzed to classify them according to their comparative suitability for fish culture, drinking, irrigation, domestic and other purposes.

There was very low concentration of heavy metals in water except Fe (0.78 to 6.33 ppm). Because river water is always flowing, so metals cannot be accumulated in flowing water. The concentration levels of Pb, Cr and Cu were very low and Cd and Hg were ranged from below detection level to a very low concentration. In simple eyes, this water is suitable for fish culture, irrigation, bathing and recreational purposes in case of heavy metal concentration but the reality is not like that. Long term exposure to a lower level of heavy metals has deleterious effects on human health and other organisms. In the present investigation, some heavy metals' concentrations (Cr, Cu, Fe) are higher than the safe recommended values, which suggest that the Turag River is partly a heavy metal polluted river and the water and fish are not fully safe for human health and ecosystem. Again lower concentration of heavy metals (Pb, Cd) can be harmful to human health and organism in case of long term exposure.

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