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FULL LENGTH ARTICLE

Quantitative assessment of toxicity in the Shitalakkhya River, Bangladesh

Jahida B. Islam, Mamon Sarkar *, A.K.M. Lutfor Rahman, K. Shahin Ahmed

Department of Chemistry, Jagannath University, Dhaka 1100, Bangladesh

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Abstract Physicochemical parameters namely temperature, pH, salinity, EC, TDS, DO and COD were analyzed from October, 2012 to August, 2013. Toxic metals Cr, Cd, Ni, Cu and Zn were quantified during June, 2013. The observed parameters ranged as Temp. 20.5–31.3 °C, pH 6.9–8.0, salinity 57–582 mg/L, TDS 80–754 mg/L, EC 121–1167 μs, DO 0.5–3.5 mg/L and COD 80–480 mg/L. Toxic metal concentrations ranged as Cr 0.0371–0.1023 mg/L, Cd 0.0065–0.0152 mg/L, Ni 0.1441–0.513 mg/L, Cu 0.016–0.1434 mg/L, Zn 0.0481–0.13 mg/L. According to the statistical analysis pH, Salinity, EC, TDS and COD show positive correlations with each other and negative correlations with Temp. and DO. Toxic metals Cr, Cd and Ni show positive correlations among themselves and negative correlations with Cu and Zn. The hydrochemistry of the water body has revealed that the water is not safe for aquatic lives as well as human health. Also household, irrigations and industrial use without proper treatment are discursive.

Introduction

Rivers are the major source of surface water supply which is used in drinking, household, irrigation and industrial purposes. But due to municipal and industrial pollution the availability of fresh surface water is becoming worse nowadays. Like all over the world, Bangladesh is facing a tremendous problem for getting fresh water. The vulnerability of surface water is very much high to pollution because of its flexible accessibility for disposal of wastes. In this industrial era Rivers are turned into dumping stations and receive a large quantity of wastes from industries and municipals (Kamal et al., 1999). The Shitalakkhya is the tributary of Brahmaputra and a traditional River in Bangladesh. It is a navigable River year round and water vehicles run on it. It was said that water of the Shitalakkhya River is a sign of purity and its vapor was only suitable for knitting Moslin saree in the whole world. In the last few couple of decades Bangladesh has experienced industrial development. Narayanganj is one of the industrial zones and the second largest developed industrial area of the country. Various types of industrial units especially dyeing and textile industries have been established in this area. More than 80% industries have no effluent treatment plant (ETP) and directly or indirectly dumping their waste in the Shitalakkhya River. Textile and dyeing industries discharge their untreated dye with heavy metals into the Shitalakkhya River. Industrial wastes contain different types of solid wastes,

* Corresponding author.
E-mail address: akash.mamon@gmail.com (M. Sarkar).
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liquid wastes and gaseous wastes. The characteristics of these wastes are different from the municipal and commercial wastes (Rahman and Bakri, 2002). By consumption and using this polluted water in bathing, washing and household work the marginal people who are living on the bank of the Shitalakkhya River especially children are prone to different types of water borne diseases, viz. nausea, skin sore, irritation in respiratory tract (Sultana et al., 2009), typhoid, dysentery, cholera, viral hepatitis, etc. and lose their life. The assessment of physicochemical water quality parameters plays an important role in classification of the water quality (Sahin et al., 2014), hydrochemistry and ecology. The assessment of water quality evaluation is very much necessary for safe and sound health, environment and ecosystem. In this study the industrial and municipal pollution effect on the Shitalakkhya River water and its toxicity were observed and after that statistical correlations are drawn among the parameters which have not been observed yet. Therefore, it could be a fruitful attempt to understand the correlation among physicochemical water quality parameters.

Materials and methods

Sampling

The water samples were collected for physicochemical parameters from 0.6 m and for heavy metals from 2.5 m depth from surface by the grab method (Alam et al., 2012). The samples are collected 100 ± 2 m into the River from the bank i.e. mid axial. For collecting samples from different selected stations 500 mL non-transparent plastic bottles were used. First the bottles were washed by detergent solution and after that those were treated with 2% (v/v) nitric acid solution overnight and finally washed with deionized water. After that the sample bottles have been dried in the air. During sampling the prior marked sample bottles were washed with sampling water and tightly screwed after sample collection. Finally they were carefully carried to the laboratory by ice carrier and preserved at 4 °C for further analysis. The samples were taken to the normal temperature before analysis.

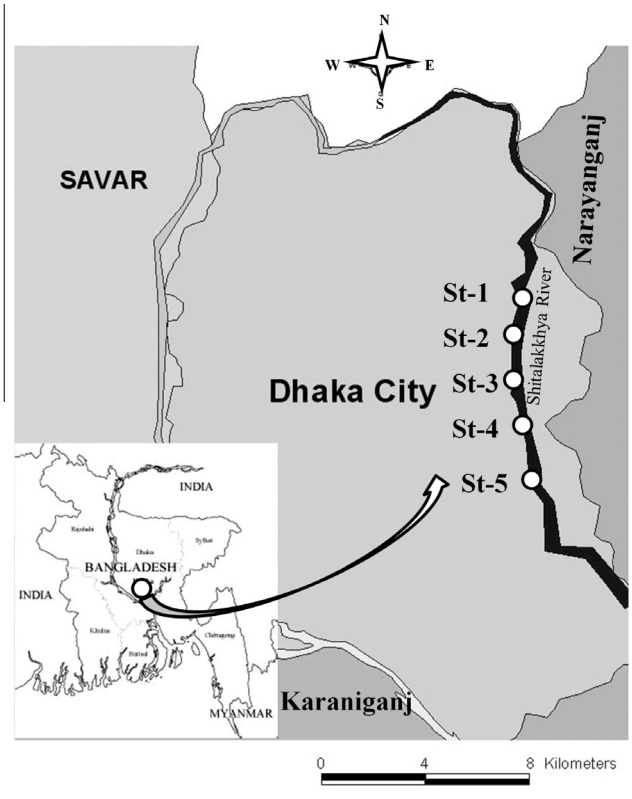

Figure 1 Shitalakkhya River, sampling stations.

Sampling stations

All the sampling stations lie between Latitude 90°50′ and Longitude 23°72′ (Tarabo) to Latitude 90°52′ and Longitude 23°70′ (Kanchpur Bridge). Five sampling stations were Tarabo (St-1), Khal ghat (St-2), Cement Industry (St-3), Sinha textile (St-4) and Kanchpur Bridge (St-5). The sampling stations are shown in Fig. 1.

Sample analysis

Samples were analyzed in the Inorganic Research laboratory, Department of Chemistry, Jagannath University. The salinity, conductivity, TDS, pH and DO were measured instrumentally. Salinity, EC and TDS were measured by 'CTS-406K' model meter, Taiwan; pH was measured by 'Twin, B-221' pH meter by Horiba, Japan; and DO was measured by 'YK-22' model meter, Taiwan. COD were determined by condensation and potassium dichromate oxidation. All reagents were purchased from Merck, Analytical Grade (AR), Germany. Toxic metal concentration was determined by 'SHIMADZU, AA-7000' model atomic absorption spectrometer. A high precision electrical balance 'KERN, ABS 220-4' was used for weighing. For toxic metal concentration determination samples were preconcentrated and then the sample was filtered through a nylon membrane filter (Whatman, pore size 0.8 μm, diam. 47 mm).

For toxic metal analysis an aliquot of 100 mL of each sample was taken in a 100 cm^3 of Pyrex volumetric flask. Then 1 M concentrated HCl (9 cm^3) was added followed by 1 M concentrated nitric acid (3 cm^3). The content of the volumetric flask was carefully heated in sand bath nearly to dryness in fume hood. After cooling the volumetric flask at room temperature, deionized water was added to the sample up to the mark of flask. Then, the sample was filtered and the filtrate was collected in a 250 mL screw cap plastic bottle (Type- HDPE container, LDPE-lined Polypropylene Cap, Brand-Thermo Scientific). Finally, they were preserved for the determination of metal concentration. The AAS was calibrated for all the metals by running different concentrations of standard solutions. Average values of three replicates were taken for each determination. The detection limit was 0.003 mg/L.

Statistical analysis

Mean and standard deviation (SD) were computed to show the average behavior of the parameters and their dispersions. Pearson's correlation (r) represented the association among the parameters. All statistical analysis was performed with SPSS (16.0 version) software.