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Analysis of water samples of four central rivers of Bangladesh

Kazi M Maraz, Nanda Karmaker, Farhana Islam, Kazi Mahfuzul Haque, Marjanul Haque, Afrina K Piya, MM Raihan, Mazharul Islam and Ruhul A Khan *

Water Analysis Laboratory, Institute of Radiation and Polymer Technology, Atomic Energy Research Establishment, Savar, Dhaka, Bangladesh.

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Abstract

Four central rivers of Bangladesh were selected for this research. The name of the rivers is Buriganga, Dhaleshwari, Shitalakshya and Meghna. The Electrical Conductivity (EC), pH, Total Dissolved Solid (TDS), and Salinity of the four river waters were evaluated. The EC values of the water of the Buriganga, Dhaleshwari, Shitalakshya and Meghna rivers were found to be 366.0, 299.2, 290.4 and 130.8 $\mu\text{S}/\text{cm}$ respectively. Similarly, the pH values of 7.67, 7.38, 7.30 and 7.18 were found for the river waters of the Buriganga, Dhaleshwari, Shitalakshya and Meghna respectively. The EC and pH values were found higher for the Buriganga river water than that of the other three river waters. The TDS and salinity of the Buriganga river water were found 180 mg/l and 0.72% respectively. On the other hand, the TDS and salinity of the Meghna river water was found lower compared to the other three rivers. From this research, this is clear that the quality of the Meghna river water is much better than the river waters of the Buriganga, Dhaleshwari, and Shitalakshya. The quality of the Buriganga river water was found inferior. Dhaka city, the capital of Bangladesh, stands on the bank of the Buriganga river, and as a result a large number of urban waste goes directly to the river Buriganga. As a result, the water of Buriganga became polluted. This investigation proved that the Meghna river water quality is still much better and suitable for many applications.

Keywords: River Pollution; Water Pollution; Buriganga River; Meghna River; Electrical Conductivity; TDS

1. Introduction

Bangladesh is a land of rivers. More than 230 rivers flowing across Bangladesh. Dhaka City, the capital of Bangladesh, is one of the most overcrowded cities in the world with a population of more than 16 million. Dhaka is located on the bank of the Buriganga river and is surrounded by the rivers Turag, Dhaleshwari, Balu, and Shitalakshya. Most of the industries and factories are situated on the banks of these five rivers or close to the river system. There are more than seven thousand industries located near these rivers. The rivers around Dhaka city are increasingly being polluted as a result of a huge volume of toxic wastes from industries and sewage lines. In this investigation, four central rivers of Bangladesh were selected for investigation. The name of the rivers is as follows: Buriganga, Dhaleshwari, Shitalakshya and Meghna. These four rivers extend up to 70 km from the center of the capital Dhaka. The combined water of these rivers gradually flows into the Bay of Bengal by the name Meghna river [1-5]. A brief description of the four central rivers of Bangladesh is given below.

The Buriganga river is a tide-influenced river passing through the west and south of Dhaka City. In ancient times one course of the Ganges used to reach the Bay of Bengal through dhaleshwari. This course gradually shifted and ultimately lost its link with the main channel of the Ganges and was renamed as the Buriganga. The water levels during high and

* Corresponding author: Ruhul A Khan

Water Analysis Laboratory, Institute of Radiation and Polymer Technology, Atomic Energy Research Establishment, Savar, Dhaka, Bangladesh.

low tides in this river really a surprising matter. The Buriganga river originated from the Dhaleshwari river near Kalatia. The average width and depth of this river are 400 meter and 10 meter respectively. This river is only 27 km long. The Turag river has joined the Buriganga river at Kamrangirchar of Dhaka. The main flow of the Buriganga comes from the river Turag. Buriganga river meets with the Dhaleshwari river at Munshiganj district. The Buriganga is of great economic importance to Dhaka. It provides river connection by launch and country boats. Water pollution in the river Buriganga is at its highest level now. The most significant source of pollution appears to be from industrial and urban wastes. In the dry season, the dissolved oxygen level becomes very low and the river water becomes toxic. Most importantly, the quality of the Buriganga river water has continuously been deteriorating. Due to severe water pollution problems, Buriganga is under the threat of becoming a dead river in the future. Therefore, immediately necessary measures should be taken to save the life of the river Buriganga [6-10]. Figure 1 shows a digital image of the river Buriganga.



Figure 1 The Buriganga River of Bangladesh

The Dhaleshwari River is a distributary of the Jamuna river of Bangladesh. The river takes off in the northwestern part of Tangail district. It is a twisting river having two branches. The main stream flows north of Manikganj district and joins the other branch, the Kaliganga, south of Manikganj. The Kaliganga again joins with the Dhaleshwari. The Buriganga was once a distributary of the Dhaleshwari river and used to discharge its flow again into the Dhaleshwari. It meets the Shitalakshya river near Narayanganj district and flows south to meet the Meghna river near Shaitnol of Chadpur district. Total length of the river Dhaleshwari is about 160 km and an average depth of about 37 meter. The Dhaleshwari River flows along with central part of Bangladesh. This river contributes immensely to the socio-economic development in its vicinity as well as the country [11-14].

The Shitalakshya river is a distributary of the famous Brahmaputra River. It is also known as Lakshya River. The river Shitalakshya is one of the most prominent rivers in the flood plain region of Bangladesh. It is located in the Narayanganj district, near the capital city of Dhaka. The river port of Narayanganj is one of the oldest port in Bangladesh. The Shitalakshya river flows in the central part of Bangladesh then it merges with the Dhaleshwari river near Kalagachhiya. The river is about 110 kilometers long and the width is around 300 meters. Its flow, measured at Demra, has reached 74 cubic meters per second (2,600 cu ft/s). The river remains navigable year-round. The Shitalakshya river ran almost parallel to the Brahmaputra and after passing by Narayanganj district, it joined the Dhaleswari river. The Shitalakshya river, an urban river of high economic importance in Bangladesh, is prominently affected by harmful elements from innumerable sources and act as a sink of pollutant [15-18].

The river Meghna is one of the main rivers in Bangladesh. Meghna river is formed inside Bangladesh in Kishoreganj district above the town of Bhairab Bazar by the joining of the rivers Surma and Kushiya, both of which originate in the hilly regions of eastern part of India where it is flowing as the name Barak River. The Meghna river meets with the Padma river in Chandpur district. Other major branches of the Meghna river include the Dhaleshwari, the Gumti, and the Feni. The Meghna river flows into the Bay of Bengal in Bhola district by four major mouths: Tetulia (Ilsha), Shahbazzpur, Hatia, and Bamni [19-20]. A digital image of the Meghna river is shown in Figure 2.

Meghna has two distinct parts. Upper Meghna from Bhairab Bazar to Shaitnol is comparatively a small river. Lower Meghna below Shaitnol is one of the largest rivers in the world, because it is the mouth of Ganges-Padma and Brahmaputra-Jamuna rivers. The average depth of Meghna river is 308 meters. The maximum depth is 490 meters. The

Meghna is the widest river among those that flow completely inside the boundaries of Bangladesh. At a point near Bhola, Meghna is 13 km wide. In Daudkandi of Comilla district, the Meghna river is joined by the Gumti River, which increases the Meghna's water flow considerably. The Meghna river is reinforced by the Dhaleshwari river before Chandpur district. Further down, the Padma River joined with the Meghna in Chandpur district, resulting in the Lower Meghna. After Chandpur, the combined flow of the Padma, Jamuna, and Meghna moves down to the Bay of Bengal in an almost straight line. The Meghna river estuary is significant for fishery resources and acting as a breeding and nursery grounds for many marine and freshwater fish species. The Meghna river estuary plays a very important role in providing a massive amount of fish supplies to the local and national markets [21-22].



Figure 2 The Meghna river of Bangladesh

2. Material and methods

Four points of the four central rivers of Bangladesh were selected in this investigation. The points of the rivers are shown in Figure 3.

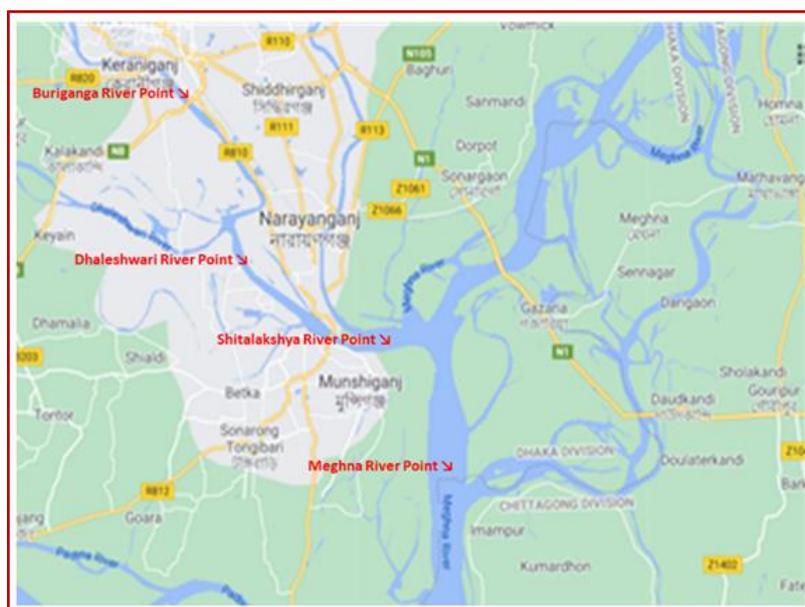


Figure 3 Four Central Rivers (Buriganga, Dhaleshwari, Shitalakshya and Meghna) of Bangladesh are shown in the figure. Sample collection points of the rivers are indicated in the figure by red marked lines

River water samples were collected in the dried plastic bottles. The Hydrogen ion concentration (pH) was determined by a digital pH meter (Model edge® HI2002 digital pH meter, Hanna Instruments, USA). The electrical conductivity (EC), total dissolved solid (TDS), and salinity of the river water samples were analyzed by combined digital EC meter (Model

HI2003-01, edge® Dedicated Conductivity-TDS-Salinity Meter, Hanna Instruments, USA). The testing of the water samples was carried out at 28°C. The river water samples were collected on 6th September 2019.

3. Results and discussion

Four points of four rivers of Bangladesh were selected for this investigation. The name of the rivers is Buriganga, Dhaleshwari, Shitalakshya and Meghna. Five samples of each point of the rivers were examined. The values presented here are the mean of that five samples. The Electrical Conductivity (EC), pH, Total Dissolved Solid (TDS), and Salinity (%NaCl) of the river waters were evaluated. The results with discussion are reported below.

3.1. The Electrical Conductivity (EC)

The EC measures the concentration of ions in water. The concentration of ions depends on the environment, movement and sources of water. The soluble ions in the surface water originate primarily by the dissolution of rock materials. Conductivity of an electrolyte solution is a measure of its ability to conduct electricity. The SI unit of conductivity is Siemens per meter (S/m). Conductivity measurements play a vital role in many industrial and environmental applications. The EC measurement is a rapid, easy, and reliable way of measuring the ionic content in water. Electrolytic conductivity of water is a function of temperature. Generally, conductivity is directly linked with the total dissolved solids in water samples. The EC value of high quality deionized water is about 0.5 $\mu\text{S}/\text{cm}$ at 25°C, for drinking water 200 to 800 $\mu\text{S}/\text{cm}$. Sea water has a high value of EC, around 50,000 $\mu\text{S}/\text{cm}$ [23-25].

The EC values of water samples of the Buriganga, Dhaleshwari, Shitalakshya and Meghna rivers were found to be 366.0, 299.2, 290.4 and 130.8 $\mu\text{S}/\text{cm}$ respectively. The EC values of the water of Buriganga river (366.0 $\mu\text{S}/\text{cm}$) was found higher than other three river water samples. The lowest EC value was reported for the Meghna river water (130.8 $\mu\text{S}/\text{cm}$). The EC values of the four river waters are reported in Figure 4. A significant reduction of EC values (64.26%) was noticed comparing to the water of Buriganga with Meghna river water.

From this investigation, this is clearly indicated that the Meghna river water quality is much better than that of the river Buriganga. Actually, Buriganga river is flowing on the bank of the Dhaka city, capital of Bangladesh. A lot of urban and industrial wastes are going to the Buriganga river and the river water became polluted. The Buriganga river ranks among the most polluted rivers in Bangladesh. The distance between Meghna river (Chandpur point) and Buriganga river (Sadarghat, Dhaka point) is about 36 nautical miles or 68 kilometers. In this investigation, Sadarghat point of Buriganga river and near Chandpur launch terminal point of Megha river were selected. This is to be noted here that the Buriganga river meets with the Dhaleshwari river at Munshiganj district then the both river waters flow and then mixed with the river Shitalakshya near Kalagachhiya of Narayanganj District. Finally the combined flows go southwards to merge into the Meghna River in Munshiganj district. The Meghna river moves down to the Bay of Bengal in an almost straight line [19-22].

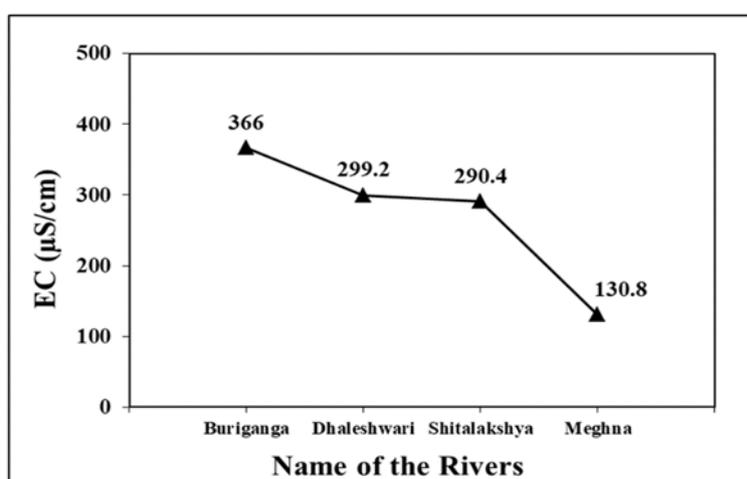


Figure 4 The EC values of the water samples of four central rivers of Bangladesh

The EC value of the Buriganga river water (Fattula point) was reported as 312 $\mu\text{S}/\text{cm}$ [7]. That experiment was conducted in September 09, 2015. In this investigation, the EC value of the Buriganga river water (Sadatghat point) was

found to be 366 $\mu\text{S}/\text{cm}$ and the experimental was conducted in September 2019. So, the reported value of EC are close to the observed value. On the other hand, the EC value of the Meghna river water was reported 115.8 $\mu\text{S}/\text{cm}$, research works was conducted in September 2015 [19]. The reported EC values of the Meghna river water is adjacent to the observed values. Therefore, it can be concluded that the observed EC value is close to the reported values published in the reputed journals.

3.2. The pH Values of the River Water Samples

Basically the pH value is a good indicator of whether water is hard or soft. The pH of pure water is 7. In general, water with a pH lower than 7 is considered as acidic, and with a pH greater than 7 is considered as basic. The normal range for pH in surface water systems is in the range of 6.5 to 8.5. The higher values of pH represent that there is high chloride, bicarbonate, carbonate in the water samples that means the water is alkaline [26-28]. The pH values of the waters of the rivers Buriganga, Dhaleshwari, Shitalakshya and Meghna were found to be 7.67, 7.38, 7.30 and 7.18 respectively. Figure 5 showed the pH values of four river water samples. From this investigation, it is clearly evidenced that the Meghna river water quality is near to neutral. The reported values of pH of the water of the rivers Buriganga, Dhaleshwari, Shitalakshya and Meghna were 8.02, 7.68, 7.55 and 6.90 respectively [7, 13, 18, 20]. The reported values of the pH of the four river waters are very similar to the investigated values.

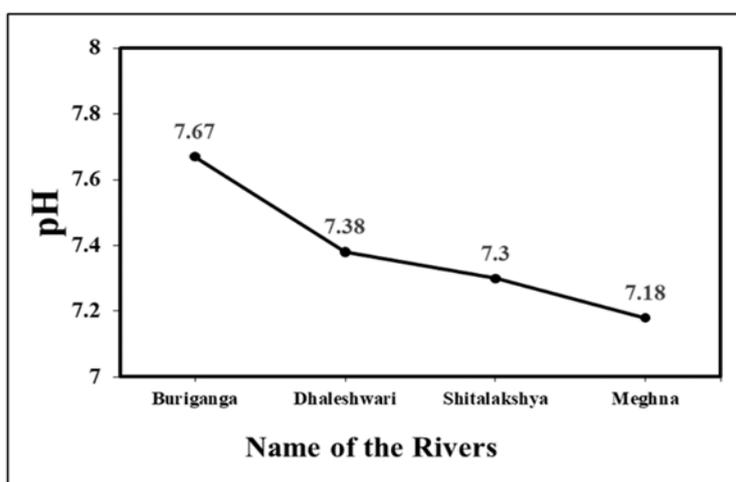


Figure 5 The pH values of the four central river waters of Bangladesh

3.3. Total Dissolve Solids (TDS)

The TDS is defined as all inorganic and organic substances contained in water that can pass through a 2-micron filter.

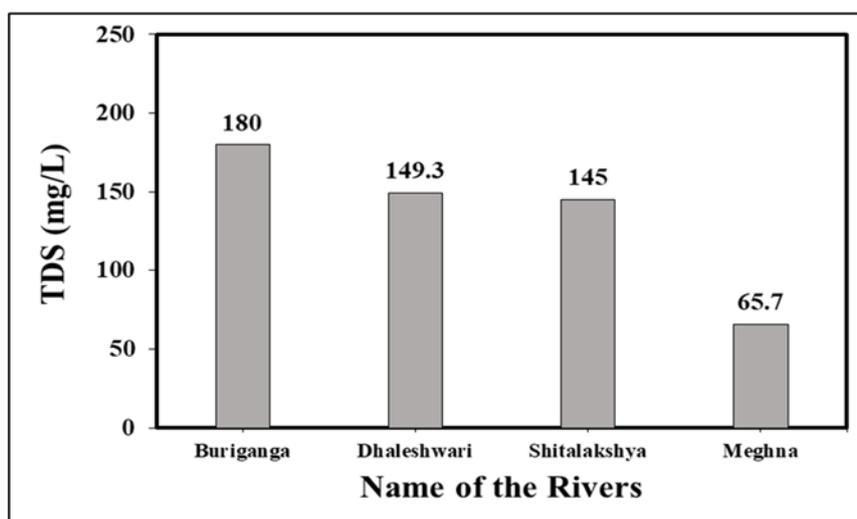


Figure 6 The TDS values of the water samples of four central rivers of Bangladesh

In general, TDS is the sum of the cations and anions in water. Ions and ionic compounds making up TDS usually include carbonate, bicarbonate, chloride, fluoride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, and potassium, but any ion that is present will contribute to the total. The organic ions include pollutants, herbicides, and hydrocarbons. The TDS is measured by milligrams per liter (mg/l). The TDS of ocean water is around 35,000 mg/l, fresh water is normally less than 100 mg/l, and the rain water is less than 10 mg/l [25-27]. The TDS values of the water of the rivers of Buriganga, Dhaleshwari, Shitalakshya and Meghna were found to be 180, 149.3, 145 and 65.7 mg/l respectively. Figure 6 represented the TDS values of water samples of four central rivers of Bangladesh. From this investigation, this is clearly evidenced that the Buriganga river water contains highest TDS values than that of the other three rivers of Bangladesh. The lowest TDS values were reported by the water samples of the river Meghna. The reported values of the TDS of the water of the rivers of the Buriganga and Meghna were as 372 and 72 mg/l respectively [7, 19]. The reported values indicated that the observed values are adjacent to the reported values. These reported values designated the validity of this research works. Finally, it can be concluded that the Meghna river water quality is much better than that of the Buriganga river water.

3.4. Salinity of the River Water Samples

Salinity is simply a measure of the amount of salts dissolved in water. An estuary usually exhibits a gradual change in salinity throughout its length, as fresh water entering the estuary from tributaries mixes with seawater moving in from the ocean. Salinity is usually expressed in parts per thousand (ppt) or percent (%). Generally, the fresh water from rivers has a salinity of 0.05% or less and for ocean water this is more than 3% [25-28].

The salinity values of the water samples of the rivers Buriganga, Dhaleshwari, Shitalakshya and Meghna were found to be 0.72%, 0.60%, 0.52% and 0.30% respectively. Figure 7 showed the salinity values of the water samples of the four central rivers of Bangladesh.

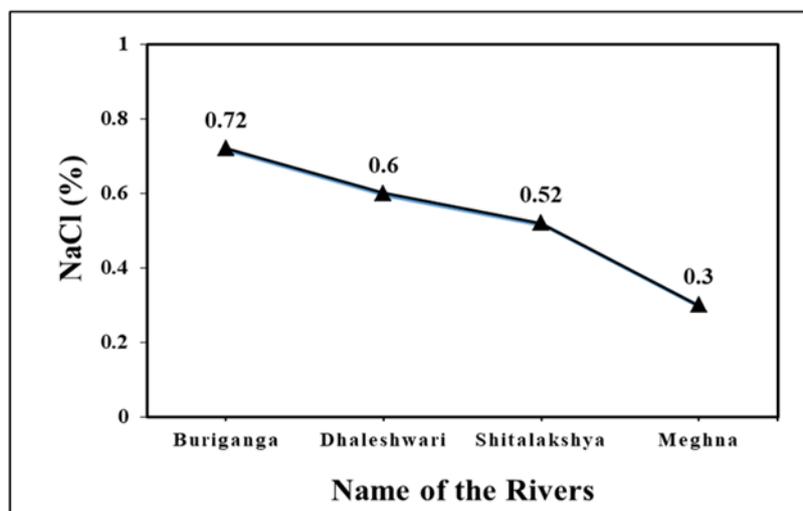


Figure 7 The salinity values of the water samples of four central rivers of Bangladesh

The observed values of the salinity of the four river water samples were compared to the reported values published in the journals. It was published that the salinity values of the water of the rivers Buriganga, Dhaleshwari, Shitalakshya and Meghna were as follows: 0.63%, 0.58%, 0.41% and 0.20% respectively [9, 14, 17, 20].

From this investigation, this is clearly evidenced that the Buriganga river water contains highest salinity values (0.72%) than that of the other three rivers of Bangladesh. The lowest salinity values (0.30%) were reported by the water samples of the river Meghna. Therefore, this is clear that the Meghna river water quality is much better compared to the Buriganga river water. In fact, Buriganga river is situated in the capital city Dhaka. As a result, a lot of urban and industrial wastes are discharges to the river Buringa and thereby the river water became polluted. This is well known in Bangladesh that the Buriganga river ranks among the most polluted rivers in Bangladesh. This investigation also proved that. On the other hand, Meghna river water quality is much better than three other river waters specially the Bruriganga river. The distance between Buriganga river (Sadarghat, Dhaka point) and Meghna river (Chandpur point) is around 68 kilometers. Though the water of the river Buriganga mixed with the Meghna river water but still the quality of the water of the Meghna river is much better.

4. Conclusion

In conclusion, the Megha river water quality is much better than that of the river Buriganga. The river Buriganga is flowing by the side of the capital city of Bangladesh, Dhaka. A lot of urban and industrial wastes are going to the Buriganga river and the river water became polluted. The Buriganga river ranks among the most polluted rivers in Bangladesh. The quality of the river waters of Dhaleshwari, Shitalakshya and Meghna were found better. The Meghna river water quality is good for marine environment. When moves from Buriganga to the downstream, the quality of the river waters getting better. Finally, the values of EC, pH, TDS, and salinity of the river water of Buriganga is alarming. The quality of the water of the three rivers is comparatively better than that of the river Buriganga

Compliance with ethical standards

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Disclosure of conflict of interest

All authors state that there is no conflict of interest.

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