RESEARCH ARTICLE OPEN ACCESS

Determination of Nutrients of the Halda River Water, Chittagong, Bangladesh

Mohammad Saydul Islam Sarkar[1], Md. Ashraful Azam Khan[2], Md. M. Maruf Hossain[3]

[1]Department of Oceanography, University of Chittagong, Chittagong-4331, Bangladesh
Email: saydul76@gmail.com
[2]Department of Fisheries, University of Chittagong, Chittagong-4331, Bangladesh
Email: aakimscu@yahoo.com
[3]Institute of Marine Sciences, University of Chittagong, Chittagong-4331, Bangladesh

Abstract:

The Halda River is one of the most important natural breeding ground of carp fishes in South Asia as well as in Bangladesh. The study was carried out to analyze the physico-chemical parameters of the effluent specially the nutrients coming from different sources & the physico-chemical changes in the water of Halda River due largely to these nutrients. Water samples from the freshwater resources were collected from different points and tide conditions and at different seasons for continuous monitoring during 2011. The data analyzed in different methods were followed during the study period like Spectophotometric methods for Nitrate and Phosphate determination. SPSS software was used for data analysis. Test of Significance (ANOVA) also done for statistical data analysis. The collected samples were analyzed for the following parameters: nitrate-N and Phosphate-P. The mean values of parameters were NO_3^-- 0.19 µgm/L, PO_4^-- 0.08 µgm/L. The finding results show the high values of Nitrate and Phosphate which is quite high with standards value for industrial effluent (EQS, 1991) for Bangladesh. The data showed the water quality slightly differs in monsoon and post-monsoon than winter season. Apart from destroying the quality of water, these increments of nutrients might be hazardous coming from different sources cause irreparable damage to the aquatic flora and fauna. Steps must be taken to save the Halda River from getting polluted or from unwanted eutrophication from the industrial effluents or from other sources.

Keywords - Halda River, Nutrient, Physico-chemical, Parameter, Effluent, etc.

INTRODUCTION

Paper and pulp industries situated near the Halda river cause water, air and solid waste pollution. Water is an integral part of operations within the paper and pulp industries and on average, the paper and pulp industries release tens of millions of waste water per day along with huge amount of nutrients. The waste water is fortified with various toxic chemicals like Volatile Organic Compounds(VOCs) such as terpenes, alcohols, phenols, methanol, acetone, chloroform, methyl ethylketone; detergents and surfactants; dyes and pigments; acids; and alkaline solutions; and lots of nutrients. The United States Environment Protection Agency (EPA) makes it mandatory that the waste water being discharged from the paper and pulp industry must be suitably treated before being discharged into rivers, lakes and other water bodies. But unfortunately there are no treatment facilities of all the industries having situated near the Halda River.

The effluent is rich in thiols, sulfur dioxide, sulfites and sulfides and this imparts a strong sulfuric stench to the effluent. Apart from this, it also

contains fibers, and resins. The waste water is also inclusive of bleaching agents such as hydrogen peroxide, chlorine dioxide and caustic soda. Other pollutants include whitening agents such as kaolin, calcium carbonate, talc and titanium dioxide.

Apart from destroying the quality of water, these increments of nutrients might be hazardous chemicals from different sources cause irreparable damage to the aquatic flora and fauna. These chemicals are accumulated in fishes, which in turn are consumed by birds, and animals like otter and mink. This leads to a condition called "Biological Accumulation" which is described as the accumulation of elements and compounds of harmful substances in the tissues of living organisms. These chemicals are persistent in thefood chain and move up from one level to another.

Solid waste produced by paper and pulp industries is disposed in a landfill. The nature of the solid waste produced by the paper and pulp industry is highly hazardous as it contains residual inks, dyes, coatings, starches, pigments, resins, fatty acids, nitrates, phosphates, paper fibers and kaolin. The resulting sludge is disposed in a landfill with the result that large amounts of land are used up to contain this waste. Apart from this, there is a significant risk of trace contaminants accumulating in the soil or the leachate running off into the nearby lakes and rivers or even contaminating the ground water level. Leachate from the solid wastes generated by the industries can easily run off to the Halda River in rainy season. Water always requires a state of equilibrium. Favorable condition appearedin nature before fish got his biological existance. Since then fish has been growing up and evolving towards upward lines harnessing the resources of nature and fighting against its advers forces.

Modern civilization is marked with the establishment of heavy industry that produce materials for better, faster and comfortable life. There is no doubt that it is science and technology that has brought man to this stage of prosperity. Man's strenuous efforts to improve his life style has put sofistication to has life. But in doing so, man has become consciously or unconsciously the greatest enemy of nature, water and environment. The more we are being developed materially the more we are doing harm to the environment onwhich depends our existence and vice varsa. We seenature's avenging attitude towards us. The results of increasing secretion of 'green house gases' that cause rifts in Ozone layer, global warming and increase in the sea level, acid rain, deplition of forests and pollution of air, water, food and soil need no longer be over exaggerated.

In stand of the global environmental condition if we look at the environmental situation of Bangladesh we also find that the level of environmentalpollution of this country is not so good. Among the different types of pollution, water pollution has reached to an allarming possition including Halda River, water is the most useful resource on earth economically, biologically and culturally. Without water, live can not survive.

With a marked rise in pollution, a rapid growth of industries near the great Halda River, the demand for pure water is gradually increasing. On the other hand the pollution of both surface and ground is rising everywhere. The industries such as Paper Mills near the Halda river, demands so much clear water, themselves, happened to be worst polluters of rivers. Usually these industries are established onthe bank of the Halda River or on a big canal which are connected to the river. Where water is easily avilable for power and for manufacturing process. Ironically enough the same industries discharge large quantities of their liquid and solid trade wastes, as well as crude sewage into the river containing huge nutrients. As a result, in way of the rivers, fishes which are formally known to be aboundant have now disappeared and even water supply are in danger.

Generally the potential impact of pollutants is more on the aquatic organisms than on the terrestrial organisms, because in the hydrosphere, pesticides and such other substances are transported to a greater distance and hance many more nontargetorganisms are likely to be exposed to them in the aquatic environment. Moreover, unlike the terrestrial environment in aquatic environment, the

body of organisms is bathed by the medium containing the toxicant.

Bangladesh is a riverine and developing country. In this country, major pollution is caused by the industrial wastes, sewage and agricultural wastes. To save the productivity and other resources of our water body, it is very essential to work about the Environmental Impact Assessment (EIA) and the effect of pollution upon the growth, development, reproduction and other processes of life cycle of aquatic organisms.

MATERIALS AND METHODS

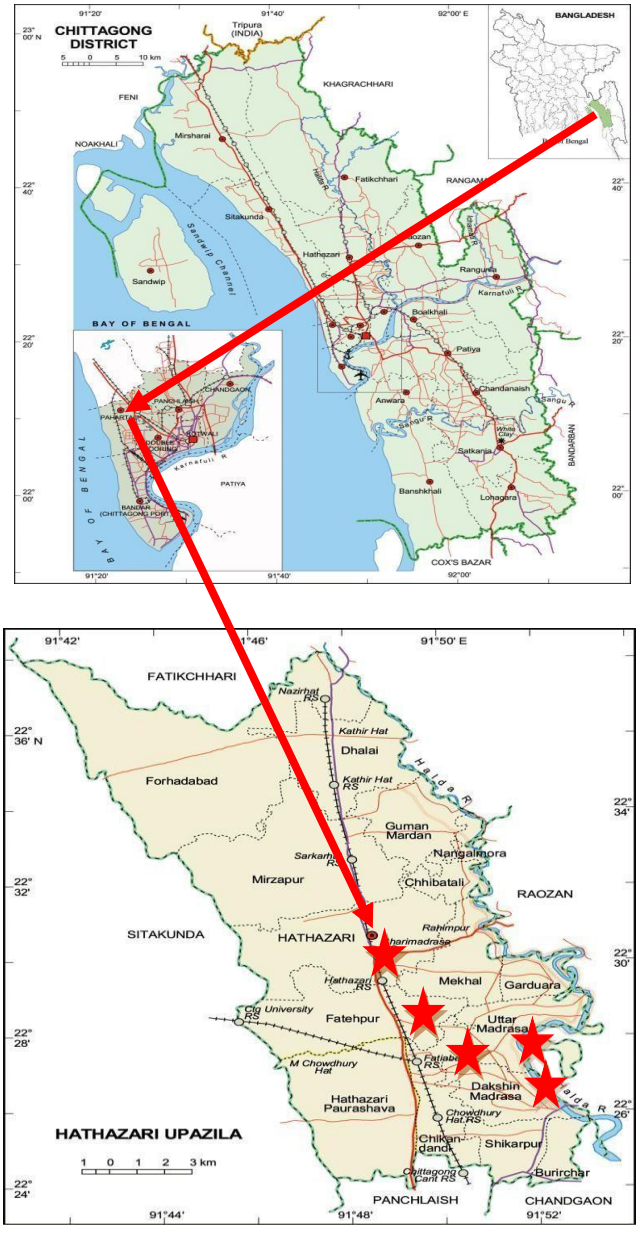
Monthly sampling was carried out from October to December, 2011 at 5 stations, 3 at the effluent discharge drain, and 1 at the meeting place and another one is for control. Water samples were collected during low tide.

Sampling stations

Asian Paper Mill up to 7 kilometers far away from Halda River. The wastes from different plants of these mills come out by different drains and combined together and finally discharge through a main effluent drain of the mill. Then the canal goes through Talukder Para, Nehalpur, Fokerer Vita and meet with Boalia canal in fisherman folk (Jele Para). Then the canal is going through the nearest urban area and opened in the 3-4 kilometer away Madarsah canal. Then Madarsah canal opened in the Halda River in Madaripul. It has been studied toassess the impact of the effluent/ nutrients dischargefrom this mill into the water body of the HaldaRiver. From the area, monthly sampling was made from October, 2011 to December, 2011 at five stations (Map). The station 5 was located one kilometer up stream to the station 4 (where the effluent meets with Halda) and considered as controlled station. So, during sampling period, therewas no effect of effluent of Asian Paper Mills in this station (station 5, controlled).

Table I Sampling stations

Station number	Station name
Station- 1	Main effluent drain of the mill
Station- 2	Nehalpur (Nanderhat)
Station- 3	Boalia canal
Station- 4	Madarsha canal
Station- 5	North Madarsha



Map I showing the sampling stations (★)

DESCRIPTION OF THE SAMPLING STATIONS

Station-1

All effluent opened into a big drain which ultimately opened to the nearest canal. It is adjacent with Hathazari road. Before mixing with canals water, effluent was collected from the big drain. This location has been considered as station-1.

Station-2

The station 2 was located at the Nehalpur (Nanderhat). It is one and half kilometers down to the station 1. It is situated on an urban area.

Station-3

Station 3 was located at the meeting place of the main drain and Boalia canal. It is situated in an agricultural field. It is also one and half kilometers down from station 2.

Station-4

This station was located near the Madaripul sluice gate, where Madarasha canal meet with the Halda River. This area called is Madaripul. It is also four kilometers down from station 3.

Station-5

The station 5 was located at the North Madarasha. It is located one kilometer up stream to the station 4 (where the effluent meets with Halda) and considered as controlled station. So, during sampling period, there was no effect of effluent of Asian Paper Mills in this station.

Methods of analysis

Nitrate-N (NO_3^-), at first 50 ml filtrate sample was taken in a 250 ml conical flask. Then added 1 ml Sulphanilamyed and shacked it well. After five minutes duration added 1 ml NNED solution. After 10 minutes it was taken Spectophotometric reading with the 543 nanometer and calculated the Nitrate- N (NO_3^-) with the absorbance (Standard Methods, APHA, 1976).

Phosphate-P (PO_4^- P), at first 50 ml filtrate sample was taken in a 250 ml conical flask. Then added 2 ml Acid ammonium molybdate solution and shacked it well. After few minutes later added five or six drops Stannous Chloride and kept it 30 minutes for Spactophotometric reading. After the duration was taken a Spactophotometric reading with the 690 nanometer and calculated the Phosphate-P (PO_4^-) with the absorbance (Standard Methods, APHA, 1976).

RESULTS AND OBSERVATIONS

Nitrate- N (NO_3^-)

Station- 1

The Nitrate- N value of station–1 ranged between 0.42 µgm/L to 0.20 µgm/L. The maximum value 0.42 µgm/L was found in monsoon (September, 2011) and the minimum value 0.20 µgm/L was found in winter (December, 2011). The value of Nitrate-N in post-monsoon was 0.22µgm/L. From the maximum value 0.42 µgm/L it started to gradually decrease and reached to its minimum value 0.20 µgm/L in winter. The average value of this station was 0.28 µgm/L.

Station- 2

The Nitrate- N value of station–2 ranged between 0.40µgm/L to 0.15µgm/L. The maximum value 0.40 µgm/L was found in monsoon (September, 2011) and the minimum value 0.15 µgm/L was found in winter (December, 2011). The value of Nitrate-N in post-monsoon was 0.20µgm/L. From the maximum value 0.40 µgm/L it started to gradually decrease and reached to its minimum value 0.15 µgm/L in winter. The average value of this station was 0.25µgm/L.

Station- 3

The Nitrate- N value of station–3 ranged between 0.24µgm/L to 0.07µgm/L. The maximum value 0.24 µgm/L was found in monsoon (September, 2011) and the minimum value 0.07µgm/L was found in winter (December, 2011). The value of Nitrate-N in post-monsoon was 0.11µgm/L. From the maximum value 0.24 µgm/L it started to gradually decrease and reached to its minimum

value 0.07 µgm/L in winter. The average value of this station was 0.14µgm/L.

Station- 4

The Nitrate- N value of station–4 ranged between 0.17µgm/L to 0.02µgm/L. The maximum value 0.17 µgm/L was found in monsoon (September, 2011) and the minimum value 0.02µgm/L was found in winter (December, 2011). The value of Nitrate-N in post-monsoon was 0.07µgm/L. From the maximum value 0.17 µgm/L it started to gradually decrease and reached to its minimum value 0.02 µgm/L in winter. The average value of this station was 0.09µgm/L.

Station- 5

The Nitrate- N value of station–5 ranged between 0.03µgm/L to 0.01µgm/L. The maximum value 0.03 µgm/L was found in monsoon (September, 2011) and the minimum value 0.01µgm/L was found in post-monsoon (October, 2011). The value of Nitrate-N could found in the other season inwinter (The value was 0.00µgm/L).The average value of this station was 0.013µgm/L.

STATISTICAL ANALYSIS

In the statistical analysis the data shows the Nitrate-N has medium significance difference (P> 0.01)with various seasons and stations (shows graphically in figure 10).

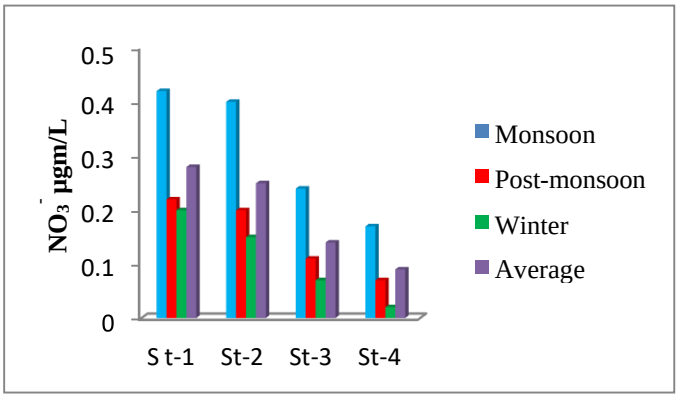


Figure 10 Nitrate- N value of station- 1, 2, 3, 4 & their average value

Phosphate- P (PO_4^-)

Station- 1

The Phosphate- P value of station–1 ranged between 0.22 µgm/L to 0.08 µgm/L. The maximum value 0.22 µgm/L was found in monsoon (September, 2011) and the minimum value 0.08 µgm/L was found in winter (December, 2011). The value of Phosphate-P in post-monsoon was 0.11µgm/L. From the maximum value 0.22 µgm/L it started to gradually decrease and reached to its minimum value 0.08 µgm/L in winter. The average value of this station was 0.14 µgm/L.

Station- 2

The Phosphate- P value of station–2 ranged between 0.18µgm/L to 0.08µgm/L. The maximum value 0.18 µgm/L was found in monsoon(September, 2011) and the minimum value 0.08 µgm/L was found in winter (December, 2011). The value of Phosphate- P in post-monsoon was 0.09µgm/L. From the maximum value 0.18 µgm/L it started to gradually decrease and reached to its minimum value 0.08 µgm/L in winter. The average value of this station was 0.12µgm/L.

Station- 3

The Phosphate- P value of station–3 ranged between 0.09µgm/L to 0.04µgm/L. The maximum value 0.09 µgm/L was found in monsoon(September, 2011) and the minimum value 0.04 µgm/L was found in winter (December, 2011). The value of Phosphate- P in post-monsoon was 0.05µgm/L. From the maximum value 0.09 µgm/L it started to gradually decrease and reached to its minimum value 0.04 µgm/L in winter. The average value of this station was 0.06µgm/L.

Station- 4

The Phosphate- P value of station–4 ranged between 0.05µgm/L to 0.01µgm/L. The maximum value 0.03 µgm/L was found in monsoon(September, 2011) and the minimum value0.01µgm/L was found in post-monsoon (October, 2011). The value of Phosphate-P could not found

in the other season in winter (The value was 0.00µgm/L).The average value of this station was 0.02µgm/L.

Station- 5

The Phosphate- P value of this station only found in a little amount that was 0.01µgm/L in the month of September, 2011 in monsoon period. But in other two stations sample were showed blank for phosphate-p. All reading of the Spectrophotometers couldn't recognize the any presence of phosphate molecule in post-monsoon and in winter.

STATISTICAL ANALYSIS

In the statistical analysis the data shows the Phosphate- P has no significance difference (P> 0.01) with various seasons and stations (shows graphically in figure 11).

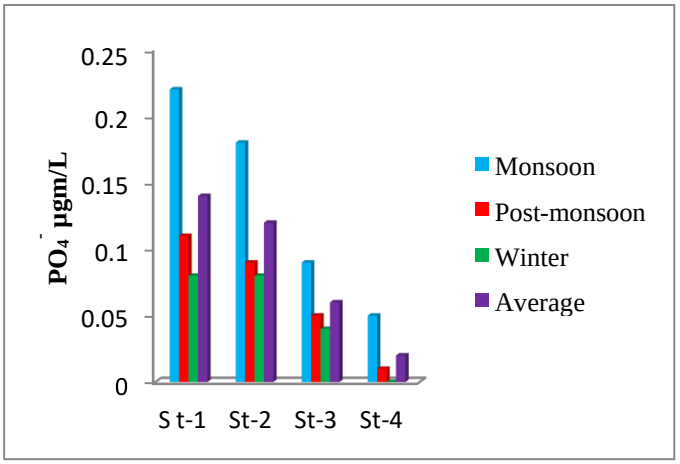


Figure 11 Phosphate- P value of station- 1, 2, 3, 4 & their average value

DISCUSSIONS

Nitrate- N (NO_3^-)

The maximum values of nitrate were observed at station-1 as 0.42µgm/L in the month of October, 2011 (monsoon); and the minimum of nitrate was 0.00µgm/L at station-5 in the month of December, 2011(winter). The values of nitrate at station-1 were always higher than those of others. The recorded values of nitrate were high in high in monsoon and low in winter.

Alam *et. al* (2007) worked and stated that the effluent and discharge area have a low concentration of nitrate. Majid and Sharma, (1999) studied on the Karnafully River and found very low concentration of nitrate. Ahmed *et. al* (2010) also found similar lower nitrate values in the Halda River water, which is similar to the present study.

Phosphate- P (PO_4^-)

The maximum values of phosphate were observed at station-1 as 0.22µgm/L in the month of October, 2011 (monsoon); and the minimum of phosphate was 0.00µgm/L at station- 4 and 5 in the month of December, 2011(winter). The values of phosphate at station-1 were always higher than those of others. The recorded values of nitrate were high in high in monsoon and low in winter.

Alam *et. al* (2007) worked on river water quality and stated that the effluent and discharge area havea low concentration of phosphate. Majid and Sharma, (1999) studied on the Karnafully River and found very low concentration of phosphate. Ahmed *et. al* (2010) also found similar lower phosphatevalues in the Halda River water, which is similar to the present study.

CONCLUSIONS

The paper and pulp industries need to identify strategies which will effectively deal with the growing nutrients problem. While the traditional system expects the environment experts to deal with this problem, it does little to solve the problem. Although there are various nutrients prevention techniques, more R&D activities in the area of nutrients control must be initiated. The entire paper and pulp industry has to view this challenge as the entire industry's responsibility and formulate appropriate plans to tackle nutrients discharge and make suitable use of the existing resources.

Halda River water quality significantly varied with seasons, tide conditions and locations. From the

location dependent variation it can be concludedthat effect of sea water reaches up to the Kalurghat point. So there is possibility of destroying biodiversity of the Halda River by the intrusion of nutrients which produce unanticipated blooms in the water column at Karnafuli River water in the pre-monsoon period at high tide. Apart from these nutrients, some hazardous chemicals from paper mills may cause irreparable damage to the aquatic flora and fauna. These chemicals are accumulatedin fishes, which in turn are consumed by birds, and animals. This leads to a condition called "Biological Accumulation" which is described as the accumulation of elements and compounds of harmful substances in the tissues of living organisms. These chemicals are persistent in the food chain and move up from one level to another.

REFERENCES

1. *Ahmed, M. J., Haque, M. R., Ahsan, A., Siraj, S., Bhuiyan, M. H. R., Bhattacharjee, S. C and Islam, S. 2010. Physicochemical Assessment of Surface and Groundwater Quality of the Greater Chittagong Region of Bangladesh, Pak. J. Anal. Environ. Chem. Vol. 11, No. 2 (2010) 1.11.*

2. *APHA (American Public Health Association), 1976. Standard Methods For the examination of water and waste water, 13th edition, 1976, Broadway, New York-10019.*

3. *Alam, MD. J. B., Muyen, Z., Islam, M. R., Islam, S., Mamun, M., 2007. Water quality parameters along rivers. Int. J. Environ. Sci. Tech., **4** (1), 159-167.*

4. *Majid, M. A., Sharma, S.K., (1999). A study of the water quality parameter of the Karnaphuly River, J. Ban. Chem. Soc., **12** (1), 17-24.*

5. *Majid, M. A and Sharma, S. K.1999. Journal of the Bangladesh Chemical Society, 12 (1999) 17.*