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Study on the physico-chemical and Coliform load of waste water collected from Haldia Industrial site

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ARTICLE INFO

Received: 15.09.2020
Revised: 23.10.2020
Accepted: 18.10.2020

Key word:

physico-chemical,

Haldia,

Green belt canal,

coliform.

ABSTRACTS

Spatial variations of some physico-chemical and microbial profile of Haldia Industrial waste water werestudiedat seven sampling stations along the Green belt canal of Haldia Industrial site during the month of January and February, 2020.The site receives domestic, agricultural and high industrial wastes. The waste water is being influxes into the Haldi River through Green belt canal and finally Bay of Bengal. Considering the ecosystem of HaldiRiver for the sustainability of aquatic animals, water quality monitoring was carried out. The pH, TSSandTDS vary inthe range of 7.30 – 7.75, 100 mg/L -525 mg/L and 225 mg/L -625 mg/L respectively. Dissolved oxygen, biochemical oxygen dem and (BOD) valueat different sites varies within a narrow range 0.92 mg/L–13.2mg/L and 4.0 mg/L – 48mg/L,respectively. The coliform count at the sampling site varied from 70-2400 MPN/100ml.Present result indicates that all the studied parameters are deviate from standard WBPCB (Cornwell, 1985) report.So, this result informed that proper effluent treatment plant or bioremediation is required before influx into the green belt canal otherwise may also trigger outbreaks of waterborne disease and alter the aquatic system of Haldia River.

INTRODUCTION

Haldia is one of the most rapidly growing towns in West Bengal and in on the deltaic tidal range of the Ganga basin. It is located at distance of 125 km South-West of Kolkata and 50 km from the Bay of Bengal at the confluence of three rivers Hooghly, Haldi&Rupnarayan in Purba Midnapore district. Haldia is also one of the biggest ports in the Eastern region and focal point for industrial development in West Bengal. The Haldia Planning Area (HPA) is bounded by the rivers Hooghly, Haldi&Hajli canal and covers a total area of around 326.85 sq. km. spread over 258 mouzas. The HPA is divided

in four police stations namely, Haldia, Mahisadal, Sutahata&Durgachak. Haldia is a port based industrialtown in West Bengal, India. Ministry of Urban Development, Govt. ofIndia has announced in 2016 that this town will be converted as one of the four smart cities in West Bengal. Haldia is also one of the biggest ports in the Eastern region and the focal point for industrial development in West Bengal. The population of Haldia as a Town has increased from 9968 in 1971 to around 200827 in 2011.

It is an industrial hub having a base of chemical and petrochemical industry. Many large industries like M/s. Indian Oil Corporation Refinery, M/s. Haldia Petrochemicals Ltd., M/s. MCC-PTA, M/s. South-Asian Petrochemicals, oil/gas terminals for HPCL, BPCL and Reliance have been set up in this region. Besides, other large industries operating in this area are detergent manufacturing unit, chemical unit, pesticide manufacturing unit, lead-acid battery manufacturing unit, vegetable oil producing unit, textile unit, tank firms either storing edible oil or petroleum products etc. A number of non-recovery type coke oven plants are also coming up in this area due to the locational benefits of obtaining imported coking coal directly through Haldia Port. In future, the industrial base is likely to be diversified, and many new industries are proposed as per the perspective plan for Haldia Planning Area.

Throughout the year, these units are generating tonnes of solid, liquid and gaseous waste materials that are exposed and released to the environment nearby. As per rule, majority of them are following the green belt mandate and treatment of wastes prior to disposal, many of them are offenders also.

The Green Belt Canal (GBC) which was originally built for fire-water supply to the port area is presently carrying most of the trade

effluent of the industries located at Haldia Municipal Area. The GBC has a stretch from the Oil Jetty-1 in the Haldia Dock Area to the Patikhali gate end (Fig.1)Boundary (in Red line) of critically polluted area in Haldia demarcated by CPCB (Green line shows the area where industries are located within the identified area and have major impact).The GBC and the Hooghly River is regularly monitored at specific locations. The GBC is guarded by metallic gates at both ends and does not seem to have a definite flow profile. The Patikhali gates are opened to discharge the effluent. The green belt canal receives liquid effluent that is mostly treated, from different industries through a no. of outfalls. Except 3 nos. of units, viz. IOC and United Phosphorous Ltd., all other units discharge their effluent to the canal indirectly i.e. to any other canal/drain/channel which is linked to GBC. IOC discharges only the overflow of its catch pit no. 6 to the canal. The industries are mostly located along the bank of river Hooghly and on the both sides of Haldia Petrochemical Link Road. Most of these industrial units discharge their effluent into the Green Belt canal leading to the river Hooghly. The water quality of Green Belt canal is regularly monitored by the State Board in eleven sampling stations.

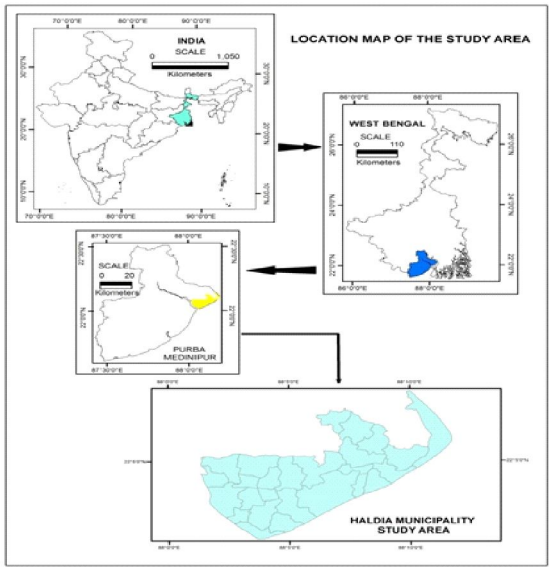
In 2017, Central Pollution Control Board has ordered Tata Chemicals to shut its Haldia Plant which produced fertilizers like diammonium phosphate and single superphosphate for non-compliance of norms on liquid effluent discharge. Chemicals released from pesticide industry are persistent in nature. They can affect soil ecology, enter into the food chain through plant food materials and affect human health. Oil refinery and petroleum industries are most potent in their ability to generate chemicals which are persistent, toxic, bioaccumulable/ biomagnifiable, carcinogenic/ mutagenic and dispersible. The hazardous oily waste is composed of total petroleum hydrocarbons (TPH), water, and sediments which is more polluted (Dibble et al., 1979). The TPH constitutes is more toxic because this complex mixture is alkane; aromatic; nitrogen, sulfur, and oxygen containing compounds (NSO); and asphaltene fractions (Bhattacharya et al., 2003).The effect of oil contamination has severe impacts in the plant and animal ecosystem including human health (Mandal et al., 2007). Crude oil exposure is more injurious and damage to lungs, liver, kidneys, intestines and other internal organs. Polycyclic aromatic hydrocarbons (PAH) may lead to cancer, Inhalation leads to headache, nausea, dizziness, respiratory irritation, BTEX (Benzene, Toluene, Eethyl benzene & Xylene) cause mutations, cancers, birth defects, nervous disorders, and liver disease, depression, irregular heartbeats etc. (Lee et al., 2006; Chen et al., 2008; Lewis et al.,2008 and Rice et al., 2007). Oil contaminated soil loose its fertility for crops and have impact on seed germination. (Yoshida et al., 2006 and Gong et al., 2001). Hence disposal of the oily waste in an improper manner may cause a serious environmental problem (Yustle et al., 2000). Polluted water and soil have detrimental impact on soil fertility, microbial population in the soil and crop quality. They

cumulatively can affect sustainable agriculture. Keeping the anthropogenic pressure comes from Haldia Industry, present projecthighlight the level ofphysico-chemical and microbial profile of waste water from Haldia Industrial site.

MATERIALS AND METHODS

1. Location of the study area

Haldia is one of the most rapidly growingtowns in West Bengal on the deltaic tidal range of the Ganga basin. It is located at distance of 125 km south-west of Kolkata and 50 km from the Bay of Bengal at the confluence of three rivers Hooghly, Haldi and Rupnarayan in Purba Midnapore district. The extension of Haldia (township) is 22º01´262 2 N to 22º04´182 2 N latitude and 88º01´562 2 E to 88º08´40 2 2 E longitude. Haldia municipality has 26 wards but industries are concentrated mainly in ward No.8, 9, 11 and 12.So sample has been collected both from more industrial wards (No.11 &12)and residential wards (No.19 & 23).



2. Collection of Water sample:

Water samples are collected from the waste laden area of the each industrial unit at 7 points (effluent release point near IOC second Gate, IOC Main Gate, Hoogly Met Coke Gate, Exide Gate, TATA Chemicals, Petrochemicals Unit, UPL gate etc.) in sterile amber colored bottles and transported to the laboratory for analysis.

Figure:1 GBC near Haldia petrochemicals

3. Determination of Physico-chemical parameters of water

3.1 Determination of pH

The pH of the surface water was measuredat a time with a potable digital pH meter (Model BST-BT-BT65; sensitivity =±0.01).

3.2 Determination of Total Dissolved Solid (TDS) and Total Suspended Solid (TSS)

The total suspended solid, total dissolved solids were analyzed the laboratory as per the standard procedure (APHA, 1998).

3.3. Determination of DO and BOD of water sample For chemical variables of water like Dissolved Oxygen (DO) and Biochemical oxygen Demand (BOD) was analyzed by the standard method (APHA, 2005;Trivedy and Goel, 1986).

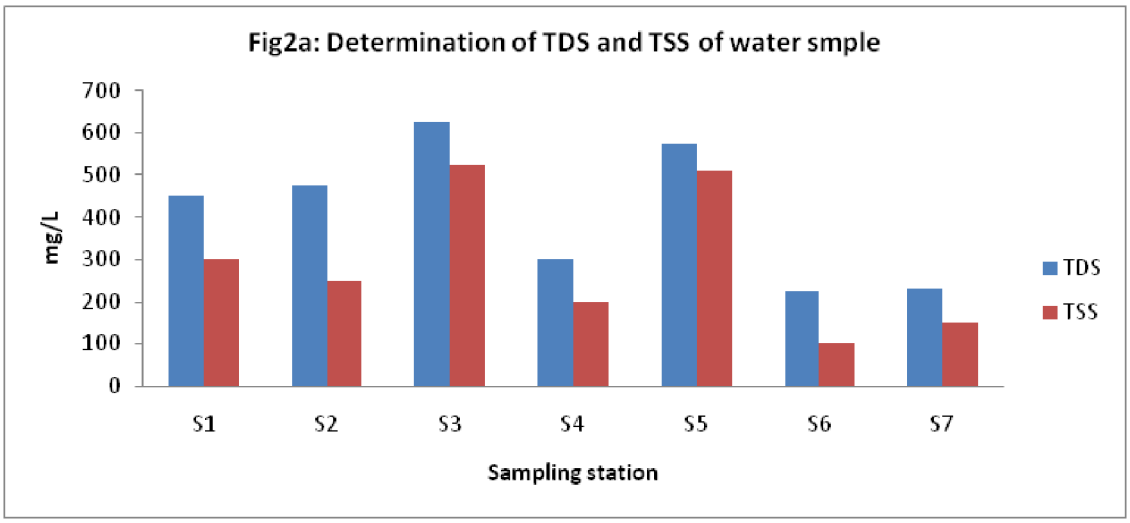
3.4 Determination of total coliform in water

The total coliform and fecal coliform of water sample was determined Multiple fermentation (5test tube) Technique by (APHA, 1998).

RESULTS

Table .1 Determination of pH, TDS, and TSS of the collected water sample

Sampling station	Water sample	pH	Total Dissolved Solids (TDS, mg/L)	Total Suspended Solids (TSS, mg/L)
S1	Green belt canal, IOC 2nd Gate	7.36	450	300
S2	Green belt canal, IOC main Gate	7.55	475	250
S3	Hoogly Met coke	7.75	625	525
S4	Behind Exide	7.68	300	200
S5	Tata Chemicals	7.30	575	510
S6	Haldia Petrochemicals	7.47	225	100
S7	Near UPL Gate	7.65	230	150



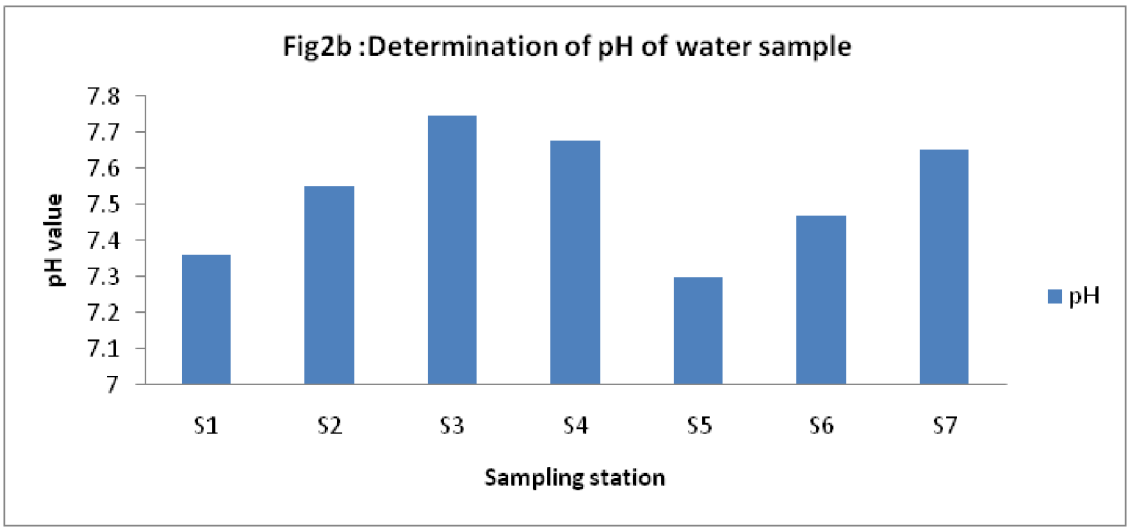


Table.2Standard value of treated Industrial wastewater by WBPCB

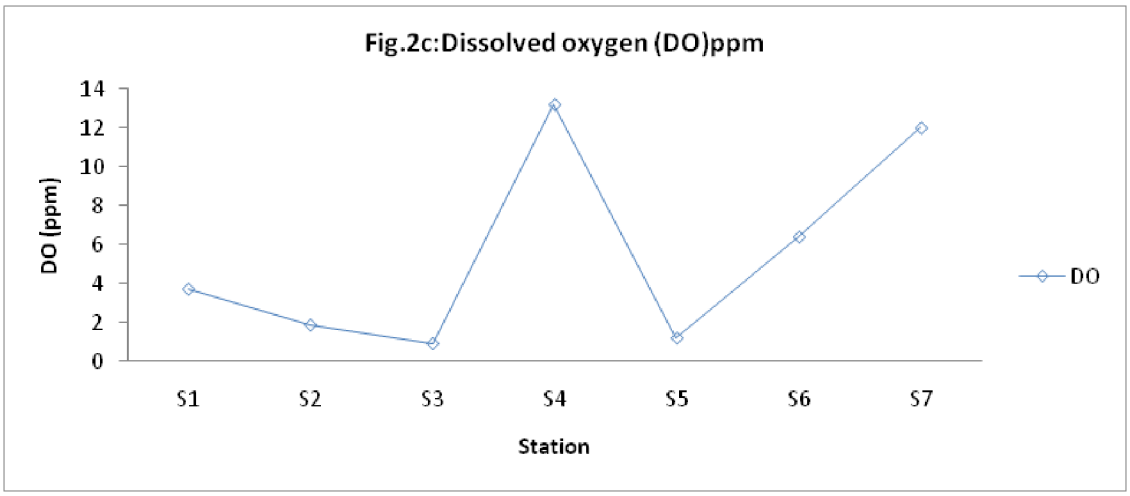
Sl. No	Parameters	Unit	WBPCB Standard
1	p^H	-	6.5-8.5
2	TSS	mg/L	100
3	TDS	mg/L	200
4	DO	mg/L(ppm)	6
5	BOD	mg/L(ppm)	30
6	COD	Mg/L	250
7	Coli form	MPN/100ml	<200

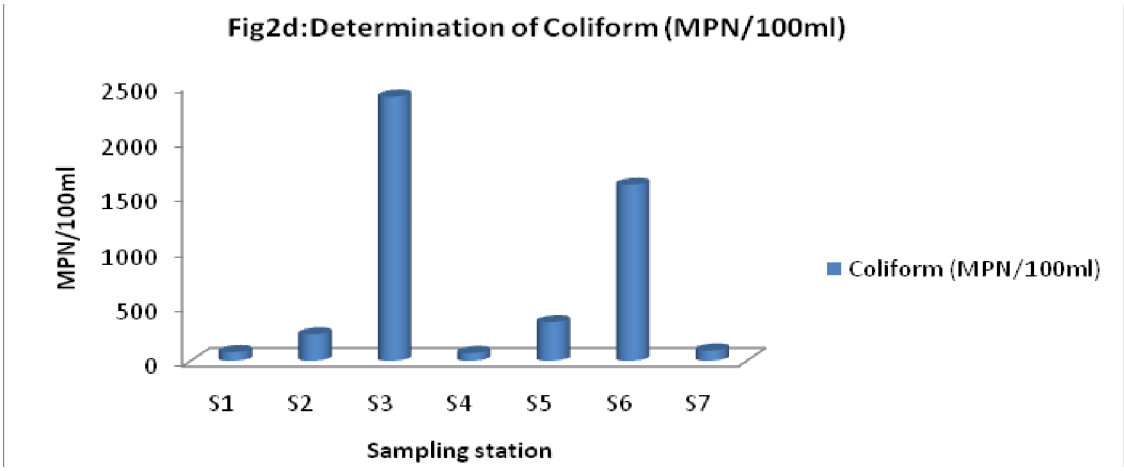
Table.3Typical range of composition of untreated Industrial wastewater (Davis and Cornwell, 1985)

Sl. No	Parameters	Unit	WBPCB Standard
1	p^H	-	6.5-8.5
2	TSS	mg/L	100-350
3	TDS	mg/L	200-1000
4	DO	mg/L(ppm)	6-8
5	BOD	mg/L(ppm)	100-300
6	COD	Mg/L	250-1000
7	Coliform	MPN/100ml	<230(91/492/EEC) <200(ONRW)

Table: 4 Determinations ofDO, BOD, and Coliform

Sampling Station	Water sample	Dissolved Oxygen (DO) ppm	Biological Oxygen Demand (BOD) ppm	Coliform (MPN/100ml)
S1	Green belt canal, IOC 2nd Gate	3.72	21	79
S2	Green belt canal, IOC main Gate	1.88	6.8	240
S3	Hoogly Met coke	0.92	42	2400
S4	Behind Exide	13.2	13.6	70
S5	Tata Chemicals	1.2	48	350
S6	Haldia Petrochemicals	6.4	36	1600
S7	Near UPL Gate	12	4.0	94





DISCUSSION

Water pH

The water pH of allthe sampling stations showed slightly alkaline (Fig.2b) and remainedalmost constant (pH7.30 – 7.75) which is within the standard value (Table-1,2&3). Alkaline pH of each water bodies was due to discharge of alkaline chemicals from theHaldia industrial area or due to rainwater-runoff fromembankments rich in soluble alkaline matters. Comparatively high pH of the water atHoogly Met coke may be attributed to discharge of huge raw coke waste in to the Green Belt canel. According to Boyd (1990), the high pH can also affect fishhealth. For most freshwater species, a pH range between6.5 - 9.0 isideal, the observed pH is usually between pH 7.30 and 7.75. Therefore,the observed pH of water in different stations indicates within the normal range for aquaculture.

Total Dissolved Solid (TDS) and Total Suspended Solid (TSS)

The population of Haldia as a Town has increased from 9968 in 1971 to around 200827 in 2011. It is an industrial hub having a base of chemical and petrochemical industry. Many large industries like M/s. Indian Oil Corporation Refinery, M/s. Haldia Petrochemicals Ltd., M/s. MCC-PTA, M/s. South-Asian Petrochemicals, oil/gas terminals for HPCL, BPCL and Reliance have been set up in this region. Besides, other large industries operating in this area are detergent manufacturing unit, chemical unit, pesticide manufacturing unit, lead-acid battery manufacturing unit, vegetable oil producing unit, textile unit, tank firms either storing edible oil or petroleum products etc. Such industrial waste consist different types of dissolved solid materials likecarbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, calcium, magnesium,sodium, potassium, iron, manganese, and a few others.. TheTDS valueof seven water sampling station varies from225 mg/L -625 mg/L (Table- 1) which deviate from standard permissible level (Table2&3). The TDScorresponding to each location isshown in Fig.2a. The maximum value

of TDS is 625mg/L at Hoogly Met coke. It is due to discharge of unused high coke in to the water body. This water alsocontains huge quantity of organic and inorganic matterswhich come from this industry. The minimum valueof TDS is 225 mg/L at site Haldia Petrochemicals. This Low value indicates the presence of insoluble hydrocarbon in the water which is influxed fromHaldia Petrochemicals. The concentration of TSS for the water samples ranged from 100 mg/L -525 mg/L which were also exceeded the desirable limit(Table-2&3).

Dissolved oxygen and Biochemical oxygen demand of water sample

The dissolved oxygen (DO) is one of the most important parameters ofwater quality assessment. It plays an important role on the biotic life ofan aquatic system and this can be used as an index of water quality forpollution studies (Thirumala et al, 2011).The range of DO value of the studied water sample is 0.92 mg/ L–13.2mg/L which indicate that the DO value of four stations are below the permissible level and other three stations are just above the permissible level.Therefore,present investigation indicates that Green belt canal water is considered as unhealthy for aquatic animals. Maximum values of DOobserved were 13.2 mg/lit at Behind Exideand minimum valuesobserved were 0.92 mg/ lit at Hoogly met cock station during the studyperiod (Fig.2c and table-4). High values of DO at Behind Exide could be due to high expose with tidal water than other stations. In general, a saturation level of at least5 mg/lit is required (Lioyd, 1992) for aquatic animal. Values lower thanthis can put undue stress on the fish, and levels reaching less than 2mg/L may result to death (but 3 mg/L to some species). Biochemical Oxygen Demand (BOD) detects the presence of organic load as well as microbial population. With increase the BOD value decrease the water quality. Drinking water usually has a BOD ofless than 1 mg/l. But, when BOD value reaches 5 mg/l, the water isdoubtful in purity (WHO, 2011). The BOD of water sample variedfrom 4.0 mg/L – 48mg/L throughout the sampling stations(Fig.2d) which is within the permissible level and some stations exceed the standard but average result indicate the presence of high level of anthropogenic stress. Many scientist also reported that an increase in BOD level as indicative of increasing pollution and hazards for aquatic animals (Kudesia and Verma, 1986; Mahadevan and Krishnaswamy, 1984, Sinha, 1988). With high anthropogenic pressure in water causes ecological unbalanced(Chandrashekar et al, 2003).Therefore, proper wastewater management required to minimize the anthropogenic load in Green belt canal.

Coliform in water

Coliform bacteria consist of several genera belonging to Family *Enterobacteriaceae*.Fecal coliform which belongs to this group isfound mostly in feces and intestinal tracts of humans and other warmblooded animals. It is not pathogenic; however, it is a goodindicator of the presence of pathogenic bacteria. High levels of fecalcoliform in the water may cause typhoid fever, hepatitis, gastroenteritis,dysentery and eat

infection. In recent times increased attention isgiven to the possibility of cultured fish as vector of human pathogenicbacteria (Islam et al, 2000). Fish living in natural environment areknown to harbor pathogenic Enterobacteriaceae (pillay, 1990). Invasionof fish muscles due to the breakage of immunological barrier offish by pathogen is likely to occur, when the fish are raised in pondwith coliform of greater than 10^4per 100 ml, in pond water (Guzmanet al, 2004).The maximum density of total coliform (TC) in the water was recordedinHoogly Met cokeand Haldia Petrochemicals station, which may be due to high exposure with fecal material of local people compare to other stations and low amount of TC was enumerated in Behind Exidestation(Table- 4&Fig.2d) but the average coliform load in all the stations are not suitable for sustainability aquatic animals.Therefore, one of the important recommendation outputs of the present study is that the local authority in Haldia Municipality should take this serious issue of water quality degradation in Haldi River water. Moreover, there should be a regular orconstantly monitoring for the quality of the stream, because this could increase the risk of direct threats to humanhealth and environment, because more pollution could increase the concentrations of unhealthy water pollutants forall organisms

CONCLUSION

Present study highlight the pollution level of Green belt channel which information will be more important for Waste water quality management of Haldia Municipality as well west Bengal Pollution control board.Therefore, one of the important recommendation outputs of the present study is that the local authority in Haldia Municipality should take this serious issue of water quality degradation in Haldi River water. Moreover, there should be a regular orconstantly monitoring for the quality of the stream, because this could increase the risk of direct threats to humanhealth and environment, because more pollution could increase the concentrations of unhealthy water pollutants forall organisms.

ACKNOWLEDGEMENT

The authors are thankful to Principal, Dr. JayasreeLaha,Raja N.L .Khan Women's College (Autonomous), for providing the library, laboratory facilities and for uninterrupted encouragement.

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