Environmental Pollution on Turag River Due to Kashimpur-Konabari Industrial Area

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NOVEMBER, 2014

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A Thesis Submitted to the Department of Civil and Environmental Engineering Islamic University of Technology of Islamic Cooperation in Partial Fulfilment for the Degree of Bachelor of Science in Civil Engineering Organization

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NOVEMBER, 2014

DECLARATION

We hereby declare that the undergraduate project work reported in this thesis has been performed by us and this work has not been submitted elsewhere for any purpose (except for publication).

November, 2014

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ABSTRACT

Bangladesh observed industrialization since last one hundred years. The process was in small level but the change of time, the appearance of industrialization has changed. Garments industries have taken the place of handlooms. This has happened not only in case of garments industry but also in other industries because of mechanization. Our country is facing a great challenge to protect the environment because of this kind of industrialization. The industrial belts are being more and more polluted with a numerous population. Every year 1.5 million children die from diarrheal diseases (WHO 2009), and many of these deaths can be attributed to unsafe drinking water. Lack of access to drinking water and exposure to waterborne diseases from unsafe drinking water are problems faced by many people in the developing world. The WHO (2010) estimates that 884 million people worldwide lack access to improved sources of drinking water. Persons obtaining water from unimproved sources are at risk of drinking water contaminated with pathogens that may cause diseases such as cholera, enteric fever, dysentery, and hepatitis. Even people with access to so-called improved sources may not have microbiologically safe water and are at risk for developing the same diseases caused by drinking from unimproved sources. For these reason governments are also concerned about the pollution due to industrialization and urbanization. Some rules and regulations are also imposed on industries for human safety measurements. This study was conducted to investigate the effectiveness of imposed law and further assessment if necessary.

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CHAPTER ONE:

INTRODUCTION

1.1 Background:

Water is the key ingredient for survival of all life forms on this planet. Hence, quite naturally human settlements old or new chose to settle close to a source of fresh water. Despite its importance, water is the most poorly managed resource in the world (Fakayode, 2005). The existing tendency of industrialization and urbanization may contribute greatly to the poor quality of water through indiscriminate disposal of solid waste, industrial effluents and other toxic wastes which are the major environmental issues posing threats to the existence of human being (Furtado et al., 1998; Chindah et al., 2004; Ugochukwu, 2004; Emongor et al., 2005; Rahman et al., 2008). The concentrations of chemical parameters of industrial effluent were above the allowable limits and also tended to accumulate at the downstream area (Fakayode, 2005). Generally municipal solid waste is collected and dumped in a mixed form in an unscientific manner on open waste land or low lying areas even near rivers, ponds and other ecological sensitive regions, which resulting in the pollution of water whereby the quality of the water deteriorates (Sahu, 2007). The waste dump sites virtually become a breeding ground for all kinds of diseases (Sahu, 2007). Solid waste leachate is the greatest threat to groundwater which possesses various chemical and biological contaminants (Bidhendi et al., 2010).

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of industrialization. The industrial belts are being more and more polluted with a numerous population.

One of the main industrial belt near the capital city of Bangladesh,Dhaka, is the Konabari BSCIC (Bangladesh Small and Cottage Industries Corporation) area at Gazipur district adjacent to the capital city Dhaka of Bangladesh, which is approximately at the latitude of 24.00ºN and longitude 90.34ºE. The elevation of the area was approximately 10 meters and situated beside the Tangail-Gazipur highway. This area is geographically a part of the Pleistocene terrace, popularly known as madhupur tract which composed of alluvial soil of the Pleistocene period. Such lands are characterized by high, undulated land surface with red soil, criss crossed by flood plains and streams. The Turag River is flowing through the study area. The study area is a unique place where industrial effluents are directly discharged through different channels into the river, and solid wastes are dumped regularly on the bank of the river in an unscientific manner. In this area there are approximately 152 polluter industries,56 dyeing and textile industries, 50 chemical and pharmaceuticals,9 food processing and 37 other engineering industries. Each major industries of 10 ton capacity produces 1250 m^3 effluent each day which contains an assortment of chemicals including salts, dyes, bleaches etc.

1.2 Objectives:

This paper has two objectives. The first objective of this study is to determine the current status of Turag river water quality by measuring the various physicochemical parameters like pH, total dissolved solids (TDS), total suspended solids (TSS), 5 days biochemical oxygen demand (BOD5), chemical oxygen demand (COD), Dissolved oxygen (DO) etc. Then find out the effectiveness of present water treatment process

and measurement taken by industries and government by comparing the obtained data from past few years and present conditions of Turag River.

The second objective is to evaluate the mitigation process of water pollution in Turag River caused by both industrial and domestic water (treated or untreated) discharge to it. The aim is to point out what kind of water management and allocation challenges the sectors may face and the intensification of these sectors may cause, how the current water governance can answer to these challenges and whether there is need for improved water management, while considering the economical, ecological and social impacts of these water-related activities.

The research is based on the databases of international agencies and existing literature, including published articles, reports and documents, as well as information collected from the international, governmental and local organizations.

CHAPTER TWO:

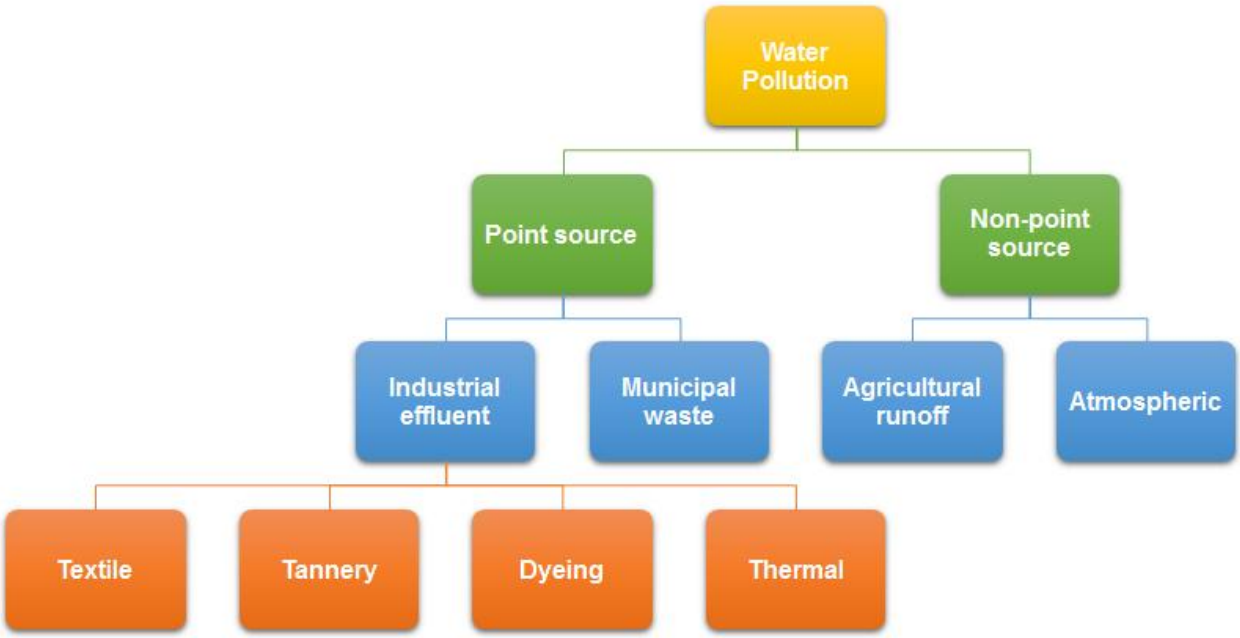
LITERATURE REVIEW

2.1 Causes of Pollution

Industry is a small user of water in terms of quantity, but has a significant impact on quality. Over three-fourth of fresh water draw by the domestic and industrial sectors, return as domestic sewage and industrial effluents which inevitably end up in surface water bodies or in the groundwater, affecting water quality (Mukharjee and Nelliyat, 2006). Presently 10% of waste water generated is being treated; the rest is discharged as it into water bodies (Sattar and Islam, 2005). When the waste stream contains a complex mixture of toxic substances predominantly natural and synthetic organic substances, metals and trace elements as well as pathogens from domestic and industrial sectors enter into streams, river and other water bodies, they get dissolved or suspended or deposited on the bed resultant in the pollution of water quality (Islam and Tanaka, 2004).

Heavy metals such as Cu, Fe, Pb, Mn, Zn, Cd, Co etc which are present in water as trace amount, but have significant effect on water environment and thus on human existence. Contamination of these heavy metals deteriorates the water quality i.e. change the water properties such as pH, TDS, EC etc and alter natural processes and natural resource communities, unabated degradation of the aquatic environment poses consequences for fishery resources and their habitats.

2.2 Sources of Pollution:



2.3 Categories of the Industries

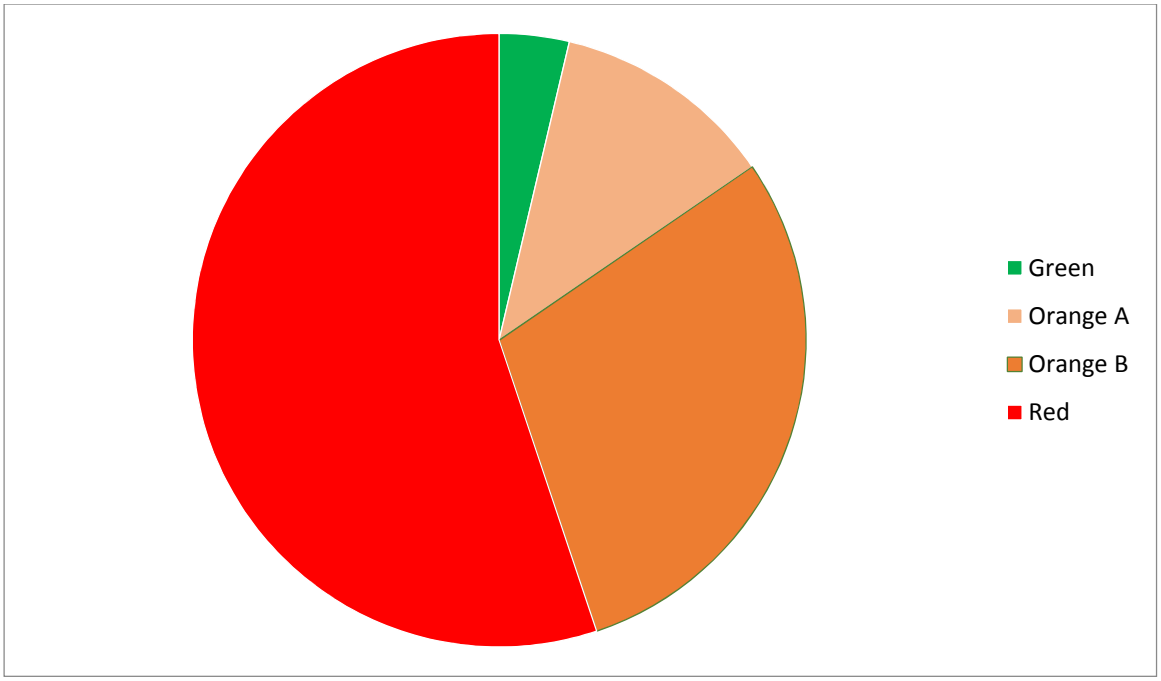
A local textile dying industries discharge waste water which varies from 150 to 330 liter per kg of fabric, whereas the recommended amount of waste water that can be discharged from composite textile dying industries 100 liter per kg fabric as per environmental conservation rules (ECR'97).

Disposal of large amount of waste water with highly toxic compound from various industries is extensively threatening to the ecosystem and aquatic life and it also enters in our food chain. These pollution leads to yield of poor quality of fish with the smell of chemicals. Again the textile industries dispose large quantities of sulphates in their waste water. This can be converted in the environment to hydrogen sulfide, a very poisonous gas.

Bangladesh Environmental conservation Rules, 1997 known as ECR'97 classifies industrial units and projects into four categories depending on the environmental impact. The categories are:

- Green
- Orange A
- Orange B
- Red

By analyzing industries in kashimpur-konabari zone, this classification can be projected as:



N.B. This is projected by following the criteria mentioned in ECR'97 (Rule 7) Schedule 1

2.4 Seasonal Flow of the River:

Variability of river flow influences water quality, energy cycles, biotic interactions and habitat of rivers (Naiman et al 2002). More recent time the river scientists refer to the flow regime in fresh water systems as a master variable due to its strong influence on the environmental factors e.g. water chemistry, physical habitat, biological composition and interactions (WB, 2008).

The flow in the Turag river varies from season to season. For the convenience in analysis of the flow data, annual flow had been characterized in three separate seasons named Monsoon (July to October), Pre-monsoon (February to May), and Dry season (November to January and June). According to Bangladesh water development board the seasonal flow of Turag river is given bellow:

Table 2.4.1 : Seasonal Flow of Turag River

Season	1989-2004 (cms)	2005-2009 (cms)
Monsoon	**475.3**	**437.525**
Pre-monsoon	**395.125**	**448.6**
Dry	**414.575**	**304.38**

CHAPTER THREE:

METHODOLOGY

3.1 Local Survey:

Local survey will conducted based on the population around the study area, dependency on river water and understanding the operational activities of dying, chemical, food processing and other industries. This survey will be conducted by interviews of relevant workers and local people and also available data from past research papers which will be used to prepare EIA report on Turag River.

3.2 Study Area and Data Collection

The Turag River is the upper tributary of the Buriganga. The Turag originates from the Bangshi River (Fig. 1). The Turag flows through Gazipur district and joins the Buriganga at Mirpur in Dhaka district. The Tongi Khal links the Turag with the Balu River (Choudhury and Choudhury, 2004). The entire regime of the Turag is almost a semi-funnel shaped basin and its catchment is located on the central and southern part of the Madhupur tract and flows from north to south within the basin and its length is about 40 miles and 15 miles in wide to the maximum. The average width and depth of the river are about 218m and 13.5m, respectively. It has a total area of 386 square miles (Uddin, 2005).

3.3 Sampling

This paper is based on investigating water quality from selected points (2) of Turag River within study area. Samples will be analyzed for various physicochemical parameters like pH, total dissolved solids (TDS), total suspended solids (TSS), 5 days biochemical oxygen demand (BOD5), chemical oxygen demand (COD), Dissolved oxygen (DO) etc. by laboratory test.

3.4 Comparison of Water Quality Parameters

Investigated result of water quality will be compared with Bangladesh standards of discharge quality for classified industries and the data collected from the past few year's researches. It will evaluate the effectiveness of present water treatment process and measurement taken by industries and government.

Table 3.4.1 : Standard river water quality parameters of Bangladesh

Water quality parameter	Domestic water standard[a]	Drinking water standard[b]	Fish culture standard[c]	Irrigation standard[d]
pH	6.5-8.5	6.5-8.5	6.5-8.0	6.5-8.5
EC (µS/cm)	NA	NA	NA	750
TDS (ppm)	500	1000	< 400	< 450
DO (ppm)	4.0-6.0	NA	5.0	NA
BOD (ppm)	NA	NA	< 5.0	NA
Cu (ppm)	1.0	1.0	0.03	0.2
Zn (ppm)	5.5	5.0	< 0.005	2.0
Pb (ppm)	< 0.05	0.05	< 0.02	5.0
Fe (ppm)	< 0.3	NA	< 0.1	5.0
Cd (ppm)	0.01	0.005	0.005	0.01

Note: NA = Not Available, U = Upstream point, M = Middle point, D = Downstream point.
Source: [a] De (2005), [b] ADB (1994), [c] Meade (1998), [d] Ayers and Westcot (1976).

Table 3.4.2 : Average parameters taken from four different sites of turag river:

Parameters	Dry Season	Pre-monsoon	Monsoon
BOD (mg/l)	**25**	**14**	**20**
DO (mg/l)	**4.3**	**6.2**	**5.25**
pH	**6.7**	**7.7**	**7.35**
TDS (ppm)	**245**	**115**	**150**

CHAPTER FOUR:

RESULT AND DISCUSSION

4.1 Sample Collection:

Two water samples (two litre each) were collected from two different selected points of the river according to study area. One sample was from upstream and other was from downstream. Samples were collected in two months interval during our study timeline. Before collecting the samples all the plastic bottles were cleaned. And after collection the bottles were kept air tight in dark place. Then all the samples were tested in IUT laboratory to measure the parameters. Each sample was divided into three 300ml testing bottles. For testing BOD we used one BOD nutrient Buffer Pillow in each testing bottle and Sodium Hydroxide Pellets as required. All the samples were kept for five days inside testing apparatus and data were collected daily. pH and TDS parameters of the collected samples were also measured by using pH meter and TDS meter.

4.2 Result Analysis:

The result obtained on some physiochemical parameters of the Turag river water samples collected from Kashimpur- Konabari zone are presented in charts and table below. Result shows that BOD varies from 8.7 to 27 which are far above fish culture standard. When BOD levels are high DO level decreases as the oxygen that is available in the water is being consumed by the bacteria. Since less dissolved oxygen is available in the water, fish and other aquatic organisms may not survive. If there is no organic waste present in water, there would not be as many bacteria present to decompose it and thus the BOD will tend to be lower and DO levels tend to be higher.

The permissible limit for BOD for drinking water is 0.2 mg/L, for recreation 3mg/L, for fish 6 mg/L and 10 mg/L for irrigation. But the result achieved for laboratory test does not meet the standard value for domestic use and agriculture. During monsoon at

July the BOD values ranging from 8.7- 10 mg/L and this is the lowest and also closest to standards. As precipitation level was higher on that month compared to other months, the river water contained lower value of BOD. The cause of this phenomenon is that rain water contain higher amount of dissolved oxygen (DO) which tends to decrease the value of BOD.

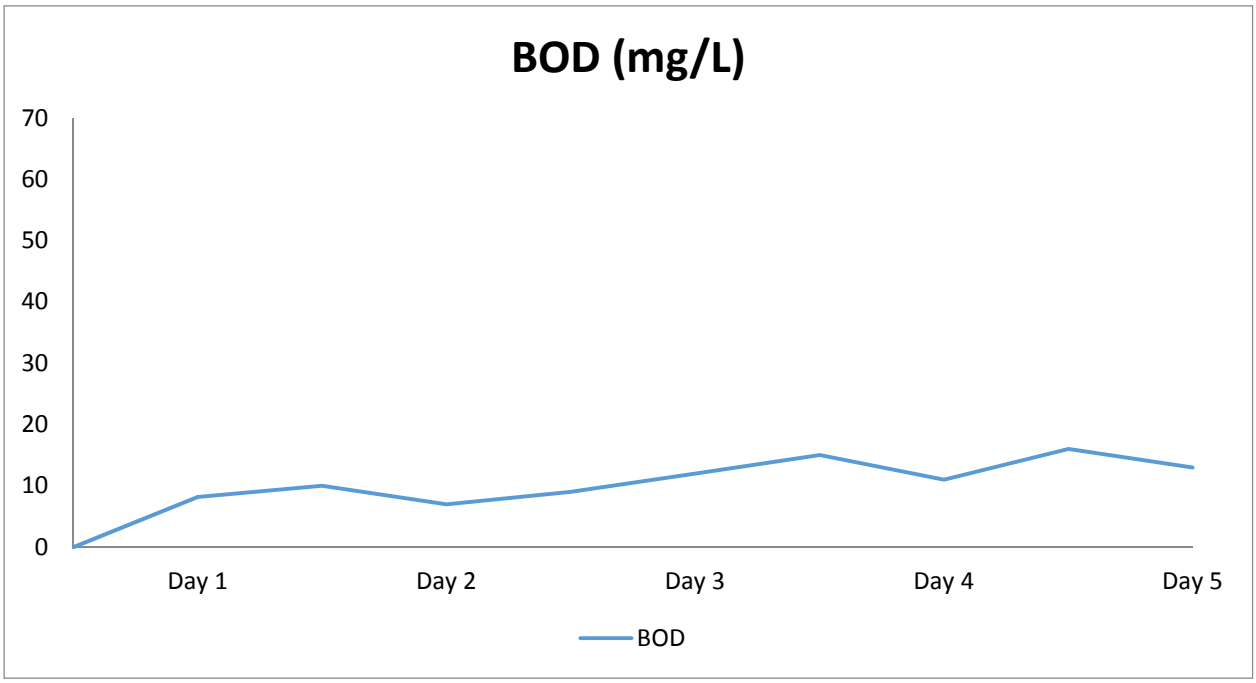


Chart 1 : BOD5 data of May during pre-monsoon at point A

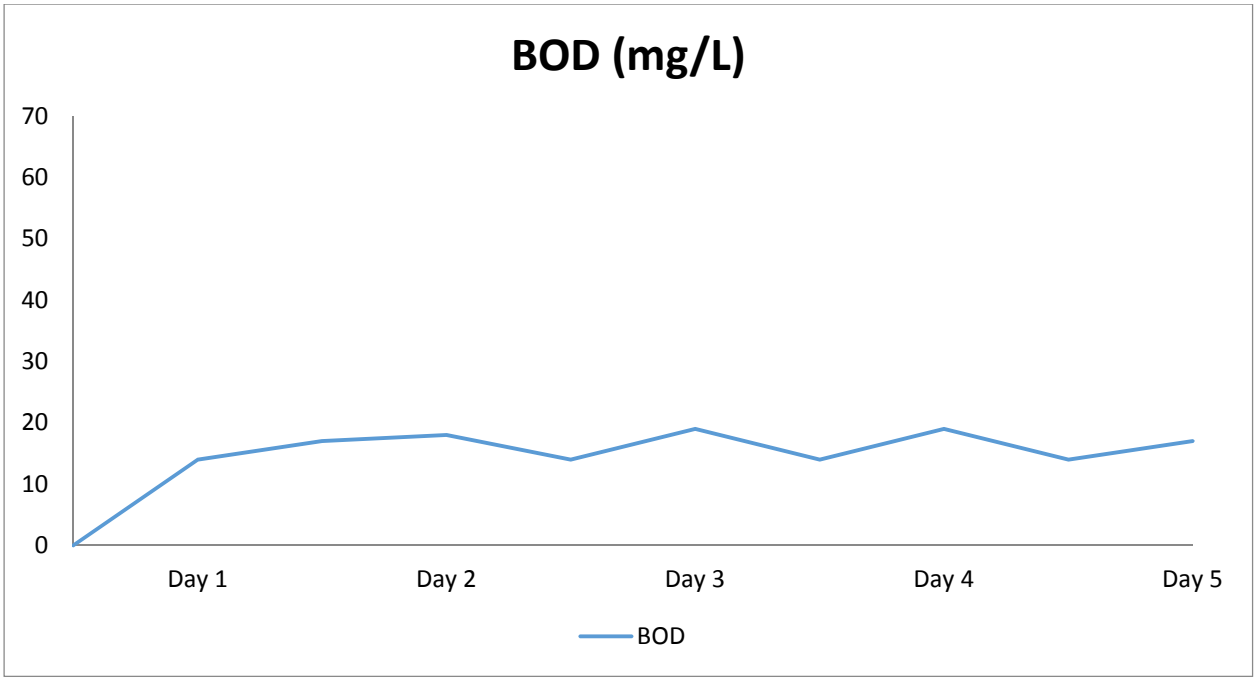


Chart 2 : BOD5 data of May during pre-monsoon at point B

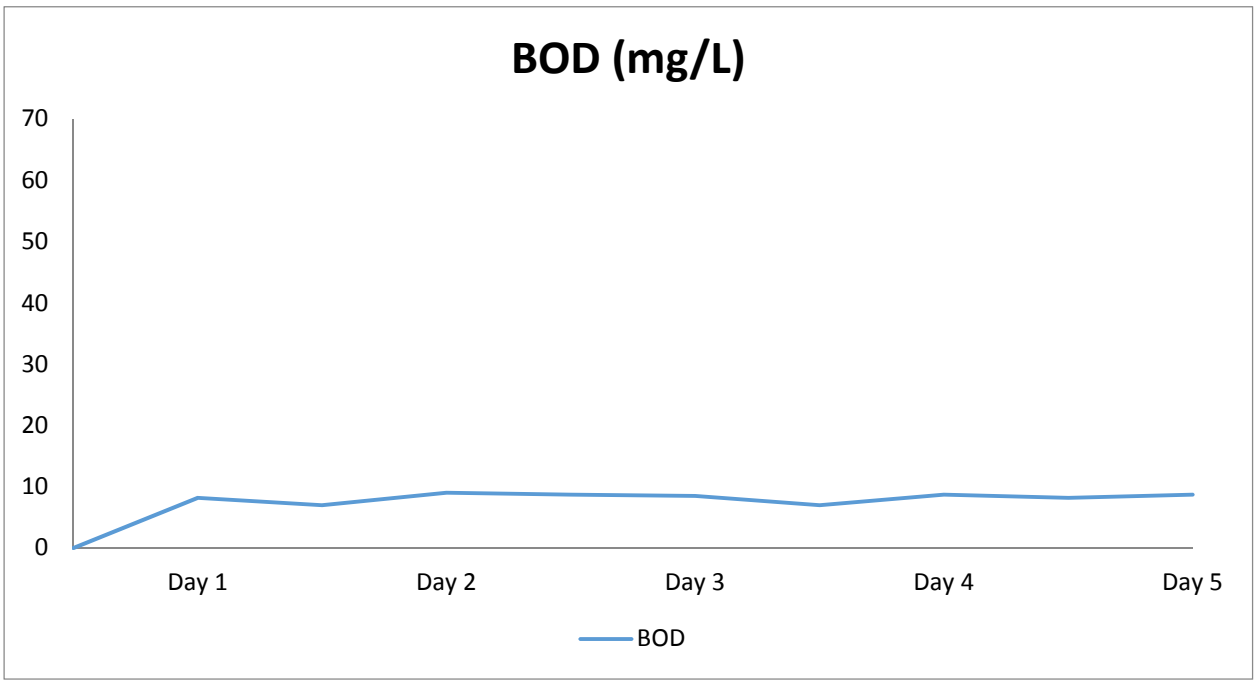


Chart 3 : BOD5 data of July during monsoon at point A

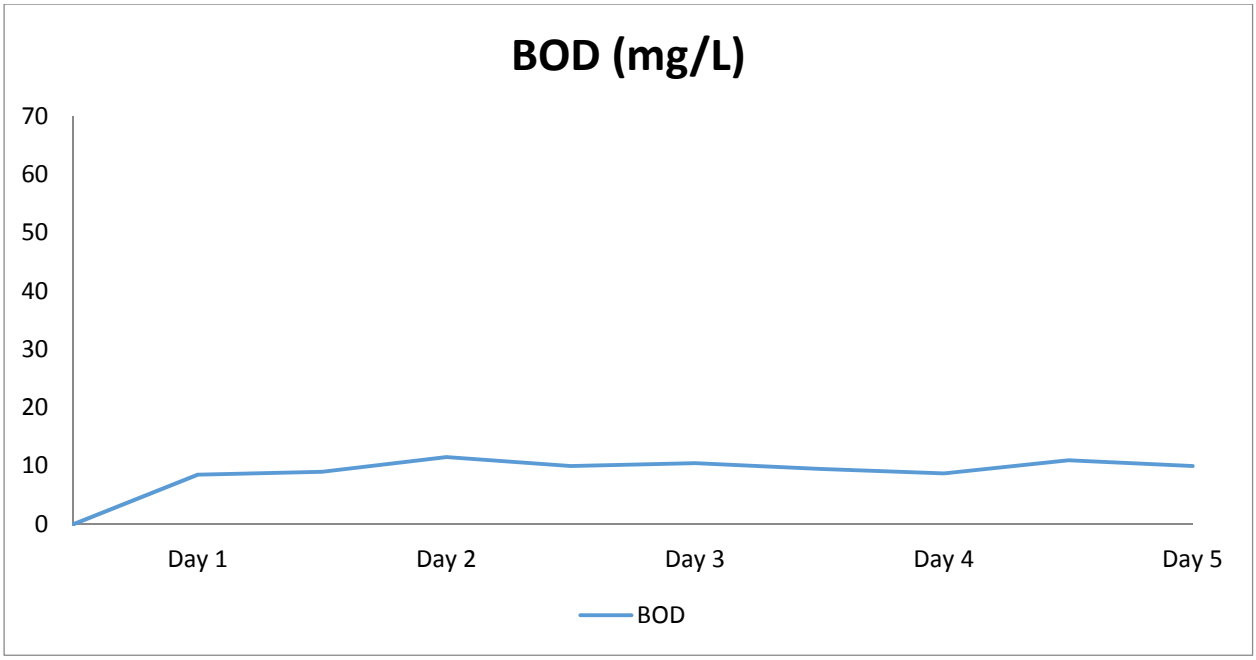


Chart 4 : BOD5 data of July during monsoon at point B

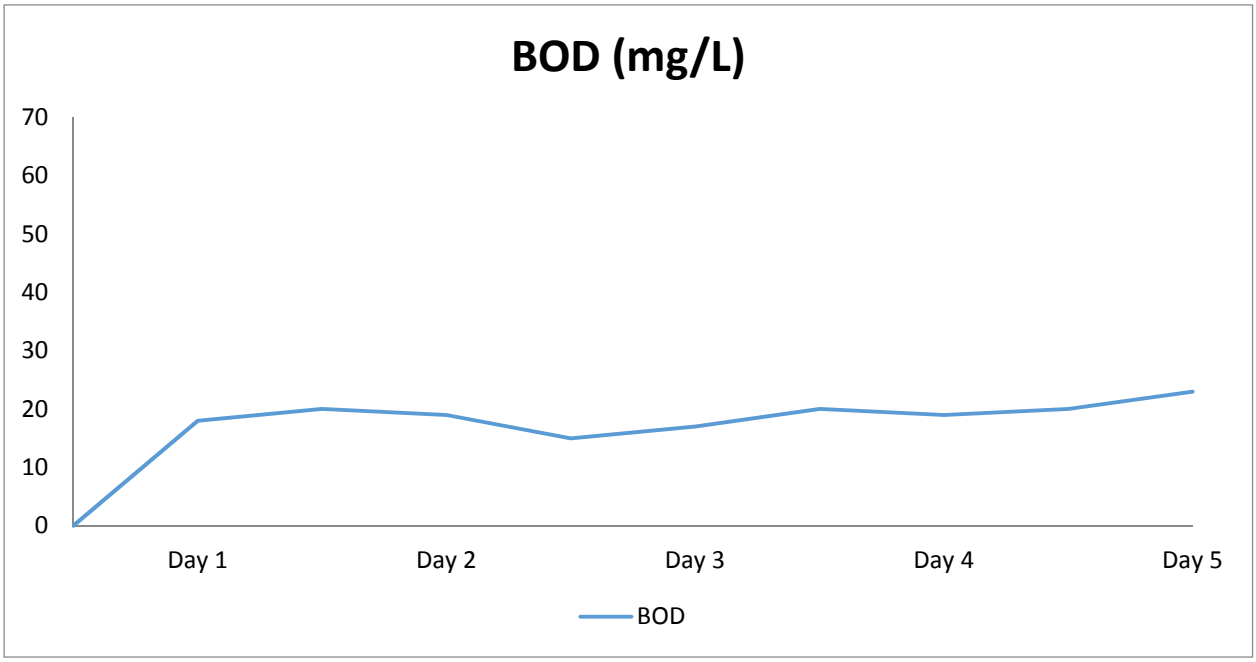


Chart 5 : BOD5 data of September during monsoon at point A

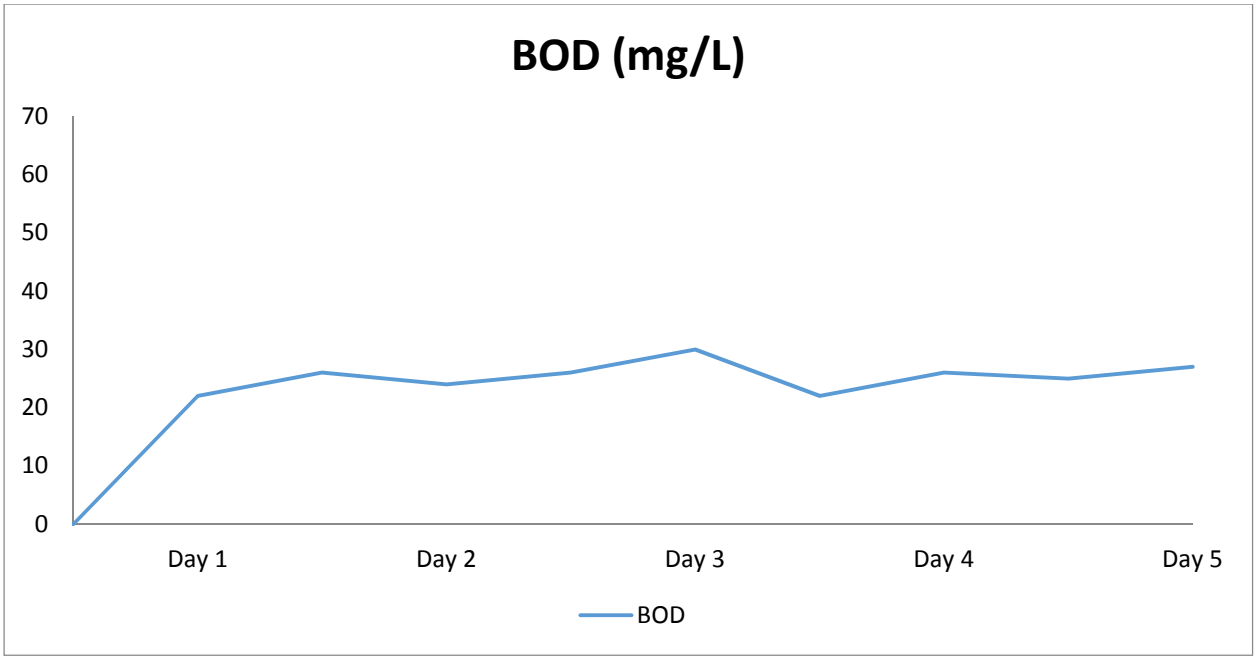


Chart 6: BOD5 data of September during monsoon at point two

Table 1: Physicochemical parameters of Turag river water samples collected at three month over the year.

	May		July		September	
	Point A	Point B	Point A	Point B	Point A	Point B
BOD5 (mg/L)	13	17	8.7	10	23	27
TDS (mg/L)	200	220	180	130	110	125
pH	7.2	7.63	6.9	7.3	7.63	7.84

The presence of cataion indicates the acidity of water which determines the quality of water as good or bad. That is why the pH of river Turag was measured and we got

value of pH from 6.9 to 7.84. The normal range for pH in surface water system is 6.5 to 8.5 and for ground water system it is 6 to 8.5 (Gob, Environment Conservation Rules, 1997). If the water is alkaline (high pH) the carbonic acid will act to neutralize it which shows the presence of carbon di oxide (CO2). But if the water is already quite acidic (low pH) the carbonic acid will only make things worse by making it even more acidic. This pH greatly affects biological activity. It also affects some properties of water body, activity of organism and effectiveness of toxic substances present in aquatic environment. Though the pH value of our water sample meets the standards given by the Department of Environment (DoE) but because of the high value of BOD this river water is no longer usable for domestic purpose or even fish culturing.

The total dissolved solids (TDS) mainly indicate the presence of various kinds of minerals like ammonia, nitrite, nitrate, phosphate, alkalis, some acids, sulphates and metallic ions etc which are comprised both colloidal and dissolved solids in water. It is also an important chemical parameter of water. The TDS values of study area lies between 110 and 220 ml/l. The salinity of water indicates the presence of ionic substances that may come from the reaction of metals and acids containing in water. During pre-monsoon the TDS of our sample water showed much higher (200 to 220 ml/l) TDS and during monsoon the value of TDS was comparatively lower (110 to 180 ml/l).

4.3 Comparison:

Lab Test Data 2014								Collected Data 2012		
	Pre-monsoon		Monsoon		Dry Season			Pre-monsoon	Monsoon	Dry Season
	Point A	Point B	Point A	Point B	Point A	Point B				
BOD (mg/L)	13	17	8.7	10	23	27		14	20	25
TDS (mg/L)	200	220	180	130	110	125		115	150	245
pH	7.2	7.63	6.9	7.3	7.63	7.84		7.7	7.37	6.7

Comparison of our lab test data and the previous collected data shows that overall quality of river water has not changed much except for TDS with a slight variation. It proves that though it is mandatory to follow the DoE rules but in this area the usability of ETP (Effluent Treatment Plant) is not effective that much. Recently even approximate 15 textile and dying industries were fined around 14 lakh BDT each because of their faulty treatment plant (prothom alo, 2014).

Also comparing with the standards for drinking water, domestic and agriculture purpose the permissible limit for BOD for drinking water is 0.2 mg/L, for recreation 3mg/L, for fish 6 mg/L and 10 mg/L for irrigation. But the result achieved for laboratory test does not meet the standard value for domestic use and agriculture. Though the TDS and pH value meet the requirements as the BOD exceeds the limit of

standards, this river water does not meet the requirements for regular usability. Also we can see that the BOD value is lower during monsoon season then the other pre-monsoon and dry season. The cause of this phenomenon is that rain water contain higher amount of dissolved oxygen (DO) which tends to decrease the value of BOD. This condition is also applied for TDS and pH value of current river water. Besides from river water flow table we see that during the monsoon the flow is comparatively high. So if we have to take restore measurement it is suggested to take steps from pre-monsoon season as per necessary.

4.4 Mitigation Measures Due to Environmental Impact

The causes of Turag river water pollution are many and being an important industrial zone Konabari-Kashimpur is a Bangladesh Small & Cottage Industries Corporation area at Gazipur. But Textile dyeing industry is playing an important role in the national economy of our country. It upgrades the lifestyle of lower class people of our country. It minimizes the problem of unemployment to a great extent. So, despite of having some adverse impact of textile dyeing industry it cannot be stopped. Rather we should find some mitigation measures to minimize the adverse impact and increase the beneficial impact.

1. The most adverse effect of textile dyeing is the decrease of surface water quality. All types of effluent should be treated before discharging as well as ETP should be installed and used by every dyeing industry.

2. To save the aquatic biology the project should be designed to protect existing fisheries and increased flood plain.

3. Better construction and maintenance is needed for sewerage and waste disposal.

4. DOE should monitor at least 6 months after in every year to check the condition of ETP, effluent samples report and the certificate of chemical composition issued by third party to ensure that, they are using within permissible limits.

5. Any textile dyeing cannot be established without proper ETP system and all license certificates by fulfilling every condition of DOE to ensure the environmental preservation of surroundings. The relevant authority from ministry of govt. should be strict in providing license and honest officers should be appointed for monitoring the textile dyeing industries.

6. Surface water pollution is a major issue due to effluent discharge in textile dyeing industry. To try and control the pollution problem, industries along with the government can set up a common effluent treatment plant at a much larger scale.These can be expected to help a large number of industries treat their wastewater in a cost-effective way.

7. Appropriate distance from the surrounding water body should be maintained for waste dumping and dumping site should be properly managed.

8. Sludge settling characteristics should be checked by SVI (sludge volume index) test. Poor settling sludge will result in low concentration of solids in the return activated sludge thus the concentration of microorganism's drops and subsequently F/M (food per microorganism) ratio increases in the aeration tank which results in a

reduced BOD, COD removal efficiency. For excellent sludge settling SVI value should be less than 50

9. Add adsorbents like bentonite clay or activated carbon to biological system in order to eliminate non-biodegradable or microorganism–toxic organic substances (Pala and Tokat, 2002).

CHAPTER FIVE:

CONCLUTION

Developing countries throughout the world are facing ever more stringent pollution restrictions. Because of economic constraints and the need to develop an industrial base, many developing countries have ignored pollution control within their industries. But It is alarming that the pollution concentration is speedily escalating day by day as different types of industries and land uses are developing along the banks of the Turag River which lead to more pollution generation and more encroachment on river bank. Concerning all measured parameters (especially BOD), it could be concluded that pollution of Turag water reached critical point with increasing tendency day by day. Consequently, in order to decrease pollution from various sources appropriate steps must be taken immediately. If the necessary steps are not taken, very soon it would be a source danger point for water pollution. But it is still possible to make return of Turag river water quality to sustainable condition only by taking improvised technology as post treatment plant for heavily polluting industries and social awareness. Although, some parameters may not at critical pollution level, the condition of the river side urbanization and industrialization with no proper waste treatment may cause severe water pollution.

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