EFFECTS OF WASTE WATER FROM TEXTILE INDUSTRIES ON KARNAFULI RIVER

M. M. Rahman*, M. H. Ali, A. A. Saeem & S. Kar

Department of Civil Engineering, Chittagong University of Engineering and Technology, Chittagong, Bangladesh
**Corresponding Author: rmdminhajur@gmail.com*

ABSTRACT
Textile industry is one of the largest production sectors in Bangladesh. These industries use high volume of water and large quantity of harmful chemical compounds throughout its operation and finally dump this polluted water in nearby water bodies. In Chittagong, Karnafuli River is the victim of such incident. This study is focused to find out the negative effects of textile wastewater on Karnafuli River. The study took wastewater sample of five textile industries near Kalurghat Industrial Area and different confluence points of river Karnafuli and analysed different water parameters including pH, BOD, COD, TS, TSS, TDS, Total alkalinity, Chloride, Faecal coliform, Electrical conductivity. It also performs heavy metal tests including Na, Ca, Mg, Mn, Zn, Cu, Pb, K and Cd. All the test results are compared with few international standards along with the Bangladesh drinking & industrial effluent standards. The comparison shows that the values of TDS & TSS in the river & the value of Turbidity in the confluence points are much higher than the standard limit. The heavy metal test shows nothing remarkable. The effects of high concentration of earlier mentioned parameters on human life and aquatic life are also discussed in this study.

Keywords: Karnafuli River; chemical waste; environmental effects; BOD; COD

INTRODUCTION
Bangladesh is a developing country and behind this development, textile industries play a vital role. It is the cardinal source of foreign currency and the contribution is about 12% to GDP (Akter, 2012). Though the contribution of textile industries to our economy is axiomatic, it has some serious environmental issues. Textile industries use high volume of water throughout the process of washing fibre and finished products, bleaching, dyeing etc. It is found from a study that textile industries consume approximately 200 litres of water to produce 1 kg of textiles (Yacout et al, 2013). Approximately 2000 different chemical compounds which includes pesticides, soda, heavy metals as colour pigments (Pb, Cd, Cu, Ni etc), minerals, acids, bases, salts etc. are mixed with (Environmental Hazards of the Textile Industry, 2005) water for various operations in textile and finally dumped into nearby water bodies. This chemical wastewater is very toxic for both human beings and aquatic lives.

Chittagong, the second most populated city after the capital Dhaka in Bangladesh is situated by the river Karnafuli. Being the centre of industries, Chittagong city possesses many textile industries and most of these industries are situated near to the river Karnafuli to meet the excess demand of water. A large number of local people also depend on this River for irrigation, cultivation, navigation, fisheries and source of drinking water. The wastewater produced by the textile industries release their effluents into the river and due to this rampant pollution by these textile industries, the amount of DO (Dissolved Oxygen) is alarmingly decreasing. From a recent survey, it is found that the amount of DO in Karnafuli River is between 3.37 to 6.37 mg/litre (Bashar et al, 2015), which is well below the required limit for shallow water fish. Another study found that the present p^H range of Karnafuli River is 6.36 to 9.86, which was previously 7.01-8.24 (Ahmed et al, 2010). Therefore, the acidity of Karnafuli River is increasing day by day, which makes it difficult to use the water as irrigation purpose, drinking purpose as well as for fishes. It is also creating severe problem in ecology, as water is a big part of it. By using this polluted water, public health is now in a threat.

Textile wastewater and their effects over every living beings is of prime concern to a mass people. A number of studies are carried out in different parts of the world to assess the negative effects of textile effluents. A study entitled as "Wastewater characteristics in textile finishing mills" analysed the different sources of water pollution in textile finishing mills and characterised the processed effluents according to treatability and reusability (Isabella et al. 2008). Another study by Y.C. Ho et el. (2012) assessed the effects of several textile waste on different environmental feature. The effect on surface water, ground water, seawater and land was also described in that paper. Imtiazuddin et el. (2012) examined the textile wastewater effect on the environment by analysing TDS, TSS and heavy metal tests.

Pollution of Karnafuli River is more than ever now as the number of textile industries are increasing near the banks of river. Thus, the value of DO, BOD, COD, TSS, TDS etc. parameters are changing to a more unfavourable limit. This study on Karnafuli River is focused to analyse different water parameters and an assessment of present condition of the River water quality based upon the analysed water parameter results. It also discussed the negative effects of wastewater consumption by the people living beside the river and the potential danger to aquatic lives.

METHODOLOGY

This study is conducted over textile industries situated in Kalurghat area. Effluent from these textile industries empty into different tributaries and finally meets Karnafuli River. To assess the condition of Karnafuli River this study also analyzed sample wastewater, collected from different confluence points. To conduct the study following work plan was followed:

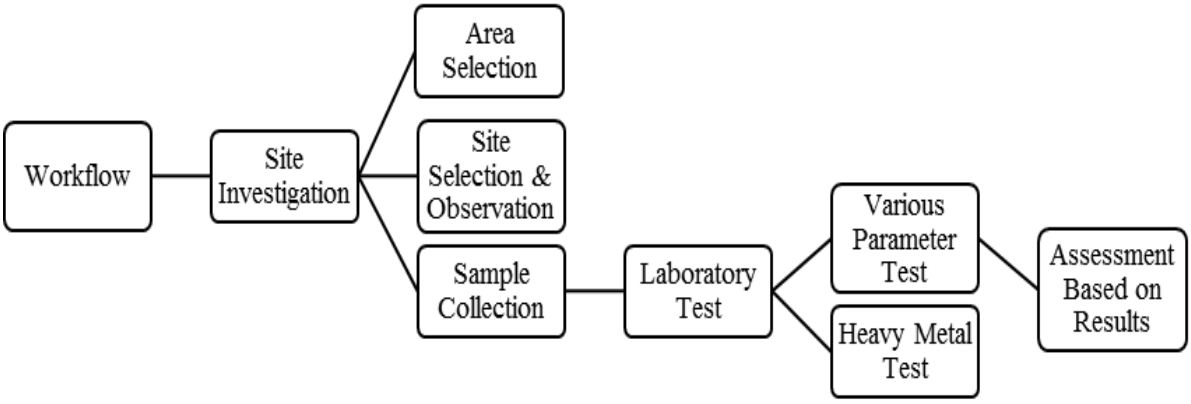

Fig. 1: Hierarchy of work plan

Kalurghat industrial area was selected to conduct the study as most of the textile industries in Chittagong is situated in that area. Eventually effluent from these textiles are explicitly emptying in Karnafuli River. A preliminary survey was carried out in Kalurghat area to assess the overall condition of textile industries. It is found that without the exception of few most of the textile industries are equipped with an effluent treatment plant (ETP). In most of the cases these ETP's were either not fully functional or required demand was not met. Moreover, it is also found from the survey that, effluents, either treated or untreated is dumped in various canals, which are running through many regions of lower income people. Kashem colony is one of them and a potential victim of many water borne disease as people living in this area use polluted water of canals because of unavailability of supply water. Assimilation capacity of these canals are almost nil because of narrow width and high concentration of textile wastewater dumping.

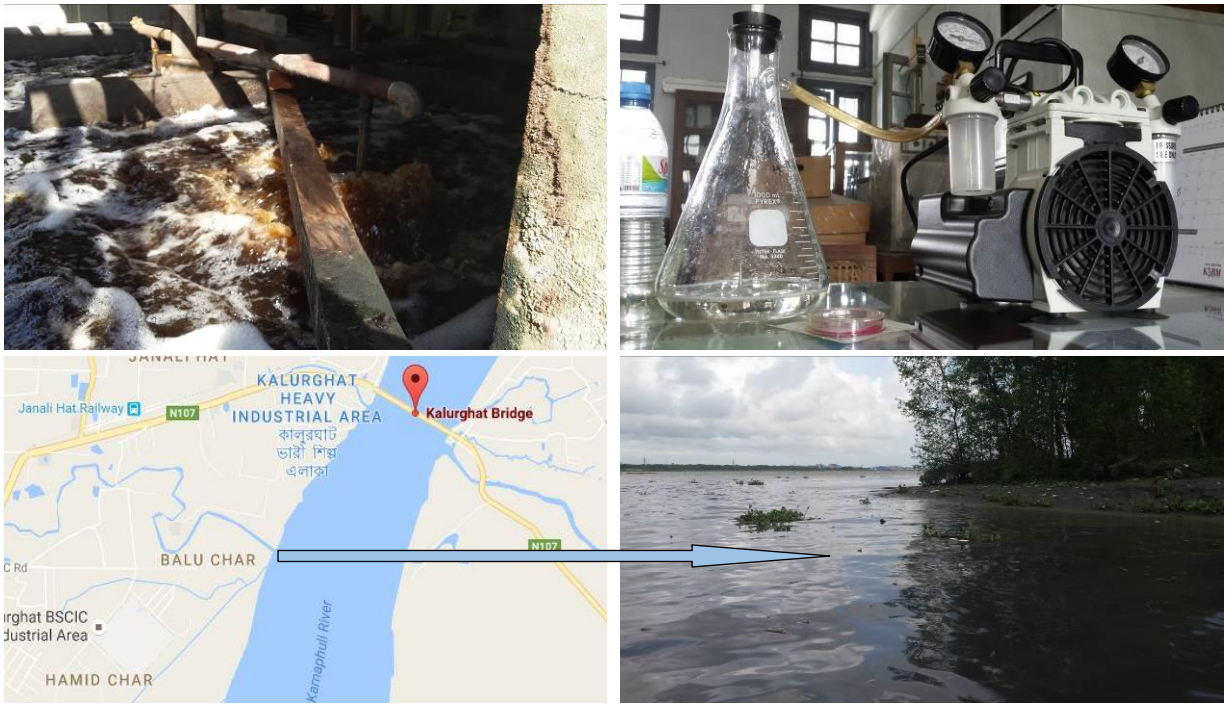

Fig 2: Wastewater collection, testing and location of Ispahani khal.

From the preliminary survey, five textile industries namely Fabion Trades, Well Group, Choice Wash, RTT Ltd and Al Hamadi Textiles were selected for sample collection. Collection of wastewater sample was carried out using plastic bottles. Proper precaution was taken while collecting sample from confluence points and different outlets following standard sampling manner. Both the effluent and influent sample of ETP were collected to analyze where it was applicable while in confluence points samples were collected in non-tidal and tidal condition and from different distance (Upstream 50m, confluence point, downstream 50 m and 100 m).

After collection of wastewater, various parameter tests including pH, BOD, COD, TS, TSS, TDS, Total Alkalinity, Chloride, Faecal Coliform, Electrical conductivity and Turbidity were conducted in Environmental lab of Civil Engineering department of CUET following American Society for Testing and Materials (ASTM) standard methods available at lab. Heavy metal tests includes Na, Ca, Mg, Mn, Zn, Cu, Pb, K and Cd. The heavy metal tests were conducted at Bangladesh Council of Scientific and Industrial Research (BCSIR), Chittagong using spectrometer. These tests determined different parameters of wastewater and represents the contemporary condition of water of textile industrial area and nearby water bodies. As the standard value of different water testing parameter is set depending upon the human and environmental compatibility, the obtained results from the lab were compared with Bangladesh drinking and industrial effluent standards, WHO drinking water standard and few other international standards to find out the effect of textile wastewater on Karnafuli River.

RESULTS AND DISCUSSION

The obtained test results of five different textile industries are tabulated in table 1, both treated and untreated effluent are tested for Fabion Trades and Well Group. Table 2 represents the standard value of different water parameters based on industrial standard, drinking standard and so on. From the comparison of test results with standard values it is found that the value of pH and DO is within the tolerable limit, so no treatment is needed here. The value of BOD for most of the textiles is within the acceptable limit considering industrial standards for Bangladesh; however, it is not satisfactory when compared to WHO drinking standards. High concentration values of TS, TSS and TDS is found in almost all the textiles in consideration. Wastewater sample of Al Hamadi textile shows unusually higher concentration values for TS (14000 mg/l) and TDS (7800 mg/l). The value of alkalinity, hardness and chloride seems acceptable considering *BIES.

Table 1: Water parameter test results of sample wastewater of different textile industries

Parameter	Unit	Untreated Effluent					Treated Effluent	
		Fabion Trades	Well Group	Choice Wash	Al Hamadi	RTT	Fabion Trades	Well Group
pH	N/A	9	8	7	8	7	8	8
DO	mg/l	4	10	7.6	9	10	8	8
BOD	mg/l	20	50	41	10	20	50	10
COD	mg/l	80	80	54	70	80	55	25
Total Hardness	mg/l as CaCO3	42	30	37	48	50	35	58
TS	mg/l	1800	1180	580	14000	540	1140	1380
TDS	mg/l	1350	800	30	7800	30	780	950
TSS	mg/l	450	380	550	6200	510	360	430
Total Alkalinity	mg/l as CaCO3	500	380	290	320	200	300	300
Chloride	mg/l	200	600	300	280	700	200	240
*FC	n/100 ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil
*EC	µmohos/cm	1699	717	371	1534	1219	1062	1766
Turbidity	NTU	11.62	53.9	24.4	9.67	40.63	6.06	6.44

*FC- Fecal Coliform *EC- Electrical Conductivity

Table 2: Water parameter standards

Parameter	Unit	WHO standards	*BDS	*BIES	Canadian Standard	U.S EPA	EU-1998	IS-10500
pH		6.5-8.5	6.5-8.5	06-8.5	6.5-8.5d	6.5-8.5[d]	-	5.5-9.0[ISW]
DO	mg/l	-	4	200	7[d]	-	-	
BOD	mg/l	-	0.2	50	-	-	-	30[ISW]
COD	mg/l	-	6	4.5-8	-	-	-	250[ISW]
Total Hardness	mg/l as CaCO3	500	200-500	-	-	-		300[d]
TS	mg/l	250	150-600	600	-	-	-	-
TDS	mg/l	-	100	-	<500[d]	500[d]	-	-
TSS	mg/l	1000	1000	2100				
Total Alkalinity	mg/l as CaCO3	-	10	150	-	20[aq.]	-	-
Chloride	mg/l	-	1010	2250	-	230[aq.]	250	-
*FC	n/100 ml	5	10	25-45	-	-	-	-
*EC	µmohos/cm	0/100 ml	-	-	-	-	2500	-
Turbidity	NTU	-	-	1200	-	-	-	10[d]

[d] Drinking water quality standard; [ISW] Inland surface water quality standard; [aq] Aquatic environmental quality standard; *BDS-Bangladesh drinking standard; *BIES- Bangladesh industrial effluent standard; *FC- Fecal Coliform; *EC- Electrical Conductivity.
(Sources: Council of the European Union. 1998; DOE 1991; Federal Provincial Territorial Committee on Drinking Water. 2008; WHO. 2008 and Fundamentals of Environmental Measurements. 2014)

Heavy metal test results show nothing remarkable of Mn, Zn, Cu, Pb and Cd when compared with standard limit ECR-1997. The test results of Na, Ca, Mg and K is not compared to any standards due to unavailability of comparable sources.

Table 3: Heavy metal test results and comparison with standard values

Heavy Metals	Na	Ca	Mg	Mn	Zn	Cu	Pb	K	Cd
Test Results	15.2	13.6	12	0.14	0.08	0.11	-	5.66	-
ECR-1997	-	-	-	5	5	0.5	0.1	-	0.5
Canadian	-	-	-	-	5	-	0.01	-	0.005
U.S.EPA.	-	-	-	0.05	5	13	0.015	-	0.005
EU(1998)	-	-	-	0.05	-	2	0.01	-	0.005
IS: 10500	-	-	-	0.1	5	0.05	0.1	-	0.01

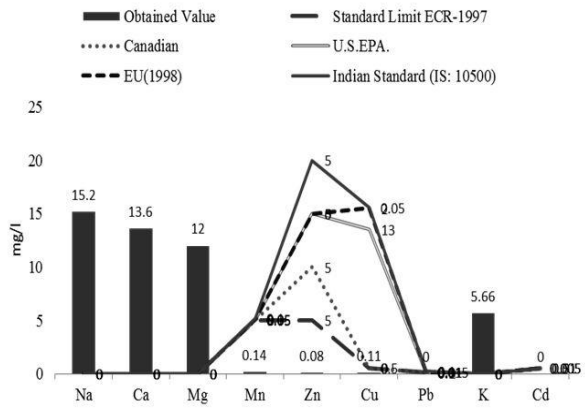

Fig. 3: Comparison of heavy metal test results

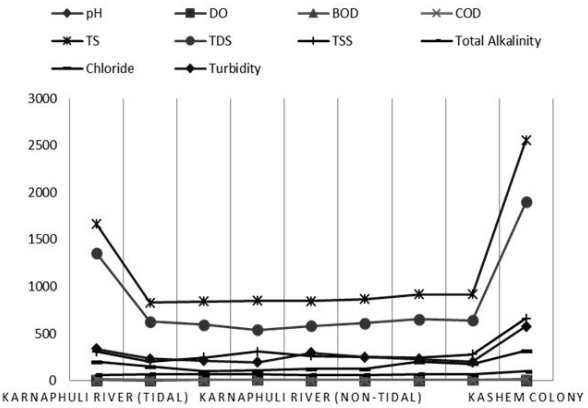

Fig. 4: Comparison of confluence point test results

Table 4: Water parameter test results of sample wastewater of confluence points

Parameter	Karnaphuli River (Tidal)				Karnaphuli River (Non-Tidal)				*KC
	u/s 50m	Confluence	d/s 50m	d/s 100m	u/s 50m	Confluence	d/s 50m	d/s 100m	
pH	7	7	7	7	7	7	7	7	8
DO	7	8.8	9.6	11	7.3	8.5	9.6	10.3	10.2
BOD	6.4	6	7	7.6	6.4	6.4	7.1	7.86	8
COD	15	10	9	12	9	9	12	10	15
TS	1670	830	843	850	846	870	920	920	2560
TDS	1360	630	596	540	582	613	655	640	1899
TSS	310	200	247	310	265	257	245	280	661
Total Alkalinity	62	70	68	68	61	64	70	68	100
Chloride	200	150	100	110	125	125	200	180	320
Turbidity	341	235	212	195	298	252	230	203	578

*KC- Kashem colony

From table 4 it is observed that the values of pH, BOD and COD in confluence points are lower than the *BIES but higher than *BDS. The value of TS and Chloride is much higher in *KC compared to the standard limits.

Effects on Karnafuli River

The present water quality of Karnafuli River is unsatisfactory, effluent of textile industries with high concentration of TDS and TSS is emptying into the River. Excess presence of these water parameters is blocking the sunlight and reducing the rate of photosynthesis in water body, thus endangering the aquatic life of Karnafuli River. Moreover, high concentration of TDS and TSS can cause physical injury and abrasion to fish skin. Water with high amount of TDS and TSS is also harmful for the nearby crop fields as undesirable accumulations in plant tissues and growth reduction might take place through consuming such water as irrigation purpose. To control the problem screening, trickling filter, sedimentation, filtration, activated sludge process, chemical coagulation etc. can be used. Turbidity is another parameter, which shows unfavorable values regarding the River water quality. Excess presence of turbidity is found both from visual experience and the test conducted in the laboratory. Due to this, less light is entered in the lower level of the River and reducing the plant productivity, thus DO is decreasing alarmingly in the River. Turbid water is also not suitable for drinking or everyday purpose as it cannot be disinfected because suspended particles hide microorganisms. To remove turbidity remedial filtration is needed and that includes flash mixing, coagulation, sedimentation and ultrafiltration. The presence of heavy metal in the river in excess amount can be detrimental and often toxic to aquatic life. Heavy metal accumulates in human body over a long period and finally results in some serious health problems like cancer. So drinking this water is not appropriate at all. Among other parameters chloride could have significant effects on ecosystem when present in excess amount, it may impact fresh water organisms and plants by altering reproduction rates, increasing species mortality and changing characteristics of the entire local system. The present study represents the picture of Karnafuli

River as a polluted one; above-mentioned effects might cause serious damage to its ecosystem and the people depend on it.

CONCLUSIONS

The preservation of ecosystem of Karnafuli River is very vital, this study found the excess presence of TSS, TS and TDS in river water. Turbid water of Karnafuli River has become a threat for aquatic life as well as for people living around the riverbanks. If measures are not taken to alleviate the present condition of Karnafuli River, it might face the fate of Buriganga River. This study observed many non-functional ETP's in textile industries, so measures should be taken to mandate an operable ETP to improve the quality of effluent. The environmental conservation act 1995 (ECA) provides that all relevant industrial to install ETP to treat their wastewater to achieve certain standards before releasing it into receiving environment. Department of Environment (DoE) is mandated to enforce this provision of law and they should take proper steps to execute it. Going on to further study on this issue, we could include other industries along with textile industries, as well as more water parameters could be tested.

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