RW06
Water Quality Aspects in and around Dhaka City

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***Abstract*—Dhaka is one of the most densely-populated cities in the world. All the economic activities in Bangladesh are Dhaka centric. Water supply problem is acute in this city. This work is on assessment of the water quality of rivers in and around Dhaka city over the years. Industrial wastewater quality has also assessed. A low cost process for tanneries is developed which shows very encouraging results. This paper is also focused on surface water treatment. The much polluted water from Shitalakhya River has been treated using low cost materials available in Bangladesh. It has been revealed that the properties of treated tannery water and Shitalakhya river water are in good agreement with the standards set by the Department of Environment, Bangladesh. It is expected that the developed laboratory scale technologies will be more effective than the available foreign technologies related to this field.**

INTRODUCTION

Dhaka, one of the mega cities of the world, has a population of about 10 million in metropolitan area [1]. About 19.4% of the total population of Dhaka city lives in the slum and squatter areas. Due to the faster growth of Dhaka city, people from all over the country come to Dhaka. Dhaka Water Supply and Sewerage Authority (Dhaka WASA) is the responsible body to supply water to this huge population. But the Dhaka WASA can only produce 1900 million liters of water per day against Dhaka city's daily demand of 2200 million liters. About 87% of total water supply by Dhaka WASA comes from deep tube wells, and rest of the supply comes from surface water treatment. But as the water table of Dhaka city is being lowered day by day, it is high time to consider surface water treatment as the primary source.

For surface water treatment, the main sources of raw water are rivers in and around Dhaka city. But the water quality of these rivers has severely damaged in recent years due to municipal and industrial untreated wastewater that are discharged into this river [2], [3]. Most of the small and large scale industries usually dump their wastes directly to the rivers without any treatment or with little treatment. The water quality is very bad, especially at dry season. At rainy season, the pollutants are diluted. At dry season, the existing treatment technology of Dhaka WASA can not treat the raw water as per standards. To have an idea of pollution level of rivers in and around Dhaka city, systematic study was conducted over the years and the results of the study are summarized in the first section of this paper.

The second section of this paper deals with the source analysis. Though most of the urban based industries in Bangladesh pollute water, some of them do the extreme damage. Which industries pollute the water body most has been identified and the pollution level has also been assessed in this paper.

To improve the water quality of the rivers, arresting the pollutants at source is the only option. But the available wastewater treatment technologies are costly. So, the industry people are likely to not using this option. In most of the cases, those who have installed the Effluent Treatment Plant (ETP) are not operating their ETPs. It is a show business only. In this regard the authors have investigated the low cost effective effluent treatment plant suitable for Bangladesh. A. K. M. A. Quader has already developed an industrial scale low cost textile wastewater treatment process with locally available chemicals [4]. Another laboratory scale low cost technology has developed in the department of chemical engineering, BUET under supervision of D. A. Begum to cope up with the tannery wastewater. We hope that it will be cost effective. Another vital event is surface water treatment technology. We are conducting research on low cost surface water treatment process without using chlorine. And the obtained result shows that the treated water qualities are within the limit of the standard values set by the Government of Bangladesh [ECR, 97]. The results of these investigations are incorporated in the third section of this paper.

EXPERIMENTAL METHODS

The DR/4000 spectrophotometer (HACH), pH meter (Denver Instrument, model-215), conductivity/TDS meter (HACH), BOD Trak (HACH), COD reactor (HACH), Alkalinity kit (HACH) are used for measurement of water quality. Experiments are conducted in accordance with the procedure recommended by the manufacturers of the equipment.

RESULT AND DISCUSSION

Different quality parameters of river water were measured at different point. In Table I, Collection points 1, 2, 3, 4 and 5 represent Buriganga river at Hazaribagh, Buriganga river at Chadnighat, Turag river at Tongi, Balu river at Demra and Balu river at Moinertek respectively. At all five collection points the BOD and DO were far beyond the standard limits set by the Department of Environment (DoE). These results along with the DoE standards are presented in Table I.

Water quality parameters in rainy and winter seasons are also compared in Fig. 1, Fig. 2, Fig. 3 and Fig. 4. Collection points 1, 2, 3, 4 and 5 represent river Buriganga at Hazaribagh, river Shitalakhya at demra Ferry Ghat, river Turag at tongi, river Balu at Moinertek respectively.

From Fig. I and Fig. 2 it is clear that the COD and TDS values are higher in winter season than that of rainy season. Because at rainy season the polluted water is diluted with the rain water, thus reduced the COD and TDS values.

Table I: Different quality parameters of water at rivers in and around Dhaka city (December 2004 – January 2005).

Parameter	Unit	Collection point				
		1	2	3	4	5
Temperature	°C	24	27	27	26	26
pH		7.38	6.9	7.6	7.2	7.2
TDS	mg/L	2290	2800	3150	2500	2350
TSS	mg/L	75	57	76	65	67
Turbidity	FTU	40	29	33	25	23
DO	mg/L	3.2	5	4.1	3.8	3.9
BOD	mg/L	85	27	51	80	75
COD	mg/L	150	56	78	130	105
Standards for inland surface water (Source of drinking water for supply after conventional treatment)[ECR, 97] [5] pH: 6.5-8.5 BOD: 6 or less mg/L DO: 6 or more mg/L						

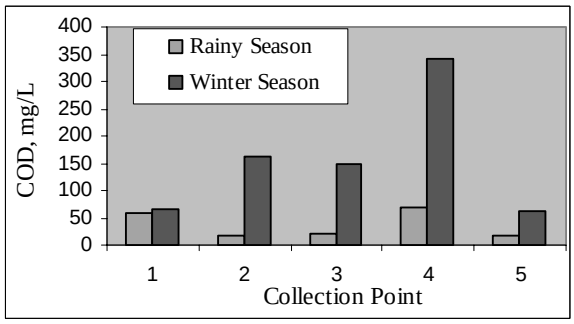

Fig. 1: Comparison of COD in rainy season and dry season. [6]

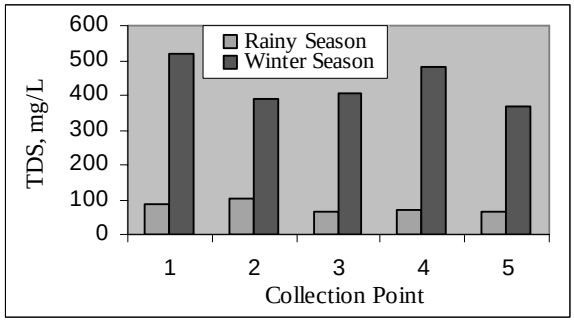

Fig. 2: Comparison of TDS in rainy season and dry season. [6]

Fig. 3 and Fig. 4 delineated the water quality situation both at rainy season and winter season. Total suspended solid is less in rainy season due to dilution of water.

Over the year change in water quality data are shown in Fig. 5, Fig. 6 and Fig. 7. All these data are collected from River Buriganga at Hazaribagh point. Fig. 5 shows that DO concentration is decreasing over the year. After the year 1998, DO concentrations have lowered such an amount that it was under the standard values (>6) set by DoE.

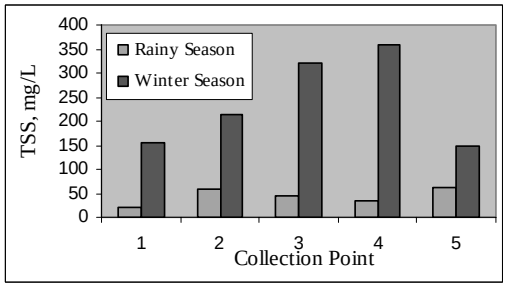

Fig. 3: Comparison of TSS in rainy season and dry season. [6]

Turbidity data shown in Fig. 6 also indicate that over the year turbidity in the river has increased significantly. Total Suspended Solid (TSS) concentrations were also increased, except in the year 2006 (Fig. 7). All these data indicates that the rivers in and around Dhaka city are polluted day by day.

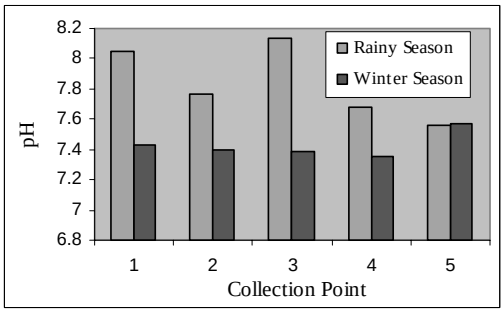

Fig. 4: Comparison of pH in rainy season and dry season. [6]

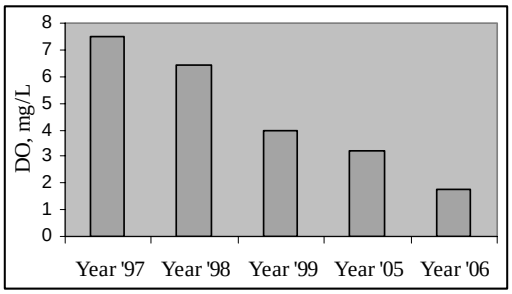

Fig 5: Over the year change in DO concentration. [7]

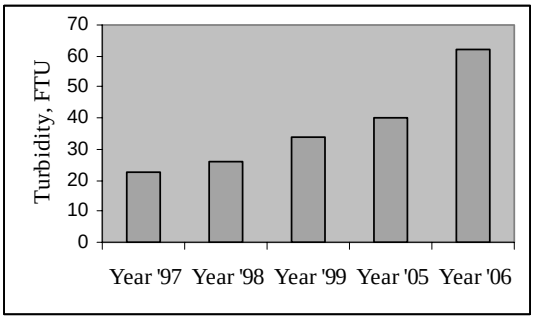

Fig. 6: Over the year change in Turbidity. [7]

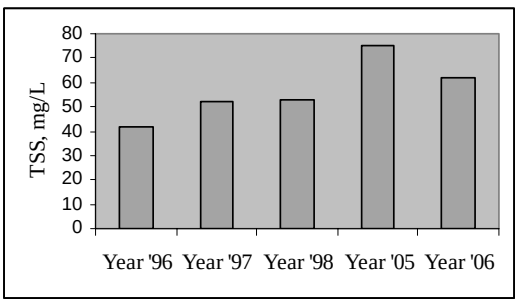

Fig. 7: Over the year change in TSS concentration. [7]

Now, the source of water pollution will be discussed. Textiles and Tanneries are the two main components of water polluting industries. Table II shows data for a chemical industry, a tannery and two textile industries. Standards for textile industries are also provided.

Table II: Effluent water quality parameters for some industries located around Dhaka city. [8]

Parameter	Industries				
	GHCL	Tannery	Textile plant 1	Textile plant 2	Standard For Textile ECR '97
TSS, mg/L	32	98.9	1911	432	100
TDS, mg/L	236	27.6	46.9	166.37	2100
Turbidity, FTU	3	95	42	172	-
pH	7.53	3.55	8.6	5.84	6.5-9
COD, mg/L	27	2652	291	974	-

A.K.M.A. Quader has developed a textile wastewater treatment system by using chlorine. For treatment of textile wastewater by using conventional methods cost of chemicals per cubic meter of effluent varies from 5 to 16 Tk., whereas for this newly developed chlorine based process the cost of chemicals is only 1.00 to 2.81 Tk [4].

An easy to implement and low cost technology for tannery wastewater treatment has been developed during this study. By using this process, the treated water can easily achieve the values set by the DoE.

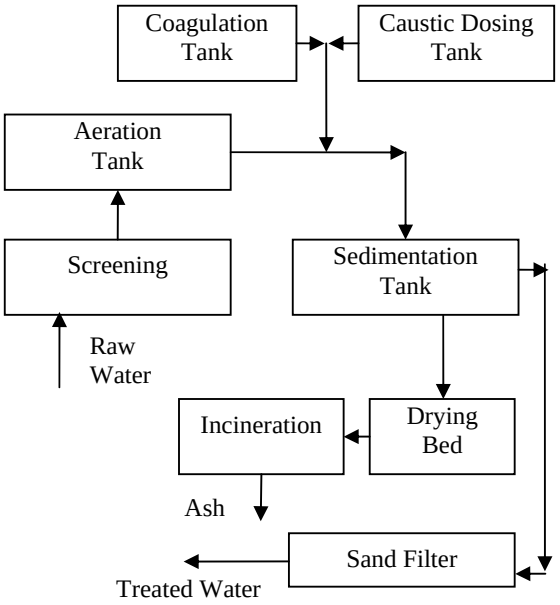

Fig. 8: Block diagram of the low cost tannery wastewater treatment process.

The wastewater quality and treated water quality by using this process is shown in Table III. Standard for Tannery effluent is also incorporated in this table.

Table III: Water quality parameter of two tanneries before and after treatment.

Parameter	Waste water of Plant A	Treated water of Plant A	Waste water of Plant B	Treated water of Plant B	Standard value [ECR97]
pH	3.96	6.89	3.45	6.73	6.0-9.0
SS, mg/L	1400	52	1900	38	150
COD, mg/L	2110	118	3335	18	250
TDS, mg/L	51000	1260	64700	1140	2100
Turbidity, FTU	204	13	317	7	-

Table IV and Fig. 9 shows the raw water quality for Saidabad water treatment plant. This water is treated with locally available chemicals. The laboratory scale treatment process is shown in Fig. 10. As the conventional water treatment process employed in Saidabad water treatment plant used chlorine, there is a chance for forming Disinfection ByProducts (DBPs). But this new process does not incorporate any chlorine.

Table IV: Water quality parameters at intake point of the river Shitalakhya for Saidabad water treatment plant.

Parameter	Time				
	June '09	Aug. '09	Dec. '09	Feb. '10	May '10
pH	6.60	6.70	7.23	7.40	7.01
Conductivity, mS	141.4	87.7	228	804	317
TDS, mg/L	62.9	39.0	76.7	399	135
NH_3-N, mg/L	0.69	0.62	1.9	14	1
DO, mg/L	2.07	2.13	2.36	1.95	2.52

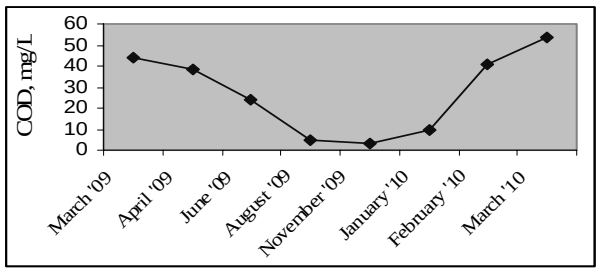

Fig. 9: Change in COD of Shitalakhya river during a year.

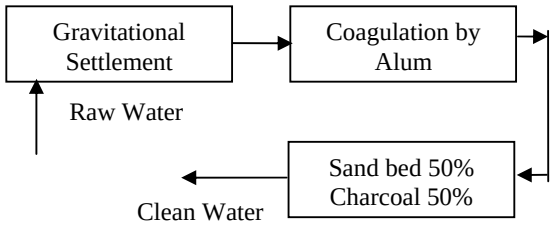

Fig. 10: Block diagram of the low cost surface water treatment process.

This process has shown an optimistic result. The treated water is clear and coli free. Research is going on with this process.

CONCLUSION

With increasing population, the demand for water is also increases in Dhaka city. So, Surface water treatment is the only viable solution to this problem. But the source water from river are so polluted that it has to be restored in the original form. This can be done by low cost viable technologies for wastewater treatment. The existing surface water technology should also be replaced by a more effective one.

RECOMMENDATION

At present, the industry owners are constructing ETPs to comply with the rules of DoE. However, they are reluctant to operate them because of high recurring cost of imported ETPs. So, the river water quality remains almost the same although the ETPs are present in many industries. That's why indigenous low cost water treatment process should be developed and its implementation should be mandatory by the GoB. This action may change the present situation.

To cope up with the growing demand of water in Dhaka city, Dhaka WASA should start surface water treatment of high capacity. But in this effort, the existing quality of river water will increase the treatment cost to a great extent. That's why; low cost effluent treatment process and efficient solid waste management should be introduced. To improve the quality of river water in and around Dhaka city immediate strong actions should be undertaken by DoE.

Efficient solid waste management system should be introduced by the government. Door to door household waste collection, collection of medical wastes from the hospitals and sorting out at sources of different wastes should be done. Solid waste is to be centrally processed to valuable products.

Existing water supply network system of Dhaka city should be modernized so that quality and quantity are assured.

Decentralization of economic activities is needed. Most of the slum dwellers are not giving revenue to Dhaka WASA. They are illegally using the supply water. Therefore it creates pressure on DWASA. If the economic activities are decentralized, these people will leave Dhaka city and thus lower the demand of water in Dhaka.

Social awareness about the consequences of environmental degradation is to be created by the government through mass media such as TV, radio and newspaper.

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