Assessment of Tannery Effluent: A Case Study on Dhaleshwari River in Bangladesh

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Abstract

Effluents from leather processing industry which already crippled Buriganga river in Bangladesh and now destroying Dhaleshwari water as well. It is one of the main source of continuous input of pollutants in river water which hampers the aquatic ecosystem. In this study we made an investigation on the effect of tannery effluents on Dhaleshwari river water near Savar, Dhaka. As the river water continuously polluted by tannery effluents so concentration of tannery effluents in river water is getting high day by day. So, the CETP's effluents and influents were mixed with Dhaleshwari water at concentration of 5%, 25%, 50%, 75%, 90% and analyzed along with the river water, effluent and influent of CETP. Then physicochemical properties like pH, Conductivity, Total Dissolved Solid(TDS), Total Alkalinity(TA), Total Hardness(TH), Dissolved Oxygen(DO), Biological Oxygen Demand(BOD), Chemical Oxygen Demand(COD), Sulfate , Chloride and Chromium are analyzed for all the samples and the results show that with the increasing effluent concentration water quality getting worse day by day. If this continues, will pose a serious threat to aquatic ecosystem, agriculture and human life. We also found an idea about the efficiency of the CETP by assessing both CETP's influents and effluents.

Keywords: *Tannery effluents; River water; Concentration; Physicochemical.*

1 Introduction

Leather industry plays an important role in Bangladesh Economy due to its large potential for employment, growth and export (Tinni et al, 2014). At the same time, it poses serious environmental threats by discharging liquid effluents and solid wastes directly into surrounding low lying areas (Tinni et al, 2014). Savar is a major industrial area of Dhaka city and now a major part of Leather industry of our country relocated there. The CEPT in Savar has the capacity to treat, if properly functional, 2500 cubic meters of waste, but the tannery industries produce more than double that during this large religious festival (Lynne, 2018). Finally, not all the tanneries go through the CETP .That's why we selected Dhaleshwari River near Savar, Dhaka. Physicochemical and microbiological characteristics may describe the quality of water, therefore an analysis of physicochemical parameters of River water was made by many workers (Sinha, 1986; Trivedi et al, 2009; Sinha et al, 2000; Richa et al, 2012; Vinod et al, 2003; Yadav et al, 2011). Industrial effluents from leather tanneries discharged higher amount of metal especially chromium (Vinay et al, 2014). These effluents released on river or canal as well as dump into ground water and lead to contamination of chromium due to accumulation (Vinay et al, 2014). Tanneries caused environmental problem very much. Survey results showed that the most environmental effect was bad smell to the surrounding area, indicated by respondents of 45% and the secondly scarcity of fresh water was 32% among the respondents (Tinni et al, 2014). The waste water were fall in the nearby river and the slums people use these water which causes various diseases to them. Over 8,000 workers in the tanneries suffer from gastrointestinal, dermatological, and other diseases, and 90% of this population dies before the age of 50 (Human Rights Watch, 2012). Major problems are due to waste water containing heavy metals, toxic chemicals, chlorides, lime with high dissolved and suspended salts and other pollutants (Uberai, 2003). Tanneries generate waste water in the range of 30-35 L/Kg skin/hide processed with variable pH and high concentration of suspended solids, BOD, COD, tannins including chromium (Nandy et al, 1999). The present work is focused to see the modulatory effect of tannery effluents on physicochemical parameters like pH, temperature, conductivity, TH, TA, TDS, DO, COD, BOD, SO4, Cr *etc.* of Dhaleshwari River water. The Water quality of Dhaleshwari River can be estimated after addition of % tannery effluents in laboratory condition to predict the future status of river water (Vinay et al, 2014). This is why

we run this study. The observed values of various physicochemical parameters of water samples were compared with standard values recommended by world health organization (W.H.O, 1993).

2 METHODOLOGY

Water sample was collected from Dhaleshwari River 3km upstream from tannery village and treated and untreated tannery effluents was collected from Common Effluent Treatment Plant (CETPs) Savar, Dhaka. At 1st we collected the river water, tannery influent and effluent from CETP in the month of November and run the study. Then we also collected the river water in the month of June and run the test with influent and effluent collected from (CETPs)Savar, Dhaka. That's how we also get a seasonal variation of the river water. The percent of effluents viz. 5%, 25%, 50%, 75%, 90% v/v were made in the collected river water sample and these concentrations were used for physicochemical analysis.

The samples were kept in room temperature. The pH of samples (river water, 5%, 25%, 50%, 75%, 90% effluent, 100% effluent) was determined using a digital pH meter. Conductivity of samples was determined using EC meter. Temperature and Dissolve Oxygen (DO) were determined by digital DO meter. TDS was determined by standard method. Total Hardness (TH), Total Alkalinity (TA) were determined by titration. 5 days incubation method was used to test BOD and Chemical Oxygen Demand (C.O.D.) was measured by open reflux method. Sulphate and Chloride were determined by direct Spectrophotometric method. Trace metal Cr was determined by digesting the sample with concentrated HNO_2 and H_2SO_4 made up to 50 ml volume and analyzed by atomic absorption spectrometer.

3 RESULTS AND DISCUSSIONS

The observed average values of the samples water quality parameters of the study are given in Table 1 & 2 for different percentage concentration of effluents and influents. The effluents were collected in the month of November (winter season) 2017 and influents were collected in the month of June respectively. The Dhaleshwari river water quality is seriously affected by tannery waste. The observed average value of the Dhaleshwari river water quality parameters of the present study are given in table 1 for different percentage concentration of effluents. The treated effluent was rich in TDS, deficit in DO, high BOD and COD. The pH value ranging from 7.4 to 8.5 is an essential factor in formation of algal blooms (Palharyal et al, 1993). Low or high pH value makes the water unfit for irrigation and soil becomes alkaline resulting in poor crop growth and yield (Vinay et al, 2014). The observed value of pH for River water sample is 7.8 in winter and 7.4 in wet season, shows that Dhaleshwari water sample is alkaline in nature. Almost alkaline nature remains for different percentage dilution of Dhaleshwari water sample, not exceeding the pH value 8.5 with both tannery effluents and influents. The pH was found slightly alkaline for sample of tannery waste water. Other workers also reported alkaline tannery waste water (Deepali et al, 2009; Kadam et al, 1990). The EC of Dhaleshwari water sample was found 0.65 mS/cm in winter and 0.35mS/cm in wet season. For different percentage of sample with tannery effluent, EC was found in increasing order for both tannery effluents and influents. The EC were found from 1.16 mS/cm to 12.4 mS/cm for 5% to 100% tannery effluents modulated sample and 1.56 mS/cm to 13.33mS/cm for 5% to 100% tannery influents modulated sample. Increase in EC values indicates the presence of higher concentration of ions (Vinay et al, 2014). Furthermore, TA of River water was found 113 mg/L in winter and 238 mg/L in wet season. TA was found 286 mg/L to 1732 mg/L for different effluents percentage concentration of water samples from 5% to 100%, while TA was found 178 to 2028 mg/L for 5% to 100% influent modulation for water sample. 260 mg/L is even beyond the highest desirable limit prescribed by WHO standard for drinking water.

Table 1. Effect of different concentration of tannery effluent on physicochemical properties of the Dhaleshwari River water.

Parameters	Units	River Water	5%	25%	50%	75%	90%	Influent
Temperature	◦C	23	23	23	23	23	23	23
pH		7.8	8	8.2	8.3	8.3	8.4	8.5
Conductivity	mS/cm	0.65	1.16	3.64	6.62	9.46	11.35	12.4
TDS	mg/L	400	690	2090	3850	5560	6740	7410
TA	mg/L	238	286	565	894	1246	1494	1732
TH	mg/L	204	216	320	370	430	490	510

DO	mg/L	3.99	1.22	0.05	0.04	0.04	0.03	0.03
COD	mg/L	12	23	235	587	779	1002	1228
BOD	mg/L	4.8	20.8	50.4	82.4	102.4	160	240
Sulphate	mg/L	60	130	450	925	1025	1400	1850
Chloride	mg/L	40	160	1100	1900	2900	3700	3800
Chromium	mg/L	0.014	0.267	1.837	3.779	6.132	7.569	8.197

Table 2. Effect of different concentration of tannery influents on physicochemical properties of the Dhaleshwari River water.

Parameters	**Units**	**River Water**	**5%**	**25%**	**50%**	**75%**	**90%**	**Influent**
Temperature	◦C	29.5	29.5	29.5	29.5	29.5	29.5	29.5
pH		7.4	7.8	8.2	8.4	8.4	8.4	8.5
Conductivity	mS/cm	0.35	1.56	3.88	7.55	10.02	12.25	13.33
TDS	mg/L	270	780	3037	4630	6810	8245	9280
TA	mg/L	113	178	602	963	1454	1613	2028
TH	mg/L	179	213	343	412	507	578	602
DO	mg/L	4.41	1.8	0.11	0.04	0.04	0.03	0.02
COD	mg/L	9	24	347	713	967	1403	2314
BOD	mg/L	2.8	43	132	203	390	476	730
Sulphate	mg/L	18	200	525	1050	1200	1550	1900
Chloride	mg/L	24	120	1300	2400	3400	4300	4500
Chromium	mg/L	0.01	3.013	28.267	57.014	113.569	133.029	147.257

The value of total hardness (TH) of River water was found 204 mg/L in winter and 179 in wet season. TH was found 216 mg/L to 510 mg/L for different effluents percentage concentration of water samples from 5% to 100%, while TH was found 213 to 602 mg/L for 5% to 100% influent modulation for water sample. 180 mg/L is the highest desirable limit prescribed by WHO standard for drinking water.TA was found 286 mg/L to 1732 mg/L for different effluents percentage concentration of water samples from 5% to 100%, while TA was found 178 to 2028 mg/L for 5% to 100% influent modulation for water sample. 260 mg/L is even beyond the highest desirable limit prescribed by WHO standard for drinking water. The presence of calcium, magnesium and bicarbonates in excess makes water unfit for irrigation since its application increase problem of soil salinity and its permeability detrimental to crop plants (Srinivas, 1984) .

For different percentage of sample with tannery waste water, TDS was found in increasing order for both tannery effluents and influents. The TDS were found from 690 mg/L to 7410 mg/L for 5% to 100% tannery effluents modulated sample and 780 mg/L to 9280 mg/L for 5% to 100% tannery influents modulated sample. In winter the river water's TDS was 400 mg/L and 270 mg/L in wet season.

Dissolve Oxygen (DO), is an important factor for water (Vinay et al, 2014). Here we can see that for both the influents and effluents the value of DO is very low. For the river water we found DO value 3.99 mg/L in winter and 4.41 in wet season which are also very low.

For different percentage of sample with tannery waste water, COD value was found in increasing order for both tannery effluents and influents. The COD were found from 23 mg/L to 1228 mg/L for 5% to 100% tannery effluents modulated sample and 24 mg/L to 2314 mg/L for 5% to 100% tannery influents modulated sample. In winter the river water's COD was 12 mg/L and 9 mg/L in wet season. High COD and BOD value indicate the pollution strength of the waste water (Vinay et al, 2014).

For different percentage of sample with tannery waste water, BOD was also found in increasing order for both tannery effluents and influents. The BOD values were found from 20.8 mg/L to 40 mg/L for 5% to 100% tannery effluents modulated sample and 43 mg/L to 730 mg/L for 5% to 100% tannery influents modulated sample. In winter the river water's BOD was 4.8 mg/L and 2.8 mg/L in wet season.

Sulfate was found in increasing order for both tannery effluents and influents with increasing effluent percentage. We found Sulfate from 130 mg/L to 1850 mg/L for 5% to 100% tannery effluents modulated sample and 200 mg/L to 1900 mg/L for 5% to 100% tannery influents modulated sample. In winter the river water's Sulfate was 60 mg/L and 18 mg/L in wet season. The WHO limit for Sulfate in drinking water is 630 mg/L (WHO).

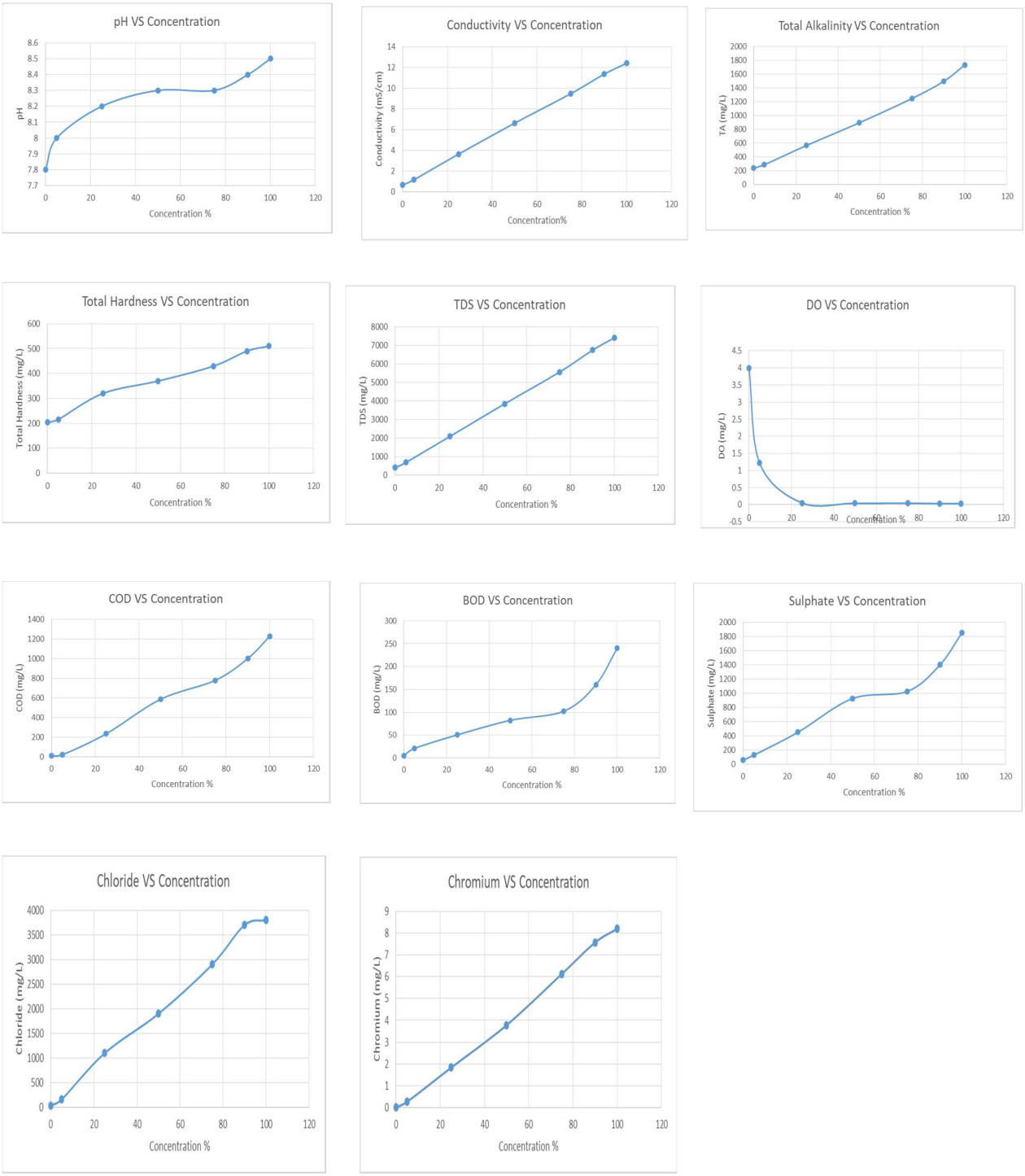

Figure 1. Effect of tannery effluents on physicochemical properties of the Dhaleshwari River water.

Chloride amount in samples also increased with the increasing concentration of tannery waste water. The Chloride were found from 160 mg/L to 3800 mg/L for 5% to 100% tannery effluents modulated sample and 120 mg/L to 4500 mg/L for 5% to 100% tannery influents modulated sample. In winter the river water's Chloride was 40 mg/L and 24 mg/L in wet season. Chromium and its compounds are toxic, which are being mixed with natural water from a variety of industrial effluents (Siraj et al, 2012). Tannery is a major source of Chromium as waste in water. It leads to liver damage, pulmonary congestion and causes skin irritation as well as results in ulcer formation (Raji, 1998). In winter we found 0.014 mg/L Chromium and in wet season 0.01 mg/L Chromium in Dhaleshwari river

water. The Chromium were found from 0.267 mg/L to 8.197 mg/L for 5% to 100% tannery effluents modulated sample and 3.013 mg/L to 147.257 mg/L for 5% to 100% tannery influents modulated sample which is higher than WHO permissible limit for Chromium in drinking water.

4 CONCLUSIONS

From the study we can see that the water quality of Dhaleshwari River is getting damaged at a great extent. After adding only 25% tannery effluent all the WHO limits were crossed. As mixing of tannery effluent is a continuous process, then that day is not so far when Dhaleshwari will turn into new Buriganga. The CETP isn't working at that limit as it need to be. So continuous and periodical monitoring of water quality is necessary so that appropriate preventive measures can be undertaken. Other than that serious environmental quality deterioration could take place in a few years which will be serious threat for human and aquatic life. We also get the idea that water quality is varies with temperature and seasons. The situation will be even more catastrophic if the effluents are directly discharged into the river without using the CETP. So all the tanneries in Savar should discharge their waste water at first into the CETP and for that necessary steps should be taken as soon as possible. Other than that the situation will be horrible.

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