Proceedings of the 5th International Conference on Civil Engineering for Sustainable Development (ICCESD 2020), 7~9 February 2020, KUET, Khulna, Bangladesh (ISBN-978-984-34-8764-3)

INVESTIGATION OF PHYSICOCHEMICAL PARAMETERS OF EFFLUENT FROM TEXTILE INDUSTRIES OF BANGLADESH

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ABSTRACT

Though textile industries have major contribution to run economic wheel of the country, their adverse effects on environment and human health is noticeable. Textile industries pollute environment and cause health hazard by producing huge amount of waste water that contains obnoxious pollutants. This paper investigates different effluent quality parameters of Effluent Treatment Plant (ETP) outlets. The samples were taken from two industries ETP outlets named Denim Plus (BD) Ltd. and Jeans 2000 Ltd situated in Chattogram EPZ. The effluent of outlets was dark color due to presence of coloring agent. A comparative study was also done over consecutive six-month sample data for both the industries and also compared with ECR 1997 water quality standards. The highest dissolved oxygen (DO) were 7.6 in September in Denim Plus Ltd effluent and 8.8 in August in Jeans 2000 Ltd. The pH values for both the industies were withinin the ECR 1997 limit. But BOD showed higher value in June and COD value get higer than standard limit in August for Jeans 2000 Ltd.Tough most of the textile indutries have ETP plant but they show reluctance to treat water. The effluents contains chemicals,salts,dyes,bleaches which contaminates water and pollute environment. By analyzing the physicochemical parameter of effluent of these two industries it is found that after treatment effluent outlets ensure standards quality with few exceptions.

Keywords: *Textile industry; Effluent; ETP; Water quality; Pollutants.*

1. INTRODUCTION

Textile and garment industries play a vital role in socio-economic development of Bangladesh. As worlds one of the biggest exporters Bangladesh holds 5% share in global market. About 85% of Bangladesh's export earnings and 10% of GDP comes from ready-made garments (RMG). Bangladesh Garment Manufacturers and Exporters association (BGMEA) has recently set a target for garment sector to reach $50 billion of exports by 2021 and $82.5 billion by 2030.To achieve the goal and to accelerate economic development of Bangladesh huge amount of water is necessary. In different stages of operation in textile industries about 85% of water is used and discharged (World Bank Group, 2015). Mainly the washing and dyeing sections consume large quantity of water. The highly polluted and toxic wastewater is discharged into the rivers, lands or drains by the industries without any kind of treatment. This irregular and unplanned disposal of wastewater has created environmental pollution problem. During the production process large amount of effluent is ejected from the industries either treated or untreated. According to environmental conservation rule (ECR 1997) the textile factories are supposed to have ETP for effluent treatment but a large number of factories are violating the rules and are continuing without ETP. As a result, the effluent discharged from the industries pollutes the surface as well as groundwater.

The effluents contain heavy metals, trace metals, colouring agents and some toxic elements. The effluent discharged into the rivers goes far away and used by people for their day to day activities and irrigation (Sarkar et al., 2015). Consequently, the physiochemical parameters of water such as pH, BOD, COD, TDS, DO get degraded due to the polluted water. It will contaminate the food chain and ecosystem. These make water very toxic and harmful for human begins crops and aquatic livings. This causes serious diseases such as cancer, damage of infant brain, body shrinkage etc on human beings, reduces soil fertility and damages crops (Munnaf et al., 2014). The environmental hazard due to wastewater is very alarming for developing countries like Bangladesh. Many international investors are now aware of environmental pollution and looking for whether textile factories have ETP or not for safe emission of effluents. It is appreciable that most of the factories are nowadays installing ETP for wastewater treatment and safe disposal of the effluent. However, to reduce environmental pollution proper monitoring is needed for efficient functioning of ETPs. The industries should be aware of the effect of polluted effluent in the environment as well as the threat it has on human life. Therefore, in this paper a comparative study was carried out in six different months to observe the change in effluent quality ejected from the ETPs of Denim Plus Ltd and Jeans 2000 Ltd in Chattogram, Bangladesh.

2. METHODOLOGY

The study area was located at CEPZ (Chattogarm Export Processing Zone), South Halishahar, Chattogram, Bangladesh. The ETP (Effluent Treatment Plant) of M/s. Demin Plus (BD) Ltd. (Sector-7, Plot-3-8) and M/s. Jeans 2000 Ltd. (Sector-7, Plot-67) is established at 22° 17' 36.16"N Latitude and 91° 46' 55.59"E Longitude

2.1 Sample Collection

Water samples were collected from ETP Outlet points of the M/s. Demin Plus (BD) Ltd. and M/s. Jeans 2000 Ltd. in 500 ml dark plastic bottle. One litre water sample was collected in each month for performing the tests on physiochemical parameters from ETP outlets of the companies.Before sampling the bottles were cleaned with detergent, rinsed with 10% HNO3, and then washed with distilled water, after that bottles were rinsed three times with the water to be sampled. Alkaline potassium iodide solution was used to protect water samples from any fungal and other pathogenic attack. After collection, the bottles containing samples were sealed immediately to avoid exposure to air.

2.2 Analytical Method

The following analyses were done from the collected water samples: pH, DO (Dissolved Oxygen), TDS (Total Dissolved Solid), BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand). To provide necessary information for each sample such as date of collection, location, time etc. were recorded in the note book and each sample collected in a plastic bottle was labeled separately with a unique identification number. Water quality parameters such as pH and DO (Dissolved Oxygen) were determined by Multi-Function Environment Meter (WTW multi 9310).TDS (Total Dissolved Solids) were determined by Digital TDS Meter (Hanna Instruments® HI 96302). COD (Chemical Oxygen Demand) was measured by COD Thermoreactor (WTW CR3200) and Photo Flex (WTE) using COD Reagent vial. As BOD (Biological Oxygen Demand) value need 5 days to give the result. First prepared amber bottle and setup Oxitop immediately after collection, after 5 days BOD (BOD5) was measured by incubation (Thermostate Cabinet, WTW TS 606-G/4-i) at 20°C.

3. RESULTS AND DISCUSSION

A study was done on different water quality parameters for consecutive six months on the samples collected from outlet of ETP plant of Denim Plus Ltd and Jeans 2000 Ltd. The different parameters such as pH, COD, BOD, DO and TDS were plotted in the graph against different months shows whether the observed values are within the standard guideline of ECR 1997 or not.

pH indicates acidic or alkaline nature of water. From (fig-1) it is observed that the pH value for both the industries are within ECR 1997 standard which ranges from 6.5-8.5. In May Denim Plus Ltd has pH value 8 and Jeans 2000 Ltd shows pH value 6.5. In August Denim Plus Ltd has 7.8 pH and Jeans 2000 Ltd has 6.7 pH. Other than May and August pH value for both the industries in other months are close enough. The pH value of inlet effluent was maintained well in both the industries during neutralization process. For basic dyeing, pH correction was in acidic side and for acidic dyeing pH correction was done by adding alkali. This neutralization was done with a slow thorough mixing process in pH correction tank.

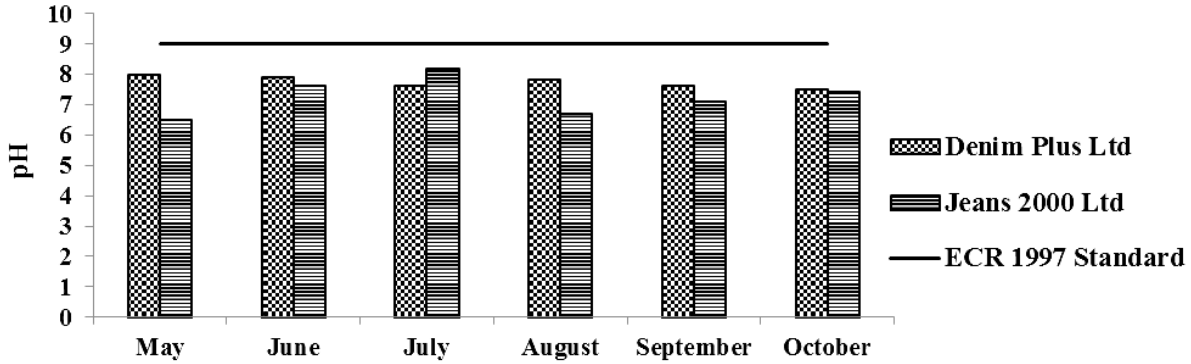

Figure 1: Values of pH in different months from May to October compared with ECR 1997 standard

Dissolved oxygen is one of the most important indicators of water quality. Naturally DO is mixed in surface water by wind effect. It is very important for the survival of fish, aquatic life for photosynthesis. After using water in industries for different purposes the water gets polluted and so DO level reduces.

When the outlet water from ETP was tested the Maximum DO was found 8.8 mg/l in August for Jeans 2000 Ltd form (fig-2) which is little higher than the standard value 8 mg/l. But in September DO level of Jeans 2000 Ltd was 3.1 mg/l which is very low and below standard level. The production rate was high in September in Jeans 2000 Ltd and the equalization tank could not work effectively because the tank did not has the capacity to hold this much of waste water. As a result the tank could not mix different types of effluent discharging from plants. So DO Level was not increased appropriately due

to lack of oxygen supply and the high temperature of effluent. Whereas Denim Plus Ltd has a relatively consistent DO level in every month other than May and June. This two month shows low DO level 5.7 mg/l and 5.8 mg/l respectively due to hot weather and less use of purified water in production plants.

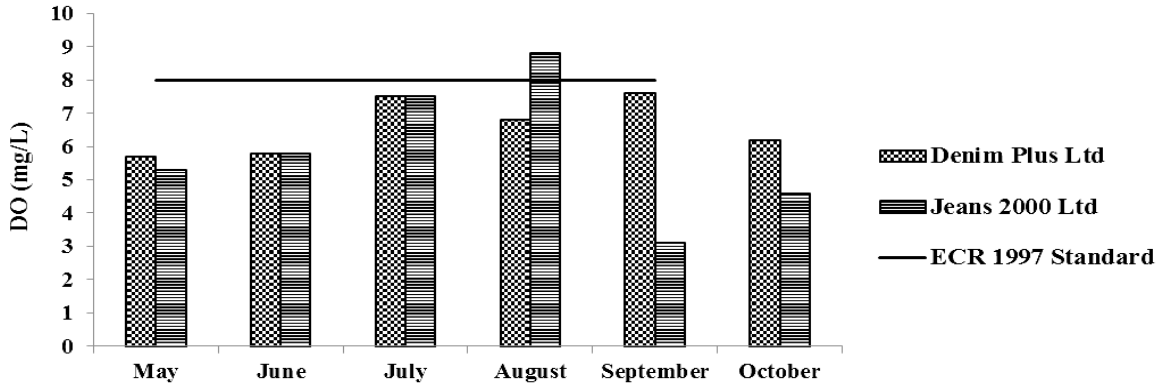

Figure 2: Values of DO (mg/L) in different months from May to October compared with ECR 1997 standard

BOD indicates the amount of organic matter in water was found higher 80 mg/l in June in Jeans 2000 Ltd. whereas the standard value for BOD is 50mg/l by ECR 1997. In sizing and desizing processing unit different pollutants such as starch, glucose, carboxy methyl, cellulose, polyvinyl alcohol etc dissolves in water which results in high BOD level. In Jeans 2000 Ltd effluent was taken into flash mixing tank after equalization tank for proper coagulation and flocculation process to skim out the oily substances and dye particles. But this process had some faults due to inappropriate dosage of coagulants and flocculants. As a result, it is observed that Jeans 2000 Ltd has in consistence changes in BOD level in different months. But in Denim Plus Ltd, the values of BOD were in permissible limit in each month as shown in (fig-3).

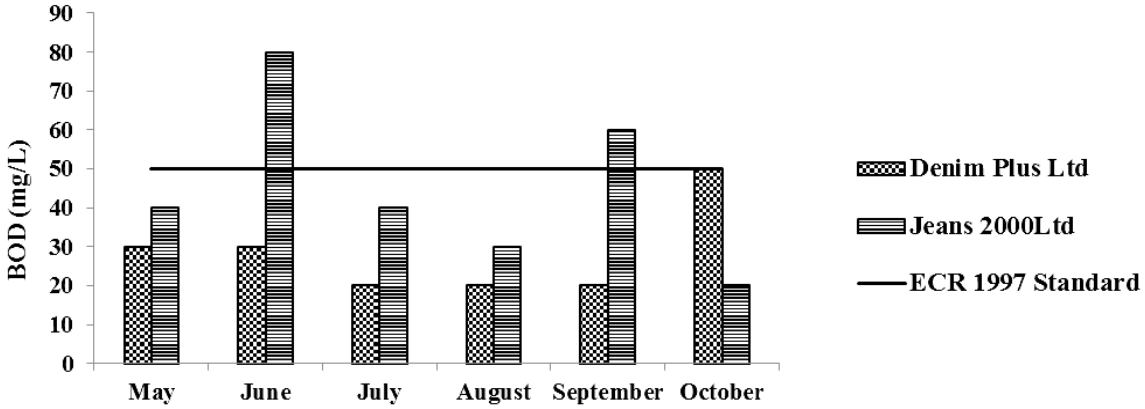

Figure 3: Values of BOD (mg/L) in different months from May to October compared with ECR 1997 standard

The COD test is done to assess the effect of discharged waste water on environment. In Denim plus the COD value observed from (fig-4) is within the ECR 1997 standard 200 mg/l but the value increased drastically to 391mg/l in August for Jeans 2000 Ltd. During scouring and bleaching process different chemicals such as dyes, salts, alkalies, Acids, Na_2S, $Na_2S_2O_2$, and soap are mixed with water and increases COD level. Different units have different toxicity level and so at first, they need to be separated according to high toxicity level. These separating stages were absent in Jeans 2000 Ltd for treating effluent. So lack of proper monitoring was one of the reasons for higher COD level.

In case of Denim Plus Ltd all COD values were very less than standard limit as they use anaerobic digestion process to biodegrade complex organic matter to treat high COD wastes. In August it shows COD 23 mg/l which is very negligible. Moreover the other COD values in each month are in reasonable range and shows a consistent trend for Denim Plus Ltd.

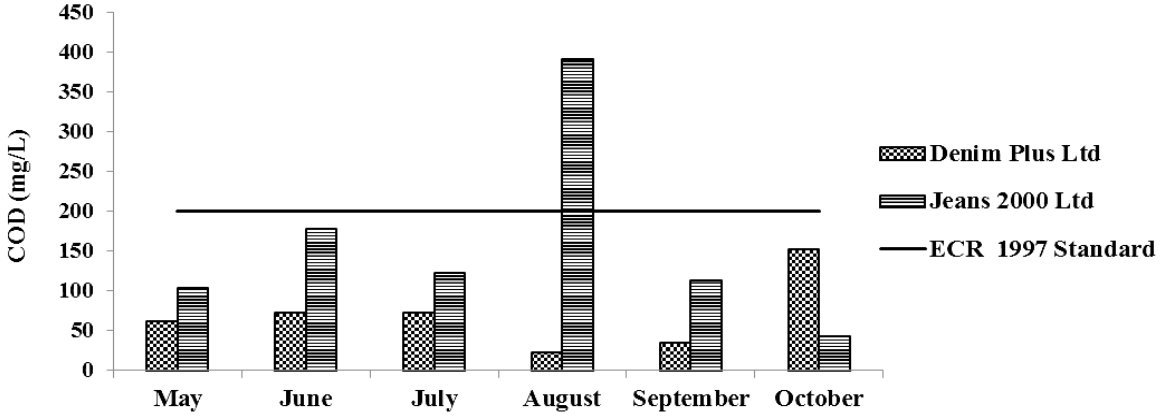

Figure 4: Values of COD (mg/L) in different months from May to October compared with ECR 1997 standard

Total Dissolved Solid (TDS) is the measurement of organic and inorganic substances present in water. Mostly TDS increases due to salts presence in dyeing operation. The six month observation of TDS in (fig-5) shows that the TDS values are within standard limit 2100 mg/l of ECR 1997 for both the factories. TDS cannot be removed totally from effluent but it can be kept within permissible limit by dilution. Jeans 2000 Ltd shows high TDS 2050 mg/l in September where Denim Plus Ltd shows TDS 1962 mg/l in same month. This limits are within standard range of ECR but TDS concentration can be reduced if the industries use salt recovery plant and practice cleaner production within factory premises.

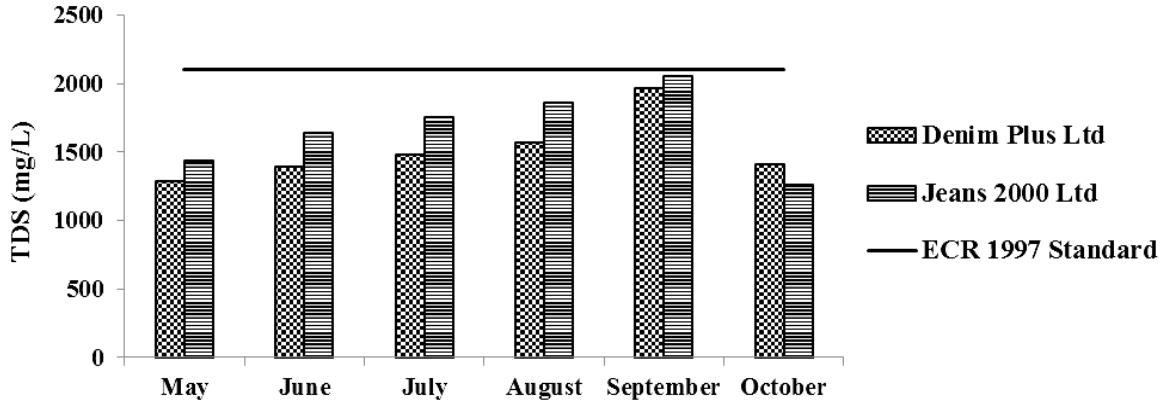

Figure 5: Values of TDS (mg/L) in different months from May to October compared with ECR 1997 standard

4. CONCLUSIONS

From the above study it is concluded that most of the physicochemical parameters of waste water that is discharged from ETP of Denim Plus Ltd are within standard limits of ECR 1997. But the parameters such as COD, BOD and DO are not within the acceptable range for Jeans 2000 Ltd. The COD level has increased significantly in August and BOD level has increased in June. The probable reason for this abnormal increment shows lack of proper management of waste water which leads to increased volume of toxic effluent. The primary treatment of effluent such as coagulation,

flocculation, neutralization, sedimentation were not done properly for floatable and settleable material. As a result both the biodegradable and non-biodegradable organic matters were increased which led to higher COD and BOD level. Effluent should be properly monitored in every step of scouring, dyeing, bleaching and finishing. Selection of dyes, chemicals should be done carefully to reduce effluent toxicity level. However both the industries should give more emphasize to use synthetic sizes rather than using starch sizes to reduce BOD and COD level. Moreover complete operation of every stages of effluent treatment plant can help the industries to maintain standard quality effluent discharge.

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