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DIMINUTION OF ETP LOAD THROUGH WASTE WATER SEGREGATION

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ABSTRACT

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The major focus of this study was to determine or find out the stages or steps of dyeing process to discharge the wastewater of those steps without treating in ETP to reduce the load of ETP i.e. reducing processing cost of ETP and encourage the industrialists or manufacturers to use the ETP at low operating cost which will save the environment from the water pollution. From the results of this study, it appears that some stages waste water of dyeing industry is suitable for discharge directly and some are not suitable. From this study it is clear that if Textile dyeing factories discharge the wastewater of the above selected steps then, they will be able to save about 40% of ETP processing cost without hampering the environment.

Key words: *Dye, ETP, Environment and Chemicals*

INTRODUCTION

Textile industry is a very diverse sector in terms of raw materials, processes, products and equipment and has very complicated industrial chain. Textile wet processing covers the bleaching, dyeing, printing and stiffening of textile products in the various processing stages (fiber, yarn, fabric, knits, finished items). The purpose of processing is in every instance the improvement of the serviceability and adaptation of the products to meet the ever-changing demands of fashion and function (Choudhury 2006). The impacts on the environment by textile industry have been recognized for some time, both in terms of the discharge of pollutants and of the consumption of water and energy. Finishing processes can be categorized into purely mechanical and wet processes (Babu *et al.* 2007). The liquid phase for the latter type is primarily water, and - to a lesser extent - solvents and liquefied ammonia gas. Another important medium is steam. To achieve the desired effects, a range of chemicals, dyes and chemical auxiliaries are used. Environmental problems of the textile industry are mainly caused by discharges of wastewater. The textile sector has a high water demand. Its biggest impact on the environment is related to primary water consumption and waste water discharge (Eswaramoorthi *et al.* 2005).

Textile processing employs a variety of chemicals, depending on the nature of the raw material and product. Main pollution factors in textile wastewater come from dyeing and finishing processes. These processes require the use of a wide range of chemicals and dyestuffs, which generally are organic compounds of complex structure (Abdessemed and Nezzal, 2002). As all of these are not contained in the final product, these are drained with as waste and caused disposal problems. Major pollution factors in textile wastewaters are high suspended solids, chemical oxygen demand, heat, color, acidity, and other soluble substances. To remove these pollutants, operating cost of ETP is very high. The effluents resulting from these processes differ greatly in composition, due to differences in processes, used fabrics and machinery. Some of them are highly contaminated and some are nearly harmless. Scope of current project is aimed to analyze the direct discharge of low contaminated wastewater as the ETP operating cost can be minimized.

The overall objective of this study was to reduce ETP load by segregating wastewater of dyeing cycle. Specific objectives of this study were:

i) To reduce overall ETP load.
ii) To determine different parameters of dyeing wastewater.
iii) Comparing the quality parameter of selected wastewater with the standard values.
iv) To determine the safe steps for direct discharge.
v) To save the Environment.

MATERIALS AND METHODS

Sample: Untreated Industrial wastewater.

Chemicals/Reagents:

The following are the chemical used in this study.
All the chemicals are of analytical reagent grade.

i) Potassium chromate indicator
ii) Standard 0.02N sulfuric acid
iii) Concentrated sulfuric acid
iv) Manganese sulfate solution
v) Alkaline potassium iodide solution
vi) Standard 0.025N sodium thiosulfate solution(N/40)
vii) Fleshly prepared starch solution
viii) EDTA solution(N/40)
ix) Ammonium chloride-Ammonium hydroxide buffer

Apparatus:

The following are the Apparatus which are used in this study.

1. pH meter
2. TDS meter
3. Hardness Test kit
4. Incubator
5. Dryer
6. Electronic Balance

Selection of factory

Factories are selected on the base of dyeing process and region for this study because of there are some differences between knit dyeing & yarn dyeing process and quality of water varies from region to region. The following are the selected factory from where wastewater is collected

A) Knit dyeing factory:

- TEXEUROPE (BD) LTD CHANDONA, CHOURASTA, GAZIPUR. VIYELLATEX LTD. KHARTOIL, TONGI, GAZIPUR

B) Yarn dyeing factory:

- ONE TEX LTD.GILLARCHALA, SHREEPUR, GAZIPUR
- HOSSAIN DYEING. PAGAR, TONGI, GAZIPUR

Testing of wastewater parameter

Among the above mentioned waste qualities P^H, Hardness, TDS, TSS, BOD and COD are most important water quality for textile dyeing wastewater to discharge into environment. So those waste qualities are measured by the following procedures

Determination of P^H of Water

REAGENT: Standard pH solution for calibration of P^H Meter

PROCEDURE:

1) Perform calibration of the P^H meter using standard P^H solutions. The calibration procedure would depend on the P^H range of interest.
2) Take about 100ml of the sample in a beaker. Make sure not to agitate the sample in order to avoid exchange of gases between sample and atmosphere.
3) Insert P^H meter in the sample. Allow sometime for attainment of equilibrium. Turn on the P^H meter and take reading.

RESULT AND DISCUSSION

Segregation of Waste:

In a large industrial plant there may be several classes of waste varying in volume, strength, and toxicity. Some of them are highly contaminated and some are very low contaminated which may be discharged directly in the environment that will not affect the environmental condition i.e. not so harmful to environment. One may be readily amenable to biological treatment with domestic sewage, another may be quite inimical to such processes, and another may have value for by-product recovery. Careful study of their characteristics may indicate that each waste should be handled and treated separately. It is especially necessary that any toxic wastes be segregated. All such segregation requires careful planning of separate plant sewer systems.

Table 1. Standards for Wastewater Discharge from Industrial Units and Projects according to ECR, 1997

Sl. No.	Parameter	Unit	Place for Determination of Standards		
			ISW	PS	IL
1	p^H	-	6-9	6-9	6-9
2	Hardness(as $CaCO_3$)	mg/L	200-500	200-500	200-500
3	TDS	mg/L	2100	2100	2100
4	TSS	mg/L	200	500	150
5	COD	mg/L	200	400	400
6	$BOD_5 20^0C$	mg/L	50	250	100

Note: ISW-Inland surface water, PS- Public sewerage, IL- Irrigated land

ECR-Environmental Conservation Rules

Table 2. Wastewater Discharge from a one ton capacity dyeing machine

AMOUNT OF WATER DISCHARGE BEFORE SEGREGATION				
Process	M:l ratio	Amount of material (kg)	Amount of water (l)	Remarks
Scouring & Bleaching	1:8	1000	8000	Highly contaminated
Hot Wash	1:8	1000	8000	Highly contaminated
Rinse (5-10′)	1:18	1000	18,000	Low contaminated
Neutralization by CH_3COOH	1:8	1000	8000	Low contaminated
Bio polishing	1:8	1000	8000	Highly contaminated
Hot Wash	1:8	1000	8000	Low contaminated
Rinse (10-15′)	1:18	1000	18,000	Low contaminated
Acid for Controlling pH of dyeing	1:8	1000	8000	Highly contaminated
Rinse (15-20′)	1:20	1000	20,000	Highly contaminated
Neutralization	1:8	1000	8000	Highly contaminated
Soap Wash	1:8	1000	8000	Highly contaminated
Hot Wash	1:8	1000	8000	Highly contaminated
Rinse (5-10′)	1:18	1000	18,000	Low contaminated
Softening	1:18	1000	8000	Highly contaminated

Total amount of discharge water from 1000 kg capacity dyeing machine is 154,000 L

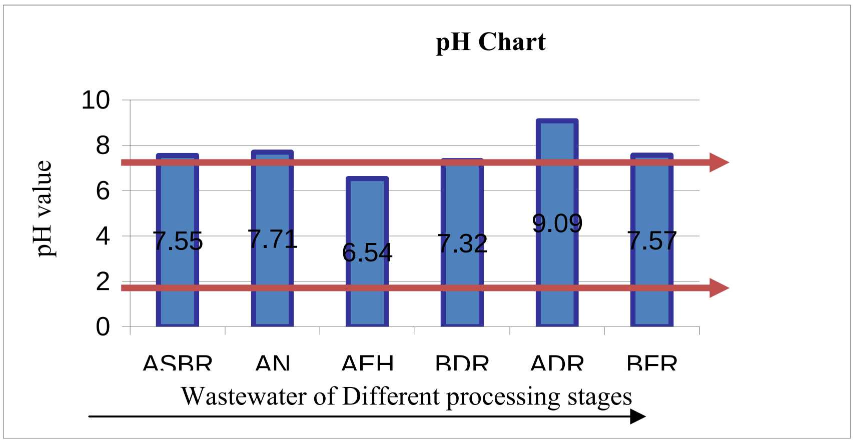

Fig. 1. pH of different wet processing stages wastewater

Maximum pH value of wastewater for discharge is 6-9 according to ECR, 1997.

In the above chart, it has been found that after dyeing rinse (ADR) wastewater has exceeded the maximum limit of pH value and rest of all the wastewaters are within the control limit. So it will not be discharged into environment without treatment in ETP.

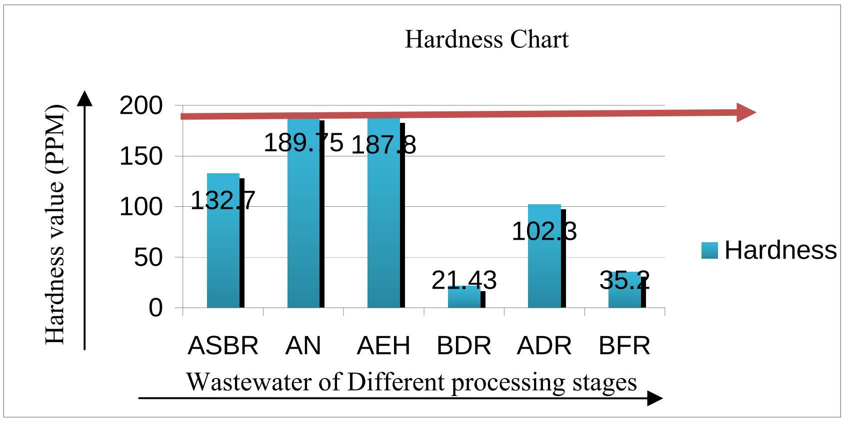

Fig. 2. Hardness of different wet processing stages wastewater

Maximum hardness value of wastewater for discharge is 200-500 PPM according to ECR, 1997. In the above chart, it has been found that hardness value of all the wastewaters is within the control limit.

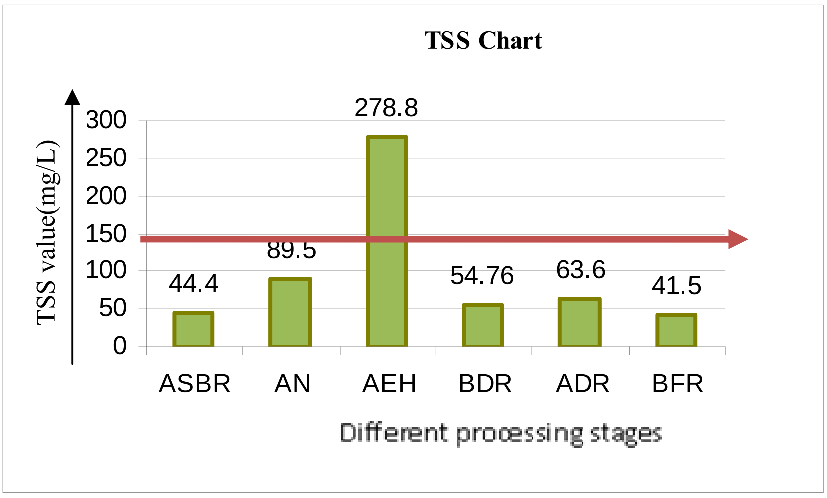

Fig. 3. TSS of different wet processing stages wastewater

Maximum TSS value of wastewater for discharge is 200 ml/L according to ECR, 1997.In the above chart it has been found that after enzyme hot (AEH) water has exceeded the maximum limit of TSS value and rest the wastewaters are within the control limit. So AEH will not be discharged into environment without treatment in ETP.

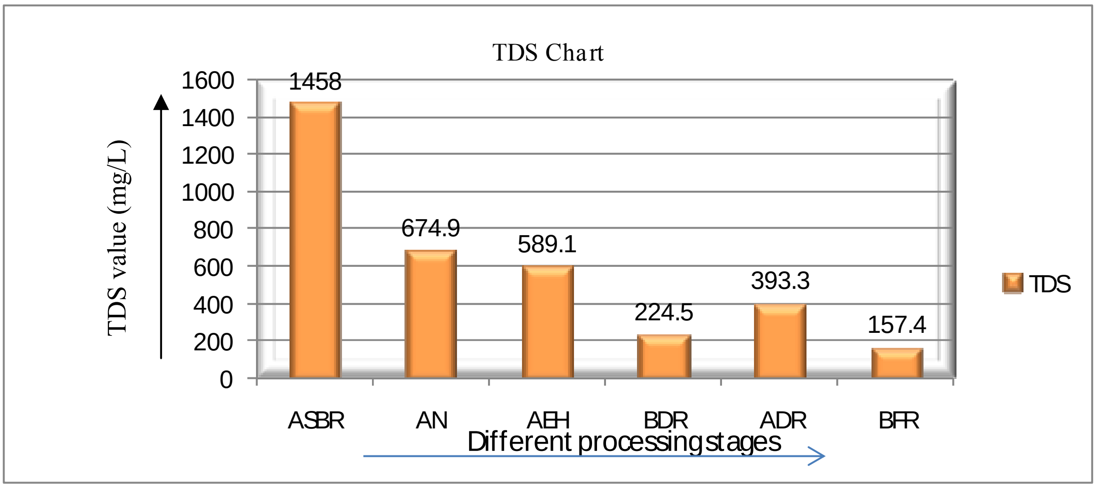

Fig. 4. TDS of different wet processing stages wastewater

Maximum TDS value of wastewater for discharge is 2100 ml/L according to ECR, 1997. In the above chart, it has been found that TDS value of all the wastewaters is within the control limit.

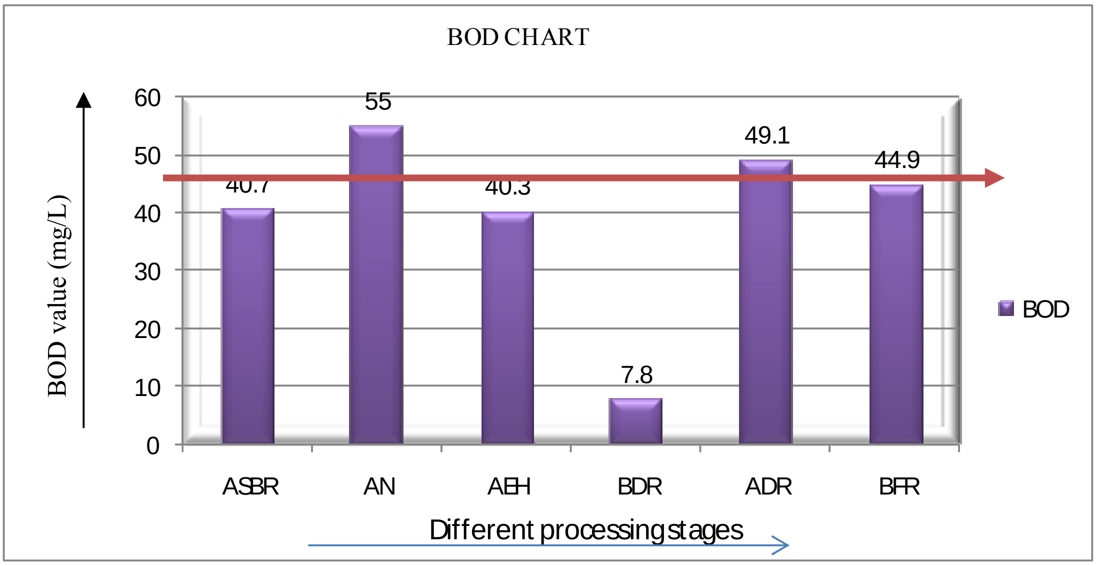

Fig. 5. BOD of different wet processing stages wastewater

Maximum BOD value of wastewater for discharge is 50 ml/L according to ECR, 1997. In the above chart it has been found that acid neutralization (AN) water has exceeded the maximum limit of BOD value and after dyeing rinse (ADR) water is to the nearest of the maximum limit of BOD value. As a result they will not be discharged into environment without treatment in ETP. But rest the wastewaters are within the control limit.

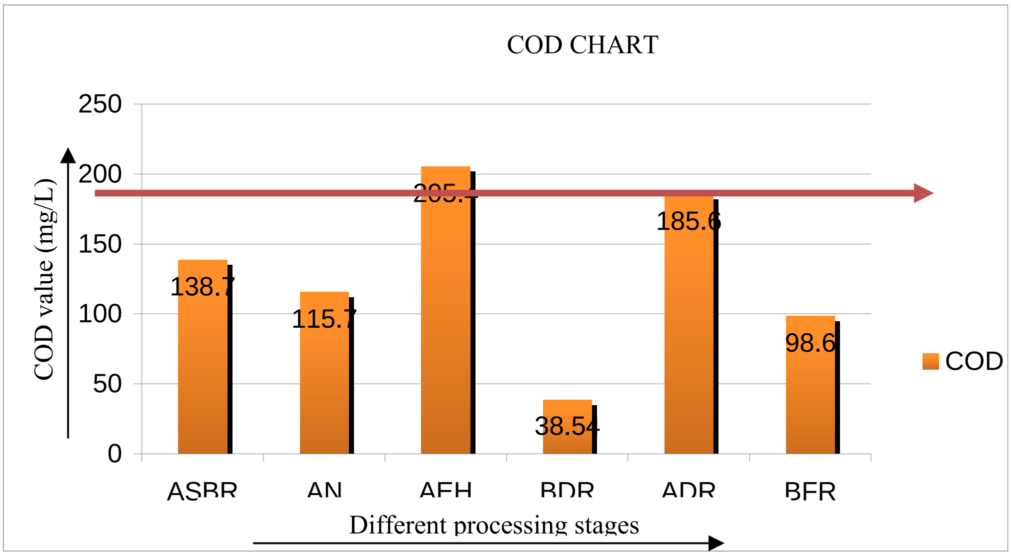

Fig. 6. COD of different wet processing stages wastewater

According to ECR, 1997 maximum COD value of wastewater for discharge is 200 ml/L. In the above chart it has been found that after enzyme hot (AEH) water has exceeded the maximum limit of COD value and after dyeing rinse (ADR) water is to the nearest of the maximum limit of BOD value. For that reason they will not be discharged into environment without treatment in ETP. But rest all the wastewaters are within the control limit (Gohl and Vilensky, 1999).

Therefore, from the above experimental data analysis, it has been found that ASBR, AN, BDR and BFR wastewater have fulfilled the wastewater standards to discharge into environment without treating in ETP. But AEH and ADR have not fulfilled the wastewater standards. Consequently they are required to treat in ETP for discharging into environment.

Table 3. Directly dischargeable wastewater from entire dyeing process

Process	M:L Ratio	Amount of Material (KG)	Amount of Water (L)
After scouring & bleaching rinse(5-10´)	1:18	1000	18000
Neutralization	1:8	1000	8000
Before dyeing rinse	1:18	1000	18000
Before finishing rinse (5-10´)	1:18	1000	18000

Total amount of segregated wastewater from 1000 kg capacity dyeing machine is 62,000L

Hence about 35-40% of ETP load may be decreased by segregating low contaminated wastewaters i.e. ASBR, AN, BDR &BFR from the highly contaminated wastewaters through suitable way.

4.3 ETP costing

A) Chemical Costing-

Table 4. Costing of chemical for processing wastewater in ETP

Chemical Name	Chemical gm/Ltr	Supply Ltrs /Hr	Chem. Kg/Hr	Price/Kg in TK	Total Chemical Cost/Hr in TK
$FeSO_4$	30	1000	30	18.00	540.00
Lime	35	1000	35	11.00	385.00
Polyelectrolyte	0.5	500	0.25	400.00	100.00
DAP	2.5	1000	2.50	75.00	188.5
HCl	30	1500	45	18.00	810.00
De-Coloring agent	2	167	0.334	100.00	33.40
				Total TK/Hr =	2056.9

B) Manpower Cost (Per Hour):

i) Cost of Operator = No of Operator × Salary of Operator

= 2×6000 = Tk. 12,000

ii) Cost of Helper = No of Helper × Salary of Helper

= 3×3000 = Tk. 9000

iii) Cost of Incharge = No of Incharge × Salary of Incharge

=1×8000 = Tk. 8000

Total Cost = Cost of Operator + Cost of Helper + Cost of Incharge

= 12,000 + 9000+8000

= Tk. 29,000

Cost per hour = {Total cost ÷ (Hours × No of days in a month)} = {29000÷(24×30)}

=Tk. 40.27

C) Electricity Cost per Hour:

The calculated Unit Electricity Cost is– TK 1.68.

Supplied Amp for ETP is 80,

Then, Total KW for an Hour = $\frac{\sqrt{3}VI \cos\theta}{1000}$

= $\frac{\sqrt{3} \times 440 \times 80 \times 0.8}{1000}$

= 48.77 KWH

Electric Bill Per Hour = 48.77×1.68 = 81.94 = TK.82 (approx.)

D) Cost required for an hour to run ETP-

Cost Per Hour = (Chemical Cost + Manpower Cost + Electric Cost)

= 2056.9 + 40.27 + 82

= Tk. 2179

E) Treatment Cost (Tk. / m^3) = Tk. 54.47

F) Treatment Cost (Tk. / L) = TK. 0.05447

G) Total amount of processing cost of ETP before segregation

= (Total amount of wastewater in liter × Treatment cost per liter in taka)

= 154000×0.05447

= 8388.38TK. /day

Therefore, ETP processing cost for a 25 tons capacity dyeing factory before segregation

= 8388.38×25

=209709.5 TK./day

H) Total amount of water have to be treated after segregation

= (Total amount of wastewater –amount of segregated wastewater)

=154,000-62,000

= 92000 L

Therefore, ETP processing cost after segregation=92000×0.05447

=5011.24×25

=125,281 TK./day

I) Total saving of ETP processing cost by segregating wastewater

= (Total amount of processing cost of ETP before segregation- ETP processing cost after segregation)

= 209709.5 -125,281

= 84000TK. /day

Thus, from the above calculation it is obvious that about 40% of total ETP processing cost can be reduced by segregating low contaminated wastewater.

Table 5. Outcome of the study

Title	Amount of wastewater (L)	ETP Processing cost (Tk./L)	Total cost (TK./day)
Before segregation	154,000	0.05447	209,709.5
After segregation	92,000	0.05447	125,281
Savings	62,000		84,000

CONCLUSION

Major conclusions derived from the analysis of these results are summarized below.

pH values satisfy the limit of Bangladesh standards (DoE Standard) and ECR guideline values. Total solids and Total dissolved solids concentration in all selected segregated wastewater satisfy the limit of Bangladesh standards and ECR guideline values for discharging wastewater and gradually decreases with increasing the time of rinsing. Hardness in all hot washes wastewater has exceeded the Bangladesh standards for discharging wastewater. Hardness concentration of all rinse wastewaters is less than DoE standard for discharging wastewater in the Environment without treating in ETP.BOD_5 values satisfy the limit of Bangladesh standards and ECR guideline values. The color concentration in some wastewater has exceeded the Bangladesh standards and ECR guideline values for discharging wastewater in the Environment without treating in ETP. In some wastewater samples, color, TDS, TSS, pH concentrations have exceeded the ECR, 97 guideline values.

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