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COMPARATIVE STUDY ON ETP DISCHARGED WATER AND WTP TREATED GROUND WATER DYED COTTON FABRIC SAMPLES

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ABSTRACT

Abir PG, Foisal ABM (2015) Comparative study on ETP discharged water and wtp treated ground water dyed cotton fabric samples. *Ins. Engg. Tech.* 5(1), 7-11.

The aim of this work is to evaluate a novel idea to find out the possibilities of using discharge water from effluent treatment plant for cotton fabric dyeing. In this experiment, we have tried to focus on the shade differences, spectrophotometric evaluation (DE value), wash fastness, rubbing fastness, perspiration fastness and p^H value comparison (after wash) while a cotton fabric is dyed using both ground water from the water treatment plant and discharge water from the effluent treated plant. This work is done at the Central Dyeing Laboratory of Microfibre Group in Bangladesh. The fabric samples used here are 100% cotton single jersey. The quality parameters such as shade differences, spectrophotometric evaluation (DE value), wash fastness, rubbing fastness, perspiration fastness and p^H value comparison (after wash) of the both dyed samples have been compared and it has been found that the results are satisfactory for the 10 gm of fabric dyed with both type of water.

Key words: *ETP water, WTP water, color fastness*

INTRODUCTION

Textile is the most important sector of Bangladesh's economy. Textile industry uses large quantity of water in its production processes and highly polluted and toxic waste waters are discharged into sewers and drains without any kind of treatment (Khan and Guah, 2012). The industrial growth of the country is threatening the environment. Textile industries generate risky effluent for human health as they use huge amount of water and eventually generate high waste water (Ghoreishi and Haghighi, 2003). Nearly 110 liters of water is needed to dye 1 kg cotton fabric and thus the water consumption of an average sized textile mill having capacity only 8 tons/day is about 1.6 millions liters per day (Shaid 2013). The textile dyeing industries of Gazipur and Narayanganj generate large amount of effluents, sewage sludge and solid waste materials everyday which are being directly discharged into the surrounding channel, agricultural fields, irrigation channels, surface water and these finally enter in to Turag and Shitalakkhya River. Many industries have their own ETP to treat the effluent before discharging it in the environment. Some of the industries like are now-a-days trying to set up an effluent treatment plant based due to a law enforced by the environmental department of Bangladesh (Khan and Guah, 2012).

Therefore, in this work we tried to determine the comparative difference on the shade of water treatment plant treated water with the effluent treated plant treated water dyed cotton fabric. It is one of the most polluting industries because of the high volume of effluent water discharged and the nature of the effluent contaminants. Wastewater from printing and dyeing units is often rich in color, containing residues of reactive dyes and chemicals, and requires proper treatment before being released into the environment (Babu 2007). The effluent water generated after dyeing and finishing processes must be treated by a combination of chemical, physical and biological methods before discharge in order to meet legislative requirements. The need to reduce waste and minimize water consumption in the industry is forcing the industry to change habits and processes related to water consumption, thus opening the way for the use of waste water and less quality water on their facilities (Lamas and Fujisawa, 2009).

Effluent water generated in the textile plant is first divided into two groups as usable and unusable. Effluents of some processes such as dyeing and desizing are declared unusable, as they contain residual dyes and a high chemical content, and therefore would need to be totally purified by conventional or advanced methods, or their combination. The water feed into the processes and the usable effluents are analyzed in terms of p^H value, COD (Chemical Oxygen Demand), SS (Suspended Solids), color, hardness and conductivity in accordance with the related standards (Erdumlu 2012).

MATERIALS AND METHODS

Laboratory dyeing procedure for cotton fabric

10 gm each sample of 100% cotton knit single Jersey bleached fabric is immersed into the dyeing pot of the laboratory dyeing machine. The dyeing pot is previously loaded with color solution according to the recipe, salt, leveling agent (Albatex DBC 1 g/lt) and water. The sample is dyed for 20 minutes at 60^0C then soda ash is added. The dyeing procedure is again continued for 20 minutes at same temperature. The samples are then rinsed wash, neutralized with Acetic acid (0.7 g/lt), soaped at 90^0C for 10 minutes consequently washed and dried.

Comparison on shade variation

The shade difference of the samples has been evaluated by Verivide light box.

Spectrophotometric evaluation

The spectrophothometric evaluation of the samples has been done by Data color 650^{TM}.

Color fastness to wash

Color fastness to wash is done by the ISO 105 C03 method. Single Test of 10 cm × 4 cm with 4 gm/liter European Color fastness Establishment (ECE) reference detergent & 1 g/lt sodium perborate solution in machine wash at 40^{0}C Sample no. 12, 13, 14 and 15 are tested.

Color fastness to rubbing

This test is designed to determine the degree of color which may be transferred from the surface of a colored fabric to a specific test cloth for rubbing (dry and wet), Method: ISO 105 × 12 and M/c Name: Crock master has been used for rubbing test.

Color fastness to perspiration

The color fastness to perspiration (acid and alkaline), Method: ISO 105 E04 and M/C Name: Carbolite Incubator, Roaches International limited, Staffordshire, England.

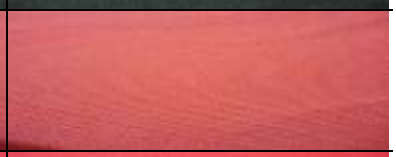
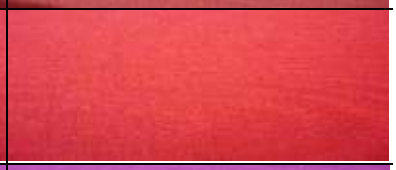
P^H test

ISO C3071 & ISO C3010 method, M/c name: Corsort Multi Parameter Analyser, Chuan Hua Precision Corporation, Taiwan. P^H test is carried out using 2 gm of dyed fabric .The fabric is cut into pieces of (0.5 cm × 0.5 cm). Five samples: sample no. 4, 5, 6, 12, 13 are taken for P^H test.

RESULTS AND DISCUSSION

Comparison on shade%

Table 1. Dyeing recipe & comparative shade between the samples

Sl. no.	Recipe	WTP treated ground water dyed samples	ETP treated water dyed samples
Sample-1	18-0201 TCX Yellow RR 0.594% Red RR 0.25% Blue RR 0.66% Salt / Soda (g/lt) 40 / 6		
Sample-2	14-4812 TCX Yellow 4GL 0.0164% T Blue G 0.082% Blue BB 0.0082% Salt / Soda (g/lt) 10 / 5		
Sample-3	19-5414 TCX Yellow 4GL 1.79% Yellow SP-3R 0.777% N Blue 2 GL 2.34% Salt / Soda(g/lt) 60 / 18		
Sample-4	16-1641 TCX Orange 2RL 0.504% Red SP-2B 0.32% Salt / Soda (g/lt) 40 / 15		
Sample-5	19-1664 TCX Yellow Sp-3R 2.96% Red SP-3B 3.84% Blue BB New 0.0012% Salt / Soda 75 / 18		
Sample-6	18-2336 TCX Blue BB 0.044% Red SP-3B 1.52% Salt / Soda (g/lt) 45 / 15		

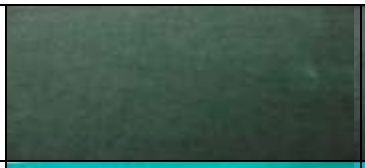
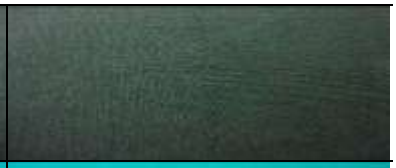
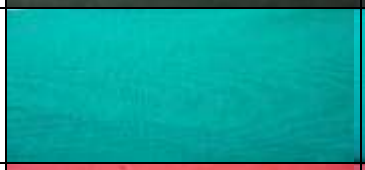
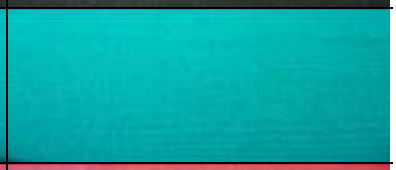
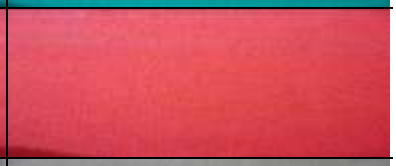
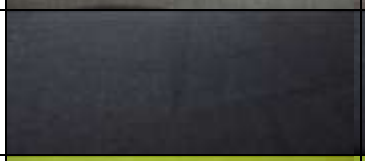
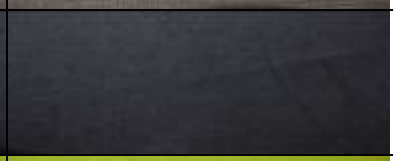
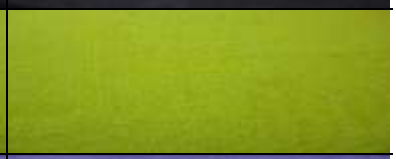
Sample-7	19-5350 TCX Yellow HB 1.42% Red HB 0.032% Blue HB 4.00% Salt / Soda (g/lt) 65 /18		
Sample-8	17-5430 TCX Yellow 4GL 0.62% Blue BB 0.52% T Blue G 0.88% Salt / Soda (g/lt) 50 / 18		
Sample-9	18-1762 TCX Orange 2RL 1.29% Red SP-2B 1.50% Salt / Soda(g/lt) 50 / 18		
Sample-10	18-0513 TCX Yellow RR 1.02% Red RR 0.324% Blue RR 0.66% Salt / Soda(g/lt) 40 / 6		
Sample-11	19-0617 TCX Yellow Sp-3R 1.79% Red SP-3B 0.44% N Blue 2 GL 0.50% Salt / Soda(g/lt) 50 / 18		
Sample-12	Yellow Sp-3R 0.566% Red SP-3B 0.899% Black B 3.27% Salt / Soda(g/lt) 60 / 18		
Sample-13	Yellow 4GL 1.009% Yellow Sp-3R 1.33% Blue BB 0.127% Salt / Soda (g/lt) 50 / 18		
Sample-14	Red SP-3B 1.30% Blue Rspl 0.272% N Blue 2 GL 0.686% Salt / Soda (g/lt) 50 / 18		
Sample-15	Yellow Sp-3R 1.05% Red SP-3B 1.8% Blue BB 0.18% Salt / Soda (g/lt) 50 / 18		

Table 1 shows the dyeing recipe and the shade of each samples dyed with ETP treated water and WTP treated ground water. The evaluation has been done under D_{65} light source in the light box. Reactive dyes of cold brand, salt and soda used amount has been mentioned on the table. The standard samples are selected from the Pantone Book TCX. The amount of salt and soda are calculated according to shade % those are practically used for the laboratory dyed samples.

Spectrophotometric evaluation

The Light sources TL83, D_{65} and A are used for the spectrophotometric evaluation. The lightness (DL), Saturation (DC) and Tone (DH), CIE lab value for references (Da and Db), Total color deviations (DE) are evaluated between the samples of ETP discharged and ground water dyed cotton samples.

Table 2. Spectrophothometric evaluation of the dyed samples

Samples	Shade	Illum/Obs.	Lightness (DL)	Saturation (DC)	Tone (DH)	CIE lab value for ref. Da	CIE lab value for ref. Db	Total color deviation DE
Sample-1	18-0201 TCX	TL 83	0.10	-0.04	-0.56	0.14	0.37	0.57
		D_{65}	0.09	0.47	0.23	0.01	0.37	0.53
		A	0.10	0.35	0.36	0.11	0.38	0.52
Sample-2	14-4812 TCX	TL 83	0.22	0.18	-0.67	-0.56	0.78	0.73
		D_{65}	0.20	0.16	-0.54	-0.39	0.70	0.60
		A	0.20	0.06	-0.56	-0.40	0.71	0.60
Sample-3	19-5414 TCX	TL 83	-0.40	-0.10	0.13	0.14	-0.09	0.43
		D_{65}	-0.43	-0.25	0.09	0.32	-0.10	0.50
		A	-0.42	-0.16	0.07	0.18	0.00	0.46
Sample-4	16-1641 TCX	TL 83	-0.29	0.53	0.33	0.90	1.23	0.69
		D_{65}	-0.40	0.46	0.25	0.97	0.89	0.66
		A	-0.31	0.51	0.22	0.96	1.14	0.64
Sample-7	19-5350 TCX	TL 83	0.33	0.13	-0.11	0.10	0.16	0.38
		D_{65}	0.34	0.20	-0.08	-0.16	0.18	0.40
		A	0.34	0.13	-0.09	-0.09	0.13	0.37
Sample-9	18-1762 TCX	TL 83	0.10	-0.67	-2.14	0.23	-3.58	2.25
		D_{65}	0.13	-0.38	-1.99	0.33	-3.36	2.03
		A	0.10	-0.63	-1.89	0.14	-3.30	1.99
Sample-10	18-0513 TCX	TL 83	0.19	0.17	0.32	-0.20	0.21	0.40
		D_{65}	0.19	0.16	0.43	-0.20	0.25	0.50
		A	0.18	0.08	0.47	-0.16	0.21	0.51
Sample-11	19-0617 TCX	TL 83	-1.26	0.02	-1.84	1.40	-0.40	2.24
		D_{65}	-1.32	0.01	-2.38	1.57	-0.62	2.72
		A	-1.21	0.30	-2.05	1.41	-0.29	2.40

From the Table 2, the spectrophotometric values under different light sources of CMC (Color matching committee) it is seen that only for the sample 9 and 11 DE value is out of range i.e. more than 1. DE values recognize the color difference between dyed fabric samples. Except these two samples all the samples both for WTP and ETP discharged water dyed samples DE value lies below 1, which is the desired outcome of this work. The DE values for the samples 1, 2, 3, 4, 7 and 10 under different light sources of spectrophotometer TL83, D_{65} and A, the samples are passed on evaluation as all the values are less than 1. On the other hand Sample 9 and sample11 show the DE value are 2.25, 2.03, and 1.99 and for sample 11 DE values are 2.24, 2.72 and 2.40 under the same light sources respectively.

Color fastness to wash

Table 3 shows that the change in color due to wash on reactive dyed WTP and ETP samples. The wash fastness rating in terms of WTP water and ETP water dyed samples 12 and 15 are 4/5 and 4 respectively. The samples for 13 and 14 the ratings are 4 and 3/4. It indicates that the results are almost same and there is no significant difference for the samples.

Table 3. Color fastness to wash

Samples	WTP water dyed samples	ETP water dyed samples
Sample-12	4/5	4
Sample-13	4	4
Sample-14	3/4	3/4
Sample-15	4/5	4

P^H tests

Table 4. p^H of WTP treated water samples and ETP treated water samples after wash

Samples	p^H of WTP water dyed samples (after wash)	p^H of ETP dyed samples (after wash)
Sample-4	7.19	7.12
Sample-5	7.05	7.16
Sample-6	7.05	7.13
Sample-12	7.08	7.10
Sample-13	7.07	7.18

From the Table 4 it is seen that p^H of the both type of samples are almost same. The both type water dyed samples are properly neutralized and washed with water. At the time of dyeing the dyebath P^H remains in

alkaline medium. Hence the samples are neutralized and washed properly to get back the P^H in neutral condition.

Color fastness to rubbing

Table 5. Results of rubbing fastness

Samples	WTP water dyed samples		ETP water dyed samples	
	Dry	Wet	Dry	Wet
Sample-1	4/5	4	4/5	4
Sample-7	5	3/4	4/5	3/4
Sample-9	4	3/4	4/5	3/4
Sample-10	5	4/5	4/5	4
Sample-11	4/5	4	4	3/4

Table 5 shows the results of rubbing fastness of the samples no 1, 7, 9, 10 and 11. In case of sample no. 1 for the dry and wet rubbing fastness rating is 4/5 and 4. For sample 7 dry and wet rubbing fastness rating is 5 and 3/4 for WTP water dyed samples on the other hand ETP water dyed samples rating is 4/5 and 3/4 respectively. Similarly sample no. 9, 10 and 11 shows the better results for both types of samples. The rubbing fastness result may reveal that WTP water and ETP water dyed samples have no significant changes in terms of both dyed samples.

Color fastness to perspiration

Table 6. Results of perspiration test

Samples		WTP water dyed samples	ETP water dyed samples
Sample-3	Acid	4	3/4
Sample-5	Acid	3/4	3
Sample-7	Alkali	3/4	4
Sample-8	Alkali	4	4/5
Sample-12	Alkali	4	4/5

Table 6 shows that the acidic and alkaline solutions for perspiration test have the better results on both types of samples. According to the Grey scale the value 4 stands for the good results, 3/4 stands for moderate results and 4/5 stands for the very good fastness to perspiration. The acidic solution has been used for sample 3 and 5. The alkaline solution has been used for sample 7, 8 and 12 to measure the perspiration fastness.

CONCLUSION

The Reusing of textile wastewater in the same industry as process water is a way to minimize the waste generation and to reduce the consumption of natural resource. In general, waste water from a textile industry needs treatment before reusing it. However this research paper shows that, it is an effort to find out the possibility to reuse the treated water for dyeing purpose again. This work has been done on small quantity of samples of single jersey knit fabric. It requires more experiments by gradually increasing the amount of fabrics in terms of dyeing with both type of water.

REFERENCES

Khan MAA, Guah AK (2012) Characterization and optimization of coagulation of textile effluent collected from gazipur, International Conference on Advances in Civil Engineering 2012 (ICACE 2012), 12–14 December 2012, CUET, Chittagong, Bangladesh.

Ghoreishi SM, Haghighi R (2003) Chemical Catalytic Reaction and Biological Oxidation for Treatment of non-Biodegradable Textile Effluent. *Chemical Engineering Journal*, 95, 163-169.

Babu RB, Parande AK, Raghu S, Prem KT (2007) Cotton Textile Processing: Waste Generation and Effluent Treatment, *The Journal of Cotton Science* 11, 141–153.

Lamas WQ, Fujisawa RS (2009) Reuse of waste water from polyester fibres dyeing process by thermal fixation with dye acid base: Case study a Brazilian auto parts facility, Engenharia Térmica (Thermal Engineering), Vol. 8, No 02, December 2009, 42-49.

Shaid A, Osman SMD, Hannan AMD, Bhuiyan MAR (2013) Direct Reusing of Textile Wastewater in Scouring-Bleaching of Cotton Goods Devoid of Any Treatment, International Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN : 2278-800X, Volume 5, Issue 8 (January 2013), 45-54.

Erdumlu N, Ozipek B, Yilmaz G, Topatan Z (2012) Reuse of effluent water obtained in different textile finishing processes, *AUTEX Research Journal*, Vol. 12, No1, March 2012.