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COMPARATIVE STUDY OF TWO DYEING METHODS USING REACTIVE DYE

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Abstract: *Environment preservation is a common worry not only for people but for companies as well. Industry is more and more concern about the necessity of developing new and more respectful processes. Dye is one of the most important processes in the textile industry but it is also considered as no too safe regarding environment issues. This process uses large amounts of water and generates big volumes of wastewater. Following this issue, new regulations and laws emerge to control the waste generated. This leads to the companies and increased costs in terms of wastewater treatments and high water consumption. In this research we compare two systems on garment finishing application, the conventional bath process and the new Ecofinish system that is able to save water and product. To compare these processes, we carried out a reactive dyeing using both systems in order to determine the quality differences in the final product. For this purpose, the samples have been tested to washing and rubbing fastness, according to UNE EN ISO 105 C10 and UNE- EN ISO 105 X12 standards, respectively. This study confirms that this system achieves water savings and reduces the wastewater produced, getting a good dyeing. This process can be considered as an alternative to the conventional one.*

Key words: *reactive dye, Ecofinish, dyeing, washing fastness, rubbing fasteness, exhaustion.*

1. INTRODUCTION

In recent decades, society has become increasingly concerned with protection of the environment. The textile dyeing industry faces the need to address its responsibility towards a wide range of health, safety and environmental issues, some of which are generic to the industry and some specific to the processe operating in particulas cases [1]. This industry is challenging day to day by the requirement to satify the demands of increasingly stringent legislation and controls introduced by goverments and regulatory agencies to ensure compliance with enviroment issues. For this reason, many authors are studying new methods [2], [3], products [4] and developing new systems [5], focused on achieving more environmentally friendly dyeing process.

The company Care Applications S.L.U. has developed an accessory that complements conventional exhaust dyebath machines to treat clothes, called Ecofinish. This accessory can get a water and product saving by vaporizing the solution.

In this study we compare both finishing processes to treat clothes, the conventional exhaustion process and the new system Ecofinish. We dyed cotton fabric using reactive dyes. The reactive dyeing process is carried out by the exhaustion system. This type of dye is water soluble and depending of the reactive group, will have a higher or lower affinity by the cellulosic fibers.

The aim of this study is to determine the washing and rubbing fastness of fabrics dyed using both processes. Moreover, we compare the amount of water, salt, CO_3Na_2 and complexing agent used en each dyeing method and we could see that dyed samples by Ecofinish system achieve the same properties which are obtained by the bathing process despite the water and product saving.

2. EXPERIMENTAL

2.1 Materials

To carry out this study, cotton fabric with the next features was used:

Table 1: *Characteristics of the fabric used.*

Sample	Composition	Structure	Density		Weight
			Warp	Weft	
Sample	96% Co 4% EA	Sarga 2E1 B 2,1	61,1 yarn/cm Title: 1/50 Nm	29,4 yarn/cm Title: 1/50 Nm	185g/m^2

We used reactive turquoise dye CI Reactive Blue 21 (Novacron Turquoise H-GN). Sodium carbonate, soap complexing agent and salt were used as auxiliary products.

2.2 Exhaustion dyeing

Table 2 shows the process followed by reactive dyeing in exhaustion machine for clothes treatment.

Table 2: *Steps for reactive dyeing.*

Steps	%	mL/L	Product	g	Water (L)	L:B 1:X	Temp. (ºC)	Time (min)	pH	Velocity r.p.m.
Preparation	0,5		Soap	5	20	20	50	10		27
		2	Sodium carbonate	40	20	20	35	20	10	27
Washing off					20	20		2		27
Dyeing		60	Salt	1200	20	20				27
		1	Complexing agent	20						
			Indirect heating				40			
	4		Dye	40	5			10		
			Indirect heating				70	10		
		20	Sodium carbonate	400				30	11	
			Maintenance	4				30		
Washing off					20	20	50	3		27
Neutralized		1	Acetic acid	20	20	20		5		27
Washing off		1	Soap	20	20	20	90	10		27
Washing off					20	20	70	3		27
Washing off					20	20	50	3		27
Washing off					20	20		3		27

2.3 Ecofinish dyeing

The following table lists the steps to perform the reactive dye through the Ecofinish system:

Table 3: *Steps for reactive dyeing.*

Steps	%	mL/L	Product	g	Water (L)	L:B 1:X	Temp. (ºC)	Time (min)	pH	Velocity r.p.m.
Preparation	0,5		Soap	5	20	20	50	10		27
		2	Sodium carbonate	40	20	20	35	20	10	27
Wash off					20	20		2		27
Spin-dry	50									
Dyeing	4		Dye	40	1	1		20		27
		20	Sodium carbonate *	20					11	
Drying							150	20		
Wash off					20	20	50	3		27
Neutralized		1	Acetic acid	20	20	20		5		27
Soaping		1	Soap	20	20	20	90	10		27
Wash off					20	20	70	3		27
Wash off					20	20	50	3		27
Wash off					20	20		3		27

* Add the alkali just at the time that the product is nebulized to prevent the dye hydrolyzes.

The Ecofinish system is an accessory that is installed in conventional exhauting machines for applying treatments on garment. The main difference between the conventional process is that the Ecofinish sprays the dissolution on the fabric and this allows the water and product savings.

3. RESULTS AND DISSCUS

In Table 4 we can see the consumption that takes place in both processes for 1 kg of textiles material:

Table 4: *Water and product consumption for 1kg garment.*

Consuption	Water (L)	CO_3Na_2 (g)	Salt (g)	Complexing agent (mL)	Dye (g)
Exhaustion	20	400	1200	20	40
Ecofinish	1	20	0	0	40
Savings with Ecofinish (%)	**95%**	**95%**	**100%**	**100%**	**0%**

These results show the water and product consumption made by two systems and we check the water, CO_3Na_2, salt and complexing agent saving achieved by the use of Ecofinish system.

The major environmental problem associated with the use of the reactive dyes is their loss in the dyeing process. The fixation efficiency is in the range 60–90%. Consequently, substantial amounts of unfixed dyes are released in wastewater. We used a 95% less of water by ecofinish system, for this reason, we achieve to reduce the amount of wastewater and the treatment cost.

Reactive dyes applied by exhaust methods require large amounts of salt to get high intensity of color, however if ecofinish system is used, the salt is not necessary to carry out the dye. Reduction of salt in the effluent reduces pollution of rivers and streams where the biological equilibrium depends to a large extent on the salt content of the water. The complexing agent is not used in the system which is studied in this work, but it is necessary the use of complexing agent in

exhaust system to get high level fixation of the reactive dye on the cotton fibers, being this type of product a pollutant substance.

In the next table are the results of the washing fastness, this shows the discharge and degradation rates of the samples dyed by the conventional process and by the Ecofinish system.

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Table 5: *Washing fastness results*

Sample	Degradation rate	Discharge rate	
		Wo	Co
Exhausted Sample	3	2	3-4
Ecofinish Sample	4	5	4-5

In the washing fastness test, the Ecofinish system improves his properties regarding the colourin discharge and degradation rates.

Table 6 shows the results of the rubbing fastness, indicating the dry and wet degradation and discharge rates.

Table 6: *Rubbing fastness results*

Sample	Degradation index		Discharge index	
	Dry	Wet	Dry	Wet
Exhausted Sample	4-5	4	4-5	3-4
Ecofinish Sample	4-5	4	4-5	3

In this table we could appreciate that the results in both systems are the same or very similar in the case of wet discharge result.

5. CONCLUSIONS

In this study we can see that the washing fatness is better when sample is dyed using Ecofinish system and rubbing fastness results are similar in both processes studied. Therefore, we can conclude that Ecofinish system can improve the results fastness obtained by the conventional exhaustion process, also take place a high water and product saving. This is the most important value of the new system, because the final product properties have been not affected despite these savings.

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