ISSN: 1999-

SEU Journal of Science and Engineering, Vol. 12, No. 2, December 2018

Burn out Printing and Dyeing of Polyester-Cotton Blended Knit Fabric

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Abstract
In this work, polyester/cotton 65/35 scoured and bleached single jersey knit fabric was burned out in colorless print paste containing required amount sulfuric acid, alginate gum, water and glycerin by flat bed screen printing method subsequent steaming, washing and drying. The burned out fabric sample was dyed with 1% reactive and disperse dyes to create the same motif of different colors. After that different quality parameters such as color fastness to wash and rubbing followed by the reflectance and K/S values for all the dyed samples were evaluated. This work was done at Midland Knitwear Ltd., Microfibre group, Narayanganj and Southeast University, Department of Textile Engineering during January 2018 to June 2018.

Keywords: *Polyester-Cotton Blending, Burn Out, Spectrophotometric Evaluation, Reflectance Percentage, K/S Values*.

I. Introduction

Burn-out printing is a fabric printing technique particularly used on fabric, where a mixed fiber material undergoes a chemical process to dissolve the cellulose fibers to create semi transparent pattern against more solidly fabrics. It is carried out using a paste containing chemicals capable of dissolving or destroying one or more of the fibre components of a blended fabric. Cotton and other cellulosic fiber are destroyed. A cotton/polyester blended fabric can be printed with a print paste containing the burn-out chemicals after the cotton portion is destroyed and only polyester remains. This allows a patterned lacey design to be imparted to the fabric. (H. M. Ahmed *et al.* 2016, A. Robertson 2006, W. Michałowski *et al*. 2005, J. Michałowska *et al.* 2003, D. Maamoun 2014).

However, this process is very corrosive and requires special screens and special care in handling. When the chemical flow over the fabric and contact with cotton portion, then it burned out the cotton by chemical reaction. Actually cotton is the victim here. When cotton burns down dyed polyester gives full shade and vacant spaces. One can literally see across this type of effect. One can take simple white fabric, blend of course. Dye or print it with disperse dye in acidic medium than apply burn out recipe afterwards go for reduction cleaning which is required for polyester. This cleaning will also wash down burned cotton.

The aim of the present work was to burn out the cotton part in the design motif of polyester/cotton blended fabric of 146 GSM (gram per square meter) and to dye the remaining cotton portion with reactive dye and polyester part with disperse dye in 1% shade of different colors. The reflectance percentages, color strength K/S values, wash and rubbing fastness of the colored samples were compared each other.

II. Materials and Methods

Single jersey scoured and bleached Polyester/Cotton (65/35) was selected. Colorless printing paste was prepared by mixing of 8 parts alginate gum, 8 parts sulfuric acid, 2 parts glycerin and about 82 parts water. Steaming was applied at 100ºC about 7 minutes. Then the fabric was hot washed and dried. The cotton part was smashed by the acid but polyester portion was remained in the design motif. After that the fabric sample was dyed with reactive Bezaktiv dyes 1% shade in three different colors with 40g/L glauber salt and 10 g/L Soda ash at 60^0C in 60 Minutes. The fabric

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samples were also dyed with disperse Terasil dyes with 1% shade at 130^0C in 30 minutes at acid medium.

II.A. Spectrophotometric Evaluation

The color depth of the dyed fabrics was analyzed by measuring the reflectance percentages and K/S values of samples. Color measuring instrument Spectrophotometer (X-Rite) color iMatch (Version 9.4.10) which determines the reflectance percentages and K/S values of fabrics through Kubelka-Munk equation as follows:

$$\frac{K}{S} = \frac{(1-R)^2}{2R}$$

,where R = reflectance percentage, K = absorption co-efficient and S = scattering co-efficient of dyes. This value represents the attenuation ratio of light due to absorption and scattering is found based on reflectance.

II.B. Wash Fastness

The color fastness to wash of a dyed fabric is the measure of its resistance to fading, or color change, on exposure to a given agency or treatment. For both fabrics ISO105 C03 method was followed.

II.C. Rubbing Fastness

Color fastness to rubbing means the resistance of color of dyed materials to rubbing. Rubbing fastness of both fabric samples were measured in (ISO 105 X 12: 1993) method.

Table 1: The photos of burn out printed and dyed fabric samples

III. Results and Discussions

III.A. Photos of the three Dyed Samples

Table 1 shows the photos of burn out printed and reactive bezaktiv dyed fabric samples 1, 2, 3 and disperse Terasil dyed fabric samples 4, 5, 6.

III.B. Spectrophotometric Evaluation

Evaluation of Reflectance %

Figure 1 shows the comparison on reflectance percentage of Sample-1, Sample-2 and Sample-3 aligned with the wavelength in nanometer (nm). The reflectance percentage of Bezaktiv yellow S-3R dyed sample-1 are 9.64, 11.08, 35.63, 61.93, 59.15, 63.23 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm. The reflectance percentages of Bezaktiv red S-3B dyed sample-2 are 27.23, 16.39, 9.28, 44.96, 75.80, 77.00 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm. The reflectance percentages of Bezaktiv blue SGLD dyed sample-3 are 25.49, 22.69, 16.10, 12.75, 18.74, 32.55 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm.

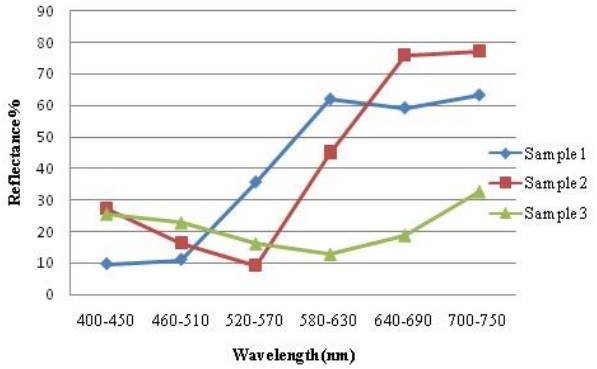

Figure 1: The line diagram shows the comparison of reflectance percentage of reactive dyed samples.

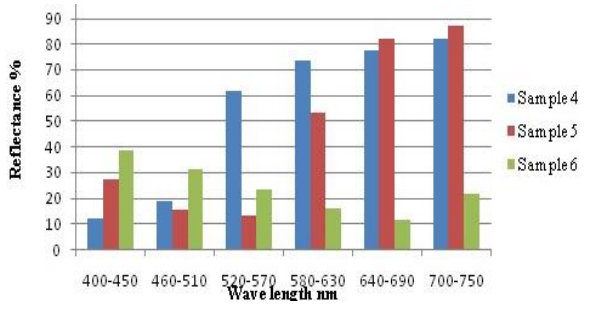

Figure 2: The bar diagram Shows the comparison of reflectance percentages of Terasil disperse dyed fabric samples

Figure 2 shows the comparison on reflectance percentage of Sample-4, Sample-5 and Sample-6 aligned with the wavelength in nanometer (nm). The reflectance percentage of Terasil yellow 4G dyed sample-4 are 11.96, 18.79, 61.47, 73.48, 77.36, 81.78 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm. The reflectance percentages of Terasil Red FBN dyed sample-5 are 27.37, 15.19, 13.00, 52.86, 81.73, 86.91 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm. The reflectance percentages of Terasil Blue BGE dyed sample-6 are 38.17, 31.16, 23.10, 16.09, 11.04, 21.69 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm.

Evaluation of K/S values

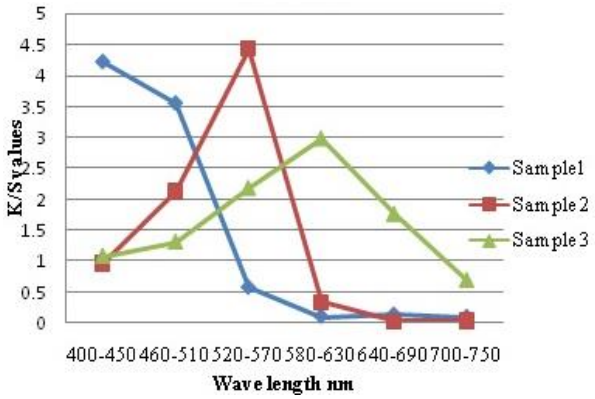

Figure 3: The line diagram shows the comparison of K/S values of reactive dyed samples.

Figure 3 shows the comparison on K/S value of sample-1, sample-2 and sample-3 of the Bezaktiv Yellow S 3R, Bezaktiv Red S-3B and Bezaktiv Blue SGLD respectively aligned with the wavelength in nanometer (nm). The k/s value of sample-1 are 4.23, 3.56, 0.58, 0.11, 0.14, 0.10 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700 nm. The k/s value of sample-2 are 0.97, 2.13, 4.43, 0.33, 0.03, 0.034 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700 nm. The k/s value of sample-3 are 1.08, 1.31, 2.18, 2.98, 1.76, 0.69 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm. The peak K/S values of Bezaktiv yellow dyed fabric sample-1 is 4.23 at 400-450 nm, Bezaktiv Red S-3B dyed sample-2 is 4.43 which is seen at 520-570 nm and Bezaktiv Blue SGLD dyed sample-3 is 2.98 at 580-630 nm.

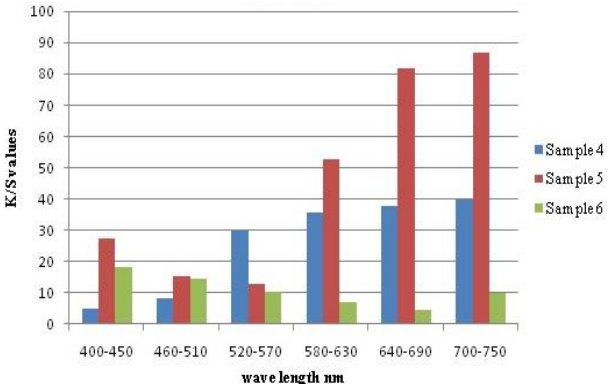

Figure 4: The bar diagram shows the coparison of K/S values of Terasil disperse dyed fabric samples.

Figure 4 shows the comparison on K/S values of Sample-4, Sample-5 and Sample-6 aligned with the wavelength in nanometer (nm). The reflectance percentage of Terasil yellow 4G dyed sample-4 are 5.02, 8.42, 29.75, 35.75, 37.69, 39.90 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm. The reflectance percentages of Terasil Red FBN dyed sample-5 are12.71, 6.63, 5.54, 25.44, 39.87, 42.46 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm. The reflectance percentages of Terasil Blue BGE dyed sample-6 are 18.10, 14.60, 10.57, 7.07, 4.57, 9.87 respectively at 400-450 nm, 460-510 nm, 520-570 nm, 580-630 nm, 640-690 nm, 700-750 nm. The peak K/S values of Terasil yellow 4G dyed fabric sample-4 is 39.90 at 700-750nm, Terasil Red FBN dyed sample-5 is 42.46 which is seen at 700-750 and Terasil blue BGE dyed fabric sample-6 is 18.10 at 400-450nm.

Table 2: Report on color fastness to wash (change in color)

Staining results on different fibers	Sample-1	Sample-2	Sample-3
Color change in Shade	4-5	4-5	4
Staining in Acetate	4-5	4-5	4-5
Cotton	4-5	4-5	4-5
Polyamide	4-5	4-5	4
Polyester	4-5	4-5	4-5
Acrylic	4-5	4-5	4
Wool	4-5	4-5	4-5

Table 2 shows the color fastness results measured by gray scale rating. In case of sample 1 the Bezaktiv Yellow S3R dyed sample was 4 -5 which indicates very good, Bezaktiv Red S3B dyed fabric sample was 4-5 which also indicates very good fastness and Bezaktiv Blue SGLD dyed fabric sample 3 was 4 in color change in shade which indicates good fastness. The staining rate was 4 in polyamide and acrylic fibers and the other fibers show the rating 4-5 with very good wash fastness.

Rubbing Fastness

Table 3: Report on color fastness to Rubbing

DRY			
Grade	**Sample 1**	**Sample 2**	**Sample 3**
Change in Color	4-5	4-5	5
Staining	4-5	4-5	5
WET			
Change in color	4	4	4
Staining	3	3	3-4

Table 3 shows the color fastness to rubbing of the samples 1, 2 and 3. The dry rubbing fastness was very good for sample 1 and 2 with rating 4-5 and 5 for sample 3 which indicates excellent. The wet rubbing results of sample 1, 2, 3 were good with rating 4. The staining rate of wet rubbing was 3 for sample 1 and 2 which indicates average and 3-4 was for sample 3 that indicate moderate to good wet rubbing fastness.

IV. Conclusion

From the above results and discussions it was revealed that the cotton part of the polyester-cotton blended fabric can be carbonized by Sulphuric acid in the motif of design and dyed the remaining cotton and polyester part with different dyes create various outlook of the blended fabric to the wearer of that specific fabric.

Acknowledgement

We would like to thank the management of the Microfibre limited for giving us the opportunity to the burn out successfully and also for their valuable suggestion. Our deepest gratitude goes to Senior Production Engineer Md. Zannatul Nayem, all over printing, Midland Knitwear Ltd., Microfibre Group.

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