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FLUORESCENT DYEING IN POLYESTER AND COTTON BLENDED FABRICS

SHREE LALEITHA G[1], ASHOK KUMAR A[2], PRITHIVRAJ G[3], VIPIN V[4], SATHISH KUMAR M[5]

[1,2]Assistant professor –Department of Textile Technology, Bannari Amman Institute of Technology Sathyamangalam -638401
[3,4,5]Students - Department of Textile Technology, Bannari Amman Institute of Technology Sathyamangalam - 638401

ABSTRACT: Fluorescent dyed fabric is the term for a material that has high visibility colour. Fluorescent dyed fabric materials are used widely for various purposes like safety wear, sportswear, leisure wear, work wear and fire brigades etc. However using the fluorescent dye is toxic compared to the reactive and disperse dye. Here, we had chosen a pc blended fabric with different portion such as 60% polyester with 40% cotton and 40% polyester with 60% cotton. First we prepared the fluorescent dye and after that the pc blended knitted fabric was treated with the process of scouring and bleaching. After this process the fabric was dyed, the polyester can dyed with disperse dye and cotton was dyed with reactive dye. The prepared fluorescent dye applied on the pc blended fabric. At last pc blended fabric is dyed with reactive, disperse and fluorescent dye. Then we had then tested on various basis like tearing, bursting strength, abrasion resistance, air permeability, stiffness, washing fastness and rubbing fastness .This may help in the near future when people plan to use the pc blended knitted fabric. In future if the fluorescent effect were fade it would be used as normal dyed fabric because of reactive and disperse dye. Normally dyeing of polyester/cotton blended fabric is dyed in two steps. The cost of double bath dyeing is quite higher than the one step or single bath dyeing. The continuous dyeing technique of polyester/cotton blended fabric providing advantages of improvement in productivity with reduced dyes and auxiliary cost and reduce material handling with minimum process time. However, double bath dyeing of polyester/cotton blend fabric gives far better results in terms uniformity of shades in both light and dark shades, while in single bath dyeing shown poor fastness property for dark shades but good fastness property for light shades

KEYWORDS

Phthalic anhydride, fluorescein, glauber's salt

INTRODUCTION

The fluorescent dyes have got a wide application all around the world which involves in various fields. Many developments in the application of fluorescent dyes in biochemical industry and also it has been used in the lasers, photoelectric cells, and solar batteries industries. Thou the fluorescent class dyes are considered to be toxic in nature, it has got a wide utilization commercially. There are also the availability of fluorescent dyes for the colouring additives in food, cosmetics, and also in some drugs other than for safety uses. The fluorescent dyes have long been used in the dyeing of textile materials. The usage of fluorescent dyes is to show a significant increase in colour brightness. When these dyes are applied to a textile material it makes the materials to be more easily perceptible and visible from the obscured areas. Because these dyes are known for its property of absorbing and emitting radiation in the visible spectral range light and in UV radiation, this is because as it belongs to a group of organic dyestuffs which helps in producing the fluorescent effect.

It is mainly used in the coloration of synthetic fibres, especially polyester and can also be used in other fibres like polyamide and acrylics. And it is being used in safety, fashion, leisure, sportswear uses. But the major setback with the fluorescent dye is its poor light fastness, because of which the fluorescent materials (garments) are disposed before its life span. Many industries used mixtures of dyes to achieve the reproducibility of the fluorescent colour with good light fastness. In this paper, the cotton/polyester (60:40) blended fabrics, mercerized 100% cotton fabric, un mercerized 100% cotton fabrics are used. The reactive dyes and disperse dyes are used to give the base colour for the fabrics. The polyester fabric is initially dyed with disperse dyes which has smallest dye molecules and for its base colour at 130°C for 1 hour at 4.7 ph. Then the fluorescent pigments are coated over the fabric with padding mangle. In the same way mercerized cotton and the mercerized cotton are dyed using reactive dyes, as it is a covalent bond, as it got a great affinity toward the fibre. The reactive dyes are treated at a temperature of 87°C for 1 hour at 12.7 ph. Finally the fabric is coated with fluorescent dyes, using padding mangle. The padding mangle is used for coating as it gives uniform coating.

The continuous dyeing of knitted polyester/cotton blend fabrics is a most important sector of the textile dyeing industry. Statistics for the USA have shown that more than half of the polyester fibre processed is destined for dyed polyester/cotton fabrics, more than half of which are dyed continuously by pad–thermos fix processes. Continuous processing of long runs to a given colour consistently high yields and re producible uniformity at a much more economical

price per meter than batch wise methods. The conventional method of exhaust dyeing for P/C blends is to dye each component separately under its optimum condition in a two-bath process. This two bath process is continuously carried out in continuous dyeing process. In this technique the dyeing of polyester/cotton blended fabric with advantages to improve the productivity and reduce the cost of dyes and chemicals and also reduction in process time. This dyeing method of P/C blend with the fluorescent dyes are of the fabric are dyed at two stages first is dyeing the polyester portion and then reduction clearing of fabric to remove the disperse dyes particle on the cotton portion. After this Process cotton portion is dyed. But, as compare to double bath dyeing, the issue of productivity and raising environmental concerns, several attempts have been made in the past to shorten this to one-bath process The key objective in the 'single bath dyeing' approach is to avoid the need for reduction clearing of polyester dyed sample, so that; significant productivity improvements can be made. Also it offers lower usage of water and chemicals and a reduction in effluent volume

The testing's are carried out to compare the quality of the product. The tests like abrasion test, microscopic analysis, water absorption test, GSM, reflectance analysis, perspiration fastness, wash fastness, light fastness are carried out to analyse the quality of the fabric and the durability of the fabric. The test result are analysed with the comparative charts.

MATERIALS AND METHODOLGY

- In this project work we have taken disperse dye, reactive dyes, fluroscent dyes and knitted blended fabrics where the content of the fabrics varies and its as follows
- Polyester fabric 60% / Cotton fabric 40%
- Polyester fabric 50% / Cotton fabric 50%
- Polyester fabric 40% / Cotton fabric 60%
- Blended fabric

Then we will bleach the fabrics and for bleaching the process is of

1	Naoh	4%
2	Na2Co3	32%
3	H2O2	10%
4	TRO	0.5%
5	Sodium silicate	10%
6	M:L ratio	1:30
7	Na2SaO3	10%
8	Temperature	120 C
9	Time	30 mins

Weight the fabric sample to be bleached. By making necessary calculations take the required amount of chemicals needed. Take the required amount of chemicals needed. Take the required amount of water needed and let it boil under a temperature 120 C and start adding the chemicals. Then finally wet the fabric sample to be bleached and then place it inside the boil and let it for 30 min.

After the time is done check if the fabric has turned white in color.

If means that the fabric has been bleached, then take the sample out and make a hot wash and let the sample dry. If hasn't turned white leave it into the boil again until it turns white. The bleaching process is a main process where it should be done before dyeing due to this process only the dyes will stick onto the fabric where it's done majorly and it's the first step to do it

DYEING

The Polyester/cotton blend fabrics are used for this experiments.

- 60p/40c
- 50p/50c
- 40p/60c

GSM	150

1	Reactive dye	0.5%
2	Fluorescent dye	2%
3	Nacl	3 g
4	Na2co3	2.5 g
5	Gluber salt	2.5g
6	Soda ash	1.5g
7	Borax	2g
8	PH of dye bath	10 - 11
9	M:L ratio	1:50
10	Temperature	120C
11	Time	40 mins

Then the flurocsent dye preparation as follows

- Phthalic anhydride
- Resorcinol
- 3 drops of concentrated sulphuric acid
- Heat to 200 degrees Celsius
- Time 5 minutes
- The crude fluorescein produced is dissolved in dilute sodium hydroxide solution (300mg in 10ml of water).
- Demonstrate fluorescence a few drops of the solution are dropped into the water under UV light.

Then we will dye the fabrics with equaling the ratios of their content and where the 2% percent of the flurocent dye will be added

Weigh the sample to be dyed. By making necessary calculations take the required amount of chemical needed. Take the required amount of water needed and let it boil at a temperature of 120 C.

Then add the required amount of reactive dye to the boiling water and then wet the fabric and put it into boil. Let it boil for 10 min. Then add the salt NaCl after 10 minutes and then let it boil. Then again after 10 minutes add Na2Co3 and mix it well and let it boil. Then finally after a total of 40 min check if the fabric has been evenly dyed, if so take it out make a cold wash and let it to dry. If not leave it again to boil until dyed evenly. Where it will be done on single and double baths where the flurocent and dyes won't get more attached to fabrics so we will do twice the process and the process is of below

Dyeing of polyester/cotton with single bath and double bath

In the laboratory, as per the dyeing recipe, the 100 ml of dye baths were prepared by adding the required amount of dye solution of disperse and reactive dyes, 2 % anti-migrating agent, 2 g/l wetting agent and acidic acid to adjust pH of 4-5. The fabric samples dyed was padded through dye bath at room temperature and then dried at 130oC. After drying the samples were thermo-fixed at temperature of 180-220oC for one min. Then the reactive dyeing was completed by adding 50 g/l glauber's salt, 2 g/l caustic, 20 g/l soda ash and 2 g/l resist salt at temperature of 100oC. Finally samples were soaped with 2 g/l soap and then washed and neutralized. Then we repeat the process and where it's the double bath and here the cotton fabric portion will be better than before and this is the process which has been carried out

RESULT AND DISCUSSION

The tests carried out and their results are being discussed with its numerical values and the charts (graph and histogram). In this chapter the tests are done as follows:

AIR PERMEABILITY

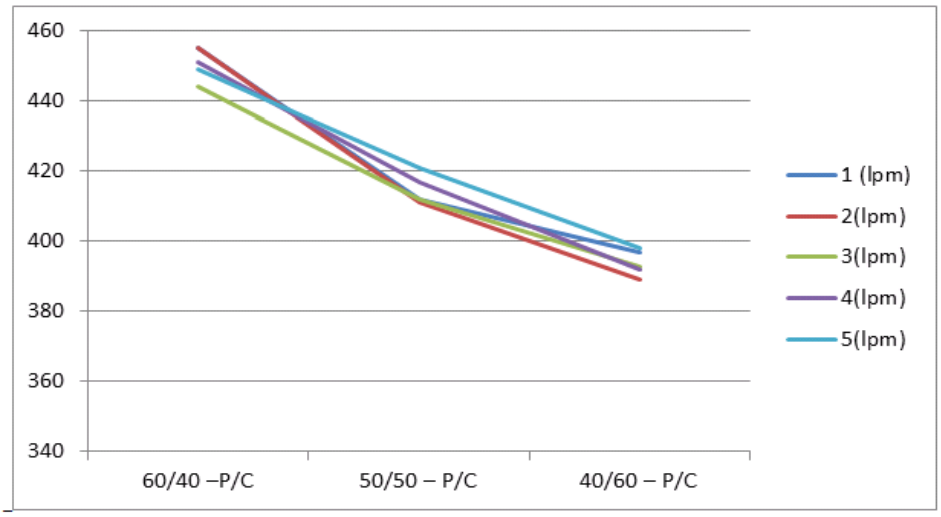
The air permeability of the fabric is the amount of the air that the fabric allows to pass through it. It is defined as the volume of air in millilitres which is passed in one second through 100s mm square of the fabric. The air permeability of a fabric is a measure of how well it allows the passage of air through it. The p/c blended fabric of 60/40 is taken and the circular dissection is made. According to the ASTM standard, the recommended test area is 38.3 cm^2, while alternate areas are 5 and 100 cm^2. So same way 5 samples were taken at 5 cm^2. It is done also with the 40/60 P/C blended fabric and 50/50 P/C blended fabric were made for tests. The fabrics are clamped in the air permeability tester and the air is drawn perpendicularly through the fabric and the airflow rate is adjusted to provide a pressure difference of between 100 and 2500 Pa between the two fabric surfaces (minimum pressure drop of 125 Pa). The pressure drop is 100 Pa for apparels and 200 Pa for industrial fabrics. The air permeability in mm/s can be calculated automatically in the tester.

Air permeability tester

4.1 Table of Comparison for Air permeability test

S.No	Samples	1(lpm)	2(lpm)	3(lpm)	4(lpm)	5(lpm)
1	60/40 –P/C	452	455	444	451	449
2	50/50 – P/C	412	411	412	417	421
3	40/60 – P/C	397	389	393	392	398

Comparison Graph for Air Permeability Test



STIFFNESS

Stiffness is the tendency of the fabric to keep standing without any support. This is one of the main factor in the study of handle and drape of the fabric it is measured in CMS (Centimeters).To carry out a test the specimen is cut to size 6 in. x 1 in with the aid of the template. Both the template and specimen are transferred to the platform with the fabric underneath. Now both are slowly pushed forward. The strip of the fabric will commence to droop over the edge of the platform and the movement of the template and the fabric is continued until the tip of the specimen viewed in the mirror cuts both index lines. The bending length can immediately be read off from the scale mark opposite a zero line engraved on the side of the platform. Each specimen is tested four times, at each end and again with the strip turned over. In this way three samples are tested. Finally mean values for the bending length in warp and weft directions can be calculated

Procedure:

1. To carry out a test the specimen is cut to size 6 in. x 1 in. with the aid of the template.

2. Both the template and specimen are transferred to the platform with the fabric underneath.

3. Now both are slowly pushed forward.

4. The strip of the fabric will commence to droop over the edge of the platform and the movement of the template and the fabric is continued until the tip of the specimen viewed in the mirror cuts both index lines.

5. The bending length can immediately be read off from the scale mark opposite a zero line engraved on the side of the platform.

6. Each specimen is tested four times, at each end and again with the strip turned over.

7. In this way three samples are tested.

8. Finally mean values for the bending length in warp and weft directions can be calculated.

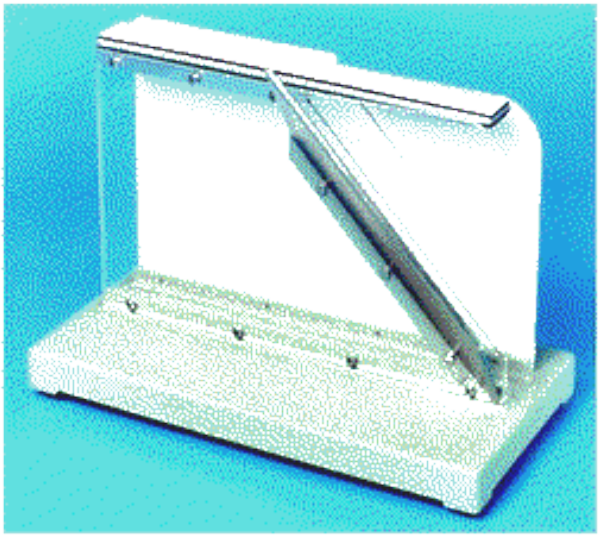
Data:

S/n		Warp (CMS)			Weft (CMS)		
		Right	Left	Mean	Right	Left	Mean
	F	2.1	2.15		2	2.39	
1	B	2.25	2.25		2.68	2.75	
	F	3.1	3.15		2.4	2.2	
2	B	2.89	2.97		2.75	2.9	
	F	2.5	2.89		2.2	2.25	
3	B	2.75	2.95	2.66	2.71	2.85	2.51

Table: Bending length obtained from test

Result:

The bending length of the fabric in warp way is 2.66 cms. The bending length of the fabric in weft way is is 2.51 cms.



60% polyester with 40% cotton	1.9cm
50% polyester with 50% cotton	2.1cm
40% polyester with 60% cotton	2.35cm

TEARING STRENGTH

It is the strength required to start or continue the tear in a fabric under specific condition and tearing force is the required to continue a tear previously started in a fabric. Its unit is usually measured in Newton N.A fabric what is tear, now let us first try to understand a fabric tears when it is snagged by sharp object, so there must be some initiation otherwise tearing will not be there. This sharp object maybe some hook, some knife edge something some nails, so there must be some it and the immediate small puncture. So, some any pointed point puncture is converted in to long rip, so that is tear, so there must be some initiation and then there will be progression. So, that initiation is by some sharp object ok any blunt object normally it is not they do not actually are generate any tear. And then the convert to long rip it is by a small extra effort. So, that if you start the tearing then the tearing will continue ok. It is the most common type of fabric failure that is the important and important for industrial fabric expose to rough handling like tents, sacks. So, there actually subjected to rough handling there will be some pointed object, sharp object and then this tearing will start.

BEFORE DYEING

KNITTED FABRIC

Bleached	Dyed
35 N	33 N

Bleached	Dyed
36 N	34 N

AFTER DYEING

KNITTED FABRIC

Bleached	Dyed
30	28

Bleached	Dyed
52	45

4.7 Fastness tests

Polyester-cotton blended fabrics were dyed using single bath and double bath techniques. After dyeing the dyed samples were evaluated for fastness properties

1. RUBBING FASTNESS

2. WASHING FASTNESS

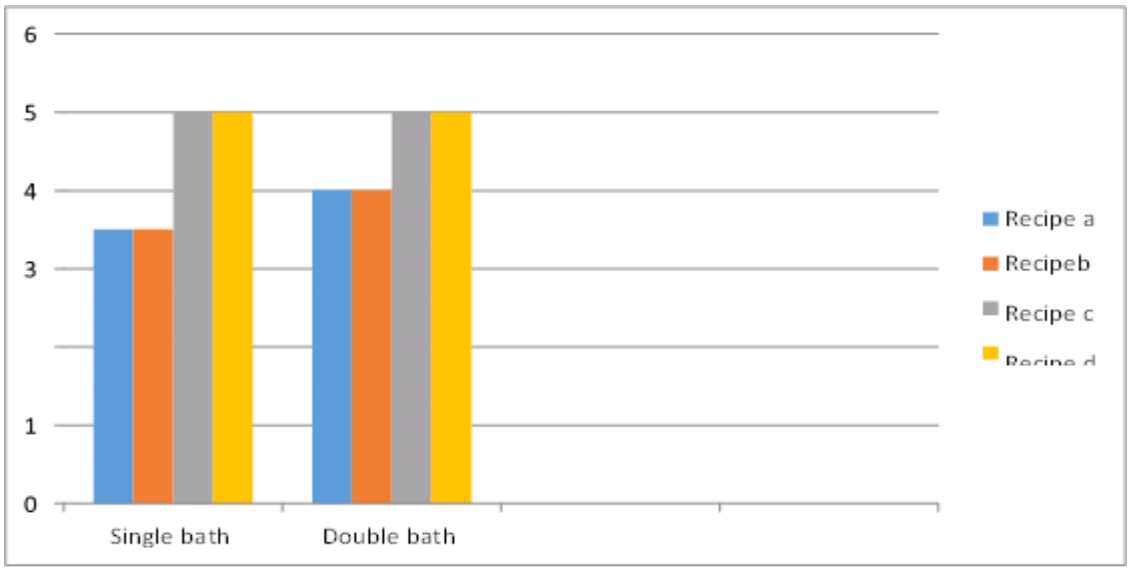
RUBBING FASTNESS

It is a step by step method to measure the rubbing fastness properties. Rubbing fastness of the material is done in dry and wet form like the following way

- White test cloth is put on to the grating and stag by steel wire.
- The sample is run twenty times manually for ten seconds. And the rubbing fastness of the sample cloth and degree of staining is accessed.
- For rubbing fastness, the rubbing cloth is placed in the water and socked and squeeze. The wet rubbing cloth is placed on to the grating and stag with stainless steel wire and run ten times manually then assesses the attaining on the rubbing cloth and the rubbing fastness of the sample cloth is accessed.

Results of rubbing fastness of single bath and double bath dyed fabric

RECIPE	**SINGLE BATH**		**DOUBLE BATH**	
	WET	**DRY**	**WET**	**DRY**
60/40 :P/C	**¾**	**4**	**4**	**4/5**
50/50 :P/C	**¾**	**4/5**	**4**	**4/5**
40/60: P/C	**4/5**	**4/5**	**4/5**	**4/5**



Theresultsofrubbingfastnesspropertiesofsinglebathanddoubledyeingofp/cblendedfabricsusingrecipe60/40:p/c, recipe B, recipe C, are given in Table. Recipe A and recipe b are darker in shade. From the table and it was observed that recipe 60/40:p/c and50/50:p/c has good rubbing fatness range4to5 in double bath but poor fastness range 3-4 in single bath this may be due to less reaction and dye fixation time. Recipe 40/60:p/c are lighter in shade. From Table it was observed that recipe 40/60:p/c has good washing fatness 4-5 in both methods. Not more change in dry rubbing but in wet rubbing of darker shade of single bath rubbing fastness is reduce.

Washing fastness

A specimen of the textile to be tested, with the adjacent fabric attached is subjected to washing under specified conditions. Te extent of any change in color and that of the staining of the adjacent fabric are assessed and the rating is expressed in fastness numbers.
There are two types of adjacent fabrics;

1. Single fiber fabric and multiple fiber fabric. In the case of multi fiber fabric only one specimen is required and in the of single fiber fabric two adjacent fabric are required. There are various colorfastness test.

Change in color of the textile and also staining of color on the adjacent fabric are assessed. A 10 x 4 cm swatch of the colored fabric is taken and is sandwiched between two adjacent fabrics and stitched, the sample and the adjacent fabric are washed together. Five different types of washing are specified as different washing methods. The solution for washing should be prepared to the required temperature of washing. The liquor material ratio is 50:1. After soaping treatment, remove the specimen, rinse twice in cold water and then in running cold water under a tap. Squeeze it and air dry at a temperature not exceeding 60°C. The change in color and staining is evaluated with the help of grey scales.

Results of washing fastness of single bath and double bath dyed fabric

Note: CC: color change; C: cotton, P: polyester

Recipe	Single bath					Double bath					
	CC	Staining on				CC	Staining on				
		C		P				C		P	
60/40 :P/C	4	3/4		4		4		4		4/5	
50/50 :P/C	4	3/4		4/5		4		4		4/5	
40/60: P/C	4	4		4/5		4		4/5		4/5	

Theresultsofwashingfastnesspropertiesofsinglebathanddoubledyeingofp/cblendedfabricsusingrecipe60/40:p/c, recipe 50/50:p/c, recipe 40/60:p/c are given in Table. Recipe 60/40:p/c and recipe 50/50:p/c are darker in shade. From Table, it was observed that recipe 60/40:p/c and 50/50:p/c has good washing fatness range 4 to 5 in double bath in compare to poor fastness range3-4 in single bath this may be due to in single bath process the reaction time is less and dye fixation time was also less.

Recipe 40/60:p/care lighter in shade. From Table it was observed that recipe 40/60:p/c has good washing fatness 4-5 in double bath and single bath.

CONCLUSION

We compared all the tests of test samples such as 60% polyester with 40% cotton, 50% polyester with 50% cotton and 40% polyester with 60% cotton. Those fabrics were dyed with reactive dye, disperse dye and fluorescent dye. The dyed fabrics were passed through the Perspire meter Abrasion tester, Air permeability tester, Projection microscope, inclined binocular Microscope, GSM, Light fastness tester, Stiffness and Bursting strength. The 60% polyester with 40% cotton fabric more efficient than 50% polyester with 40% cotton and 40% polyester with 60% cotton. In that fabric the color visibility is highly effective on it. When light rays are passed through the fabric their high visibility easily exposed. So the fabric which contains more polyester content than other fabric they are more effective with the fluorescent dye.

As dyeing of polyester/cotton with the fluorescent dyes is concerned the cost of production is very important for the overall profitability of the industry. One can develop the process in order to reduce the cost of production. In this study, polyester /cotton fabrics were dyed with single bath and double bath dyeing methods using various recipes. In double bath dyeing gave better results compared to single bath dyeing. However, the cost of double bath dyeing is higher than that of single bath dyeing. The darker shades obtained in double bath dyeing may be due to dyeing carried out at suitable individual dyeing conditions. Here polyester part is first dyed with disperse dyes and then another bath dyeing of cotton was carried out using reactive dye. The single bath dyeing is not better for darker shade. The fastness properties are poor in darker shade dyeing. This effect is occurring due to not giving the proper reaction time for dark shade. The single bath dyeing is better for light shade of dyeing. The light shade gives better result in single-bath as fixation time is sufficient

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