Color Build up on Polyester Cotton Fabric with Disperse Dye With the Shade Variation by High Temperature and High Pressure Method at Different Stages

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Abstract—*Dyeing of blend fabric such as Polyester/Cotton (P/C) is presently done with two chemically different classes of dyes namely disperse for polyester and reactive for cotton, in two bath process. Experimental work was carried out on finding the possibility of making physical mixture of Disperse/Reactive (D/R) dyes to dye the P/C blends (65/35) in one bath process. A study was also carried out to understand the stability of the physical mixture of dyes to storage and it was observed that the dyes were stable in terms of particle size, filtration time and flow rate studies. The physical mixture of dyes showed level dyeing having good fastness properties and offers the option of cost effective and eco-friendly one-bath dyeing process.*

Keywords—one-bath dyeing, Polyester/Cotton blends, Disperse/Reactive dyes, Physical mixture, Fastness.

I. INTRODUCTION

the introduction In textile industry polyester / cotton (P/C) blends have dominant market share having share of 58.45% in worldwide - market. These blends are famous due to their aesthetic value and user friendly performance. Limitations of both fibers are balanced adequately by blending these two fibers making perfect blend. However, the P/C blends posses some challenges to dyer as polyester shows a hydrophobic character while cotton shows a hydrophilic character making it inevitable to dye them with chemically different class of dyes. The conventional method of exhaust dyeing for P/C blends is to dye each component separately under its optimum conditions, i.e. in a two-bath process. To address the issue of productivity and raising environmental concerns, several attempts have been made in the past to shorten this to one-bath processes, for example Imperial Chemical Industries (ICI) have developed a rapid one-bath method using a mixture of selected disperse and reactive dyes.

The key objective in the 'rapid 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. Various other combinations of dyes like disperse/direct and disperse/vat can be used in single bath dyeing but, the matching of shade is quite difficult. Reactive dyes have some significant advantages over other dyes applicable to cotton: viz., color value, reproducibility of color, and fastness properties are usually better, and the dyeing is easier to wash-off.The one-bath two-step dyeing process uses a separated high-pH and low temperature reactive fixation step after the high temperature, low pH disperse dyeing to avoid a high rate of hydrolysis of both disperse and reactive dyes under high temperature, or high pH dyeing environment. This process is shorter as compared to two-bath dyeing process, but the drawbacks are lower dye ability and poor reproducibility. The one-bath one-step dyeing process of P/C blends with disperse/ reactive (D/R) dyes has the advantages over the conventional dyeing processes on reducing the dyeing cycle as well as energy consumption, and eliminating the use of sodium hydrosulphite, an environmentally questionable chemical in dyeing. The present work involves a method of one-bath one-step dyeing process of P/C blend with a physical mixture of D/R commercially available dyes in powder form for ease of shade matching to the dyers.

II. DISPERSE DYES

A class of slightly water-soluble dyes originally introduced for dyeing acetate and usually applied from fine aqueous suspensions. Disperse dyes are widely used for dyeing most of the manufactured fibers. The term

"disperse dye" have been applied to the organic coloring substances which are free from ionizing groups, are of low water solubility and are suitable for dyeing hydrophobic fibers. The dye has derived its name for its insoluble aqueous properties and the need to apply it from an aqueous dispersion. Of all the dyes, they are of the smallest molecular size. Disperse dyes have a five-space indentation. A colon is inserted before an equation is presented, but there is no punctuation following the equation. All equations are numbered and referred to in the text solely by a number enclosed in a round bracket (i.e., (3) reads as "equation 3"). Ensure that any miscellaneous numbering system you use in your paper cannot be confused with a reference [4] or an equation (3) designation.

III. REACTIVE DYE

A dye, which is capable of reacting chemically with a substrate to form a covalent dye substrate linkage, is known as reactive dye. Here the dye contains a reactive group and this reactive group makes covalent bond with the fiber polymer and act as an integral part of fiber. This covalent bond is formed between the dye molecules and the terminal –OH (hydroxyl) group of cellulosic fibres on between the dye molecules and the terminal –NH2 (amino) group of polyamide or wool fibers.

IV. DYEING PROCESS (POLYESTER PART DYEING)

Polyester Texties require a Heat Setting operation before dyeing. Heat settings eliminate the internal tensions within the fibre generated during manufacture and the new state can be fixed by rapid cooling. This heat settings fixed the fabrics in the relaxed state and thus avoids subsequent shrinkage or creasing of fabric.

Dye bath settings & Dyeing:

Recipe(Shade 1%):
Disperse Dye: 1 % owf
Dispersing Agent: 1 gm/lit
Acetic Acid: 1 gm/lit
PH: 5.5-6.0
Temperature: 130°C
Time: 1 hr

Recipe(Shade 2%):
Disperse Dye: 2 % owf
Dispersing Agent: 2 gm/lit
Acetic Acid: 1 gm/lit
PH: 5.5-6.0
Temperature: 130°C
Time: 1 hr

Recipe(Shade 3%):
Disperse Dye: 3 % owf
Dispersing Agent: 2 gm/lit
Acetic Acid: 1 gm/lit
PH: 5.5-6.0
Temperature: 130°C
Time: 1 hr

Procedure:

At first a paste of dye and dispersing agent is prepared and water is added to it.

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PH is controlled by adding acetic acid.

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This condition is kept for 15 minutes at temperature 60°C.

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Then the dye bath temperature is raised to 130°C and this temperature is maintained for 1 hour. Within this time, dye is diffused in dye bath, adsorbed by the fibre and thus required shade is obtained.

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The dye bath is cooled as early as possible after dyeing at 60°C.

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The fabric is hot rinsed and reduction cleaning is done if required.

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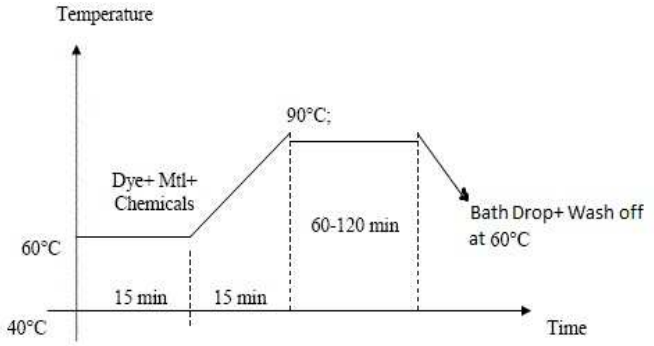
Then the fabric is finally rinsed and dried.



Sequestering Agent: 1 cc/L
Wetting Agent : 1 cc/L
Levelling Agent: 1cc/L
PH: 10
Temperature: 40°C
Time: 60 min
M:L : 1: 20

Recipe (Shade 2%):

Reactive dye: 2% owf
Salt: 35 gm/L
Soda: 10 gm/L
Sequestering Agent: 1 cc/L
Wetting Agent : 1 cc/L
Levelling Agent: 1cc/L
PH: 10
Temperature: 40°C
Time: 60 min
M:L : 1: 20

Recipe (Shade 3%):

Reactive dye: 3% owf
Salt: 45 gm/L
Soda: 15 gm/L
Sequestering Agent: 1 cc/L
Wetting Agent : 1 cc/L
Levelling Agent: 1cc/L
PH: 10
Temperature: 40°C
Time: 60 min
M:L : 1: 20

Procedure:

At first water, fabrics, salt, auxiliaries are taken in bath and run the bath was about 10 mins at room temperature.

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Soda is dosing and temperature is increasing up to 40°c for 20 mins.

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Run the bath for 40 min at this temp.

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Drop this bath.

↓

Rinsing.

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Soap wash.

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Hot wash is carried out at 90°c temp for 10 mins

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Cold wash for 10 mins.

[owf= on the weight of fabric]

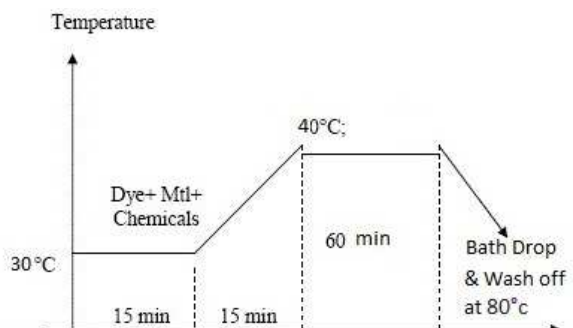

Figure 2: Drying curve (Cotton part)

VI. SAMPLE PRESENTATION:

	Shade 1%	Shade 2%	Shade 3%
1.Solid Effect (Disperse+ Reactive)			
2.Reservation Effect (Disperse Dye)			
3.Reservation Effect (Reactive Dye)			

V. COLOR FASTNESS TO WASH

ISO 105 C06 Test is used here.

VI. COLOR FASTNESS TO RUBBING

Required Apparatus:

1. Rubbing tester.
2. Sample holder with pin (a) 22 cm length
   (b) 9 cm width
3. Sample size (a) 22 cm length
   (b) 5 cm width
4. Sample plate.
5. Finger
6. Finger clip
7. Load (9+5, 9-5) N

Working Procedure for Rubbing Test:

At first we cut the fabric as per requirement size of 22cm x 5cm the fabric was set of the sample holder with pins.

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The crock fabric was taken size of 5cm x 5cm set of on the finger of the crock meter with the help of a clip & the machine b set to zero.

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Then finger was dropped on the sample & 10 turns for 10 sec for rubbing was done by operating handle. The crock fabric is collected for assessment.

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Then the finger was converted by a wet crock fabric & rubbing was done 10 times of 10 sec by operating handle.

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After that the wet crock fabric was collected for assessment.

Table 1: Results for Color Fastness to Wash

S.L	Description	Change Value	Remark	Staining Value	Remark
01	1% Solid	4	Fast(Good)	3	Average
02	1% Reserve Reactive	5	Fast(Excellent)	4	Fast(Good)
03	1% Reserve Disperse	4	Fast(Good)	4	Fast(Good)
04	2% Solid	5	Fast(Excellent)	5	Fast(Excellent)
05	2% Reserve Reactive	5	Fast(Excellent)	4	Fast(Good)
06	2% Reserve Disperse	5	Fast(Excellent)	5	Fast(Excellent)
07	3% Solid	4	Fast(Good)	3	Average
08	3% Reserve Reactive	4	Fast(Good)	4	Fast(Good)
09	3% Reserve Disperse	4	Fast(Good)	3	Average

Table 2: Results for Color Fastness to Rubbing

S.L	Description	Staining Value for Dry Sample	Remark	Staining Value for Wet Sample	Remark
01	1% Solid	5	Fast(Excellent)	4	Fast(Good)
02	1% Reserve Reactive	4	Fast(Good)	4	Fast(Good)
03	1% Reserve Disperse	5	Fast(Excellent)	5	Fast(Excellent)
04	2% Solid	5	Fast(Excellent)	5	Fast(Excellent)
05	2% Reserve Reactive	5	Fast(Excellent)	4	Fast(Good)
06	2% Reserve Disperse	5	Fast(Excellent)	5	Fast(Excellent)
07	3% Solid	4	Fast(Good)	4	Fast(Good)
08	3% Reserve Reactive	4	Fast(Good)	4	Fast(Good)
09	3% Reserve Disperse	5	Fast(Excellent)	4	Fast(Good)

VII. CONCLUSION

P/C fabrics were successfully dyed with the physical mixture of D/R dyes by one- bath one-steps dyeing process. The novelty of undertake study is successful mixing of commercially available dyes as is to give complete shade, in powder form which will open an new avenues to dyestuff suppliers to cater to the blend dyeing need of the textile processing . The work was based on a well established process of dyeing HTHP method which is commercially accepted method in dyeing sector. For the wash and rubbing fastness test ISO testing method was followed. For dyeing of P/C fabric, first polyester fabric was dyed in high temperature then cotton fabric. Performing this project we gathered some knowledge which will be helpful in our future activities during practical life.

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