

# An approach to the dyeing of semi dull and cationic dye able polyester with disperse dye and comparison with cotton polyester blend dyeing process

## Abstract

This paper puts forth the dominance of SD polyester over the cellulosic cotton fiber. SD polyester being capable of adopting the appearance of cotton fiber and cheaper than cotton fiber that's why cotton fiber is chosen for this paper. The fabric composition consists of 50% of SD polyester and 50% of CD able polyester fiber. The exhaust dyeing process is followed at high temperature. Both SD and CD polyester were dyed at the same time duration of 40 minutes and temperature were 135°C and 90°C respectively. For this purpose, experiments were done on 80/20 cotton/polyester and 50/50SD/CD polyester which shows the same results. The results were based on the parameters like GSM, fastness, stitch length and a same dyeing recipe. After completing the dyeing process the parameter like shrinkage tolerance (3-5) %, shade matching 3%, wash fastness at 60°C (4-5) %, wet rubbing fastness (4-5) %, dry rubbing fastness (4-5) %, spirality of fabric 3% (Max) were found. The only drawback of 50/50SD and CD polyester fabric is the coziness of the fabric as cotton fabric is better on this. When all the dyeing parameters and dyeing process is considered; SD and CD polyester shows better performance than cotton.

**Keywords:** semi dull polyester, cationic dye able polyester, cotton, disperse dye

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**Abbreviations:** SD, semi-dull; POY, partially oriented yarn; CD, cationic dye

## Introduction

SD polyester is a Special type of fiber which is composed of phony methods.<sup>1</sup> Researchers have studied for the replacement of the natural fiber, cotton with synthetic fiber, semi-dull polyester. SD polyester provides good spinning quality as well as good durability and strength. The most important feature of Semi dull polyester fiber is that it has the similar appearance of cotton fiber.<sup>2</sup> Another three major features of SD polyester fiber as; good color fastness, optimum finish, smoke texture.

The origin of the SD polyester fiber is the POY which has lower luster in order to POY in case of bright yarns.<sup>2</sup> The attempt of today's engineer is to replace the cotton fiber with polyester fiber for its some of the major lacking's like more moisture absorbency, shrinkage, wrinkling etc. In addition, the SD is the filament yarn of the polyester fiber. Consequently, this SD polyester fiber has the variation of counts in denier and micro denier.<sup>3,4</sup>

Cotton fiber is the most widely used and 7000 thousand years old fiber to be proved.<sup>5,6</sup> Chemically cotton fibers are mostly made of alpha-cellulose (88.00%-96.5%) where nano cellulose is positioned on either cuticle and primary wall or inside the lumen of the fibers whereas the secondary cell wall is pure cellulose. Cotton is the purest of cellulose and ample in nature.<sup>6,7</sup> When examined in the chemical composition varies with the variation of its origin and other factors. However, the Nano-cellulose include proteins (1%-1.9%), waxes (0.4%-1.2%), pectin (1%-2%), inorganic (0.7%-1.6%),

others (0.5%-0.8%).<sup>8</sup> The crystalline region dominates the cellulosic cotton fiber and alpha cellulose is prominent in its long and rigid molecular structure.<sup>9,10</sup> The amorphous region cellulosic cotton leads to the access of heat or any other reaction. Cotton is popular for its availability, ready reaction with dyes and chemicals.<sup>10</sup> Cotton fiber needs special different finishes to retain the different effects on it.<sup>11</sup> The objectives of this research are to completely replace cotton fiber for its undeniable demerit with SD and CD polyester fiber with a view to reducing the expense of dyeing.<sup>12</sup>

## Material and methods

In general, disperse dye is mostly used for polyester fiber and it is a hydrophobic fiber. Disperse dyes are the derivatives of azo, anthraquinone, nitro, and quinone group.<sup>13,14</sup> Such as:



Dyes like; Dispersol Fast Yellow G, Fast Orange G, Violet 2R, Blue GN etc. these dyes do not require carrier for swelling and keeps dyeing at boiling temperature.

## Fabric preparation

The process has been done in two types of polyester fabric, i.e. SD polyester and CD polyester. In both cases, disperse dyes were used.

## Semi dull polyester

Around 10kg single jersey mesh fabric was taken. The fabric was collected from Masco Industries Limited, Dhaka, Bangladesh. GSM of the fabric was 165. Dye liquor was about 100 liters. The recipe followed for the dyeing as follows:

RI	2%
AB45	1%
DFM	2%
Terasil Blue WBL5	1%
Terasil Red WW 3BS	0.03%
Teracil Yellow W6GS	0.003%
Caustic soda	2.00g/l
Hydros BASF	3g/l
Acetic acid	1g/l

Initially, a paste of dye and dispersing agent is prepared and water is added to it. The pH was controlled by acetic acid. Materials and other dye auxiliaries were added at 45°C. This condition was kept for 15 minutes. Then the dye bath temperature was raised to 130°C and kept the condition for one hour.<sup>15</sup> The dye was diffused in the dye

bath and adsorbed by the fabric and thus required shade was obtained. During the dyeing pH was kept between 4-4.5. After that the dye bath was cooled down as early as possible.<sup>15</sup> The fabric was rinsed and reduction cleaning was done.

## Result and discussion

### Physical test report

In this research, only physical test has been carried out. The test results are given below Table 1.

A comparative study was made between cotton fiber and polyester fiber; keeping the GSM, color, machine detail, style same (Table 2).

It was observed that the polyester fiber showed higher results as cotton fiber when the dyeing parameters were kept same for both the fibers. Analytical details of cotton and polyester fibers are given below Table 3.

**Table 1** Physical test results

Test name		Before wash	After wash	Test found %	Tolerance %
Dimensional stability to wash (BS EN ISO 6330:2001)	Length	35.00mm	34.09mm	-2.60%	±5.00%
	Width	35.00mm	34.72mm	-0.80%	±5.00%
Spirality				0.00%	±5.00%
GSM				165	165
Fabric Width				48"	48"

**Table 2** A comparative studies was made between cotton fiber and polyester fiber

Fabrication	Stitch length	GG	Fabric dia	Color	Qty.	Additional instruct			Remark
						HT ST	Dry	Comp	
80% Cotton and 20% Spun Polyester, 28/1Ne, Mesh Single Jersey, GSM-165	2.65mm	24	NON/35	Cotton Part Dye-15-0543 TCX	10kg	N/A	As set	As set	Follow the design file
100% Filament Polyester(50% CD and 50% SD), 28/1 Ne, GSM-165	2.65mm	24	NON/35	New Technology in Dyeing only CD Part Dye-19-4053 TCX +	10kg	N/A	As set	As set	Follow the design file (Cationic + Anionic Dyeing Method)

**Table 3** Analytical details of cotton and polyester fibers

Test parameter	80% Cotton and 20% Polyester	100% Filament polyester (50% CD and 50% SD)
Wash Fastness at 60°C	3-4	4-5
Wet Rubbing fastness	3-4	4-5
Dry Rubbing Fastness	3-4	4-5
Spirality of Fabric	5%	3%
Pilling of Fabric	3-4	4-5

## Conclusion

Dyeing of cotton and polyester fiber with disperse dyes has been characterized in this investigation. A comparative study of cotton and polyester fiber shows that polyester fiber requires similar time

to cotton and similar fastness properties. Semi dull polyester fiber is comparatively cheaper than cotton fiber and its appearance is similar to cotton fiber. Cotton fiber for its inherited demerits like yellowness, more moisture absorbency can successfully be replaced by SD polyester fiber.

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## Conflicts of interest

Authors declare that there is no conflicts of interest.

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