

COTTON FABRIC PREPARATION FOR VAT DYEING

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Abstract

The preparation of cotton fabric for vat dyeing has been studied. Desizing operation was carried out on the cotton fabric in which the cloth was impregnated with water and stored for 48 hours at room temperature to remove the size or starch naturally present in the cotton fabrics that can inhibit dyeing thereby allowing easy absorbency of the fabric towards water and dyes. Mercerization process was also carried out on the cotton fabrics to increase the colour yield on dyeing and significantly increases the dye affinity of the cloth relative to that of an untreated material. The untreated and treated dyed cotton fabrics was analysed using colour fastness test especially to light and wash to know the effect of desizing and mercerization on the fabric as compared to the un-desized and un-mercerized dyed cotton. The result of this analysis showed that the desizing and mercerization prior to vat dyeing gave a better vat dyed cotton fabric showed by well retained dye and improved appearance.

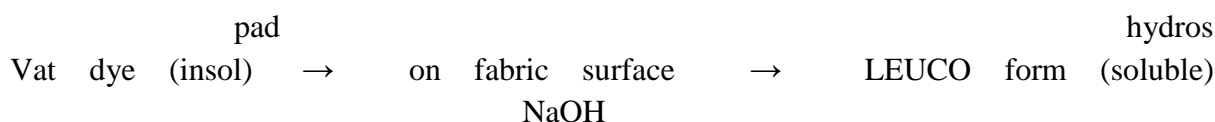
Keywords: cotton, vat dye, colour fastness, desizing, mercerization.

1.0 INTRODUCTION

Cotton can be dyed with many natural colours extracted from natural sources and synthetic dyes (Thakare *et al*, 2006). The original vat dye is indigo, once obtained from plants but now produced synthetically (Burch Paula, 2013).

Vat dye is the most popular dye used for coloration of cotton, particularly when high fastness is required (Philips *et al*, 1996). The coloration of cellulose fibres about 120 000 tons of vat dyes are being used annually (Mojca Bozic and Vanja Kokol, 2008). Vat dye is not soluble in water, but can be solubilized by reaction with a reducing agent, e.g., sodium hydrosulfite ("hydros", Na₂S₂O₄) in dilute NaOH (Philips, 1996).

Once it has been converted to its soluble (LEUCO) form, the vat dye can penetrate into the cotton fibers.



This accounts for their good wash fastness. This is because they can be applied, solubilized by reduction, and finally re-oxidized when inside the cotton (Baumgarte *et al*, 1987).

Although fabric preparation involving desizing and mercerization treatment of the cotton fabrics can definitely increase and improves the dye uptake and ensures more shelf life of the vat dyed cotton fabrics as compared to the untreated ones.

2.0 MATERIALS AND METHOD

2.1 Materials

- White cotton fabrics
- Vat dyes
- Sodium Hydrosulphite
- Caustic Soda
- Stirrer
- Nose mask
- Beakers
- Hand gloves
- Weighing balance.
- Basic laboratory glass wares, such as, conical flasks, measuring cylinders, thermometer, stirring rod, and volumetric flask

2.2 METHOD

2.2.1 Fabric preparation

The cotton fabrics were obtained in its grey state, desizing and mercerization operation was carried out on the fabrics. It was then weighed and wetted out before immersion into the dye liquor.

2.2.2 Desizing operation:

The cloth was impregnated with water only and stored for 48 hours at room temperature. During this period, the starch becomes degraded by enzymes naturally present in the medium, it was then washed off. This is necessary to allow easy penetration of the dye into the cotton fabrics as compared to the un-desized materials.

2.3 Mercerization operation:

Mercerization process was carried out by treating the cotton fabrics in a concentrated solution of 25% caustic soda for 2 minutes at room temperature. The material was then thoroughly washed in water, rinsed to remove the alkali, and dried. This increases the colour yield on dyeing and significantly increases the dye affinity of the cloth relative to that of an untreated material.

2.4 The dyeing process: The de-sized and mercerized {treated samples} were immersed in the already prepared dyed liquor, this process was also repeated for the untreated samples.

The result is as shown in the discussion of results.

2.5 Colour fastness Test:

An aspect of fabrics which is always of interest to consumer is how fast the colour is. This is because the beauty of a fabric is of no value unless the dye is fast under the conditions in which the fabric is to be used. The colour fastness tests used for this analysis are the colour fastness to light and washing. The results are displayed in tables 1 and 2.

3.0 RESULTS AND DISCUSSIONS:

3.1 RESULTS OF THE DYED FABRICS (UNTREATED AND TREATED)

The results of the dyed untreated and treated fabrics is displayed below

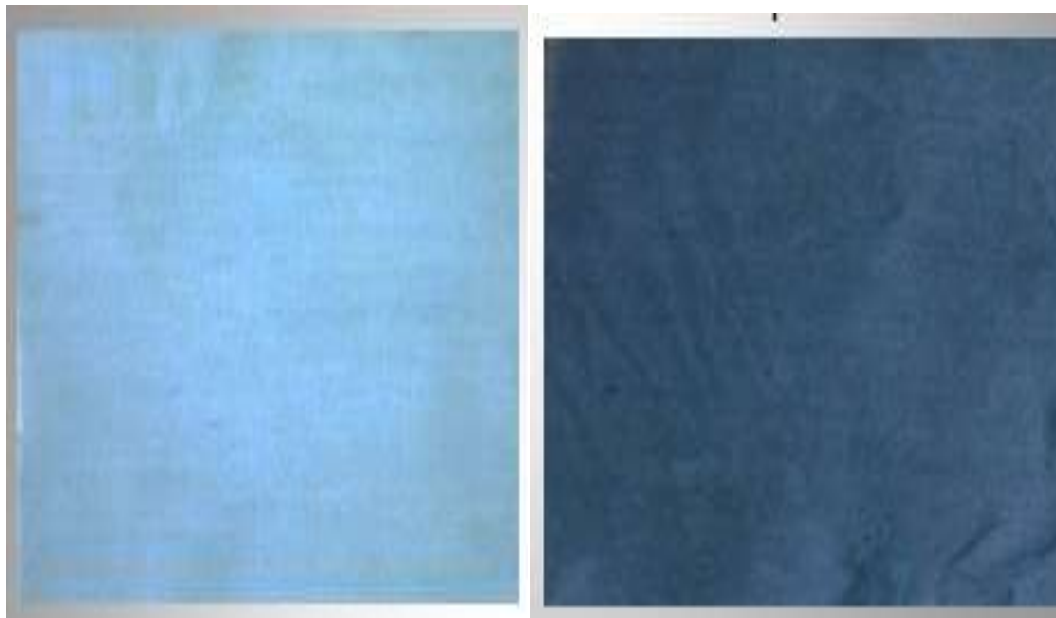


Plate1

Plate2

Plate 1 shows the sample of the untreated dyed fabrics while plate 2 shows the samples of the treated dyed fabrics (desizing and mercerization treatment). They both indicate the level of dye absorption during vat dyeing of the fabrics.

It can be seen that plate 2 which is the treated fabric is darker in colour under the same dyeing conditions with the untreated fabrics. This is attributable to the fact that treated fabrics readily absorb dyes easily as compared to the untreated fabrics.

3.2 RESULTS OF COLOUR FASTNESS TEST:

The colour fastness tests carried out are: colour fastness to light and washing.

3.2.1 Results of Colour fastness to light: The results are displayed in Table 1 below:

Table 1a

UNTREATED SAMPLES	DESIZED SAMPLES
LOW	MODERATE
LOW	MODERATE

Table 1b

UNTREATED SAMPLES	MERCERIZED SAMPLES
LOW	MODERATE
LOW	MODERATE

Table 1c

UNTREATED SAMPLES	DESIZED / MERCERIZED SAMPLES
LOW	HIGH
LOW	HIGH

Results of colour fastness to washing: The results are displayed in table 2 below;

Table 2a

UNTREATED SAMPLES	DESIZED SAMPLES
LOW	MODERATE
LOW	MODERATE

Table 2b

UNTREATED SAMPLES	MERCERIZED SAMPLES
LOW	MODERATE
LOW	MODERATE

Table 2c

UNTREATED SAMPLES	DESIZED /MERCERIZED SAMPLES
LOW	HIGH
LOW	HIGH

Tables 1a to c, show that the untreated fabric gave low colour fastness (resistance) to light. This can be attributed to the fact that the untreated cotton fabric does not readily retain the vat dyes. However in table 1a only the de-sized samples were analysed and they have moderate fastness to light. This is attributable to the fact that the desizing treatment gave a better dye absorption and retention though moderately as compared to the untreated samples.

In table 1b, only the mercerized samples were analysed, and it gave moderate fastness to light. This is also attributable to the fact that only mercerized treatment gave a better dye absorption as compared to the un-mercerized samples.

Table 1c, however showed a complete pre-treatment of both the desizing and mercerizing treatment on the cotton fabrics. This gave a relative high colour fastness to light as compared to desizing or mercerization alone. This is also attributable to the fact that desizing and mercerization treatment combined gave the most efficient form of cotton fabric pre-treatment prior to dyeing which account for the excellent high light fastness indicating that the cotton fabric readily absorbs the vat dyes and retains it.

Tables 2a to c which show the result of the colour fastness to washing, gave similar result like that of tables 1a to c, indicating that both the desized and mercerized cotton combined, gave a better wash fastness because it has better efficiency in dye absorption compared to each

alone, and by far better than the untreated samples as far as the preparation of cotton fabrics for vat dyeing is concerned.

CONCLUSION

It is a common experience that cotton fabrics fades with time when dyed with vat dyes. This research however, has shown that pre-treatment of such fabrics using desizing and mercerization, gave a better and more durable fabrics due to imparting on the fabrics the high absorption and retention ability that would not have been possible if not pre-treated, as assessed by the colour fastness test especially to light and washing.

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