TECHNICAL BULLETIN

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TRI 3004

GARMENT DYEING

WITH PIGMENTS

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INTRODUCTION

The popularity of the "weathered" or "distressed" look for casual clothing has led to the development of numerous techniques for producing this look during the laundering process. In general, the procedure is to dye fabric in piece form, make-up garments, and then launder, washing down the color to produce the desired look. This process involves strict control over dyestuff selection and application to ensure uniform and reproducible results.

As an alternative, a garment-dyeing process has been developed to produce garments with the popular weathered or distressed look without subsequent garment washing. This process uses pigment dyes, which were previously considered to be non-substantive or non-chemically reactive to any fiber substrate by any process other than padding or printing with a binder. An affinity for the cotton garment by the pigment is achieved by exhausting a cationic polymer onto the garment prior to the addition of the pigment dyestuff.

RECOMMENDATIONS

Most companies, which supply either the pigment or the cationic polymer, offer a complete system that has been evaluated for effectiveness and application conditions. It is important to choose a system that yields high pigment exhaustion and is reproducible. Other important considerations are color range, fastness, cost, and desired results. The choice of fabric substrate is also critical to achieving the desired look. It is important to choose fabrics such as twills, single knit piques, or other types of fabric with a textured surface to achieve the best look with the pigment-dyeing process.

The recommended piece of equipment for this process is generally a rotary drum machine capable of being programmed with a variable drum speed during the dyeing cycle. However, other types of equipment, such as paddle machines, are also utilized in pigment garment dyeing.

The cationic fixative is exhausted onto the garment first and acts as the link between the fabric and the pigment. Once this bath has been dropped and the garment rinsed, the pigment is applied. It is important to keep the liquor-to-fabric ratio high (20:1) and the initial bath temperature low (80F/27C) to gain uniform exhaustion of the pigment onto the garment. A long rate of rise (2°F (1°C) per minute), when increasing the temperature of the bath, will also aid uniform exhaustion of the pigment.

Once the pigment dyeing is completed and after rinsing off any excess color, a low temperature or air-curable binder, usually an acrylic-based product, must be applied to the garments to improve the fastness to rubbing or crocking. It is preferable, where possible, to use a cationic rather than a nonionic binder since the cationic binder can be exhausted onto the fabric. Because reproducibility from one dye lot to the next may be difficult, it is important to carefully select the garment components, dyestuffs, and chemicals to be used and to monitor the dyeing process. Only with precise process control is it possible to reproduce colors between dye lots within currently accepted tolerances.

COLORFASTNESS

The colorfastness to washing of garments dyed with this pigment-dyeing process is satisfactory for the type of distressed looks desired. The colors are intended to continue to washdown over the life of the garment. However, the selection of the type of cationic polymer pretreatment greatly influences the washfastness that can be achieved. Additionally, the higher the color concentration, the worse the fastness to crocking or rubbing even when increased concentrations of binder are used. Pigments have excellent lightfastness.

TROUBLESHOOTING[1]

Problem: Blotchy or Non-Uniformly Dyed Garments
Possible Causes:

1. Garments contain a finish, softener, or an optical brightener.
2. Liquor ratio is too low (want 20:1).
3. Extraction speed too high after pretreat cycle.
4. Excessive bath temperature at beginning of pretreat or dye cycle.
5. Dye bath temperature ramped too quickly.
6. Improper addition or dilution of dyes/chemicals.
7. Live steam injection into bath.
8. Hard water.
9. Acetic acid added too early in dye cycle (bath should be 70-80% exhausted first).
10. Garments not scoured properly.
11. Garments were allowed to dry out after pretreatment stage.
12. Garments not allowed to wet-out sufficiently before adding pretreatment.

Problem: Poor Dye Yield
Possible Causes:

1. Garments contain a finish, softener, or an optical brightener.
2. Garments were allowed to dry out after pretreatment stage.
3. Liquor ratio is too high.
4. Agitation is too slow.
5. Excessive washing between cycles.
6. Excessive time spent in any cycle.
7. Too much/too little pretreatment.
8. Not pretreated for correct time and/or temperature.

Problem: Dye Spots
Possible Causes:

1. Machine not clean.
2. Excess pretreat not rinsed from garment before dyeing.
3. Acetic acid either not diluted or added too quickly.
4. Dye not properly diluted or stirred before bath addition.
5. Incompatibility of auxiliaries.

Problem: Poor Colorfastness
Possible Causes:

1. Fluorescents usually have poor lightfastness.
2. Inadequate aftertreatment may cause poor washfastness.

Problem: Pilling
Possible Causes:

1. Cylinder rotation is too high.
2. Liquor ratio is too low.
3. Excessive cycle time.

PIGMENT GARMENT DYE
TWO BATH/THREE STEP METHOD - A
ROTARY DRUM MACHINE
LIQUOR RATIO 20:1

1. Load machine, set bath @ 80°F (27°C).
2. Adjust pH to 4.7 with acetic acid.
3. Run 5 minutes.
4. Add cationic pretreatment, heat to 140°F (50°C) @ 3°F (1.5°C) per minute.
5. Run 10-20 minutes.
6. Drop.
7. Fill and rinse 3 minutes.
8. Drop.
9. Fill and rinse 3 minutes, drop.
10. Fill, set bath @ 80°F (27°C), and add prediluted dye over 15 minutes. Run 10 minutes.
11. Heat to 140°F (60°C) @ 2°F (1°C) per minute.
12. Run 10-20 minutes (check exhaustion).

    To improve exhaustion and dye yield, pH may be adjusted to 6.0 to 6.5 with acetic acid. For red shades, this may decrease yield. Dye bath should be totally exhausted.
13. Add binder over 10 minutes.
14. Run 15 minutes and drop.
15. Fill and rinse 5 minutes, drop.
16. Repeat above step 2 more times.
17. Extract.
18. Fill and rinse 5 minutes with softener.
19. Drop, extract, and tumble dry.

PIGMENT GARMENT DYE
TWO BATH/THREE STEP METHOD - B
ROTARY DRUM MACHINE
LIQUOR RATIO 20:1

1. Load machine, set bath @ 80°F (27°C).
2. Adjust pH to 4.7 with acetic acid.
3. Run 5 minutes.
4. Add binder.
5. Heat to 120°F (50°C).
6. Run 10 minutes.
7. Add cationic pretreatment over 10 minutes.
8. Heat to 140°F (60°C) @ 3°F (1.5°C) per minute.
9. Run 10 minutes.
10. Drop.
11. Fill @ 80°F (27°C) and rinse 3 minutes.
12. Drop.
13. Fill and set bath @ 80°F (27°C).
14. Add diluted pigments over 15 minutes and run 10 minutes.
15. Heat bath to 140°F (60°C) @ 2°F (1°C) per minute.
16. Run 10-20 minutes (check exhaustion).
17. Drop.
18. Fill at 80°F (27°C), rinse 3 minutes, and drop. Repeat.
19. Fill and rinse 5 minutes with softener.
20. Drop, extract, and tumble dry.

DYESTUFF AND CHEMICAL SUPPLIERS*

Pretreat® 10, Aftertreat® SS - 30, and Speedye® Pigment Dyes

Yorkshire Americas
P. O. Box 1926
Greenville, South Carolina 27602
Telephone: 800-443-9358

Imperon® Pigment Dyes

DYSTAR L.P.
Dyes and Textile Chemical Department
Routes 202/206 North
Somerville, New Jersey 08876
Telephone: 201-685-2060

Sil-Fin® WHP (Cationic Silicone Emulsion)

High Point Textile Auxiliaries L.L.C.
P. O. Box 2316, 243 Woodbine Street
High Point, North Carolina 27261
Telephone: 919-884-2214

Glo-Tex International
25 Stan Perkins Road
Spartanburg, SC 29307
Telephone: 864-579-9897
Fax: 864-579-8679

* The chemicals and dyestuffs listed are those used by Cotton Incorporated in this study. Products from other suppliers may also be satisfactory.

REFERENCES CITED

1. Lee, J., "Pigment Garment Dyeing," AATCC Symposium on Garment Wet Processing Technology (March 1995).

RESEARCH AND TECHNICAL SERVICES

Cotton Incorporated is a research and promotion company representing cotton worldwide. Through research and technical services, our company has the capability to develop, evaluate, and then commercialize the latest technology to benefit cotton.

- Agricultural research leads to improved agronomic practices, pest control and fiber variants with properties required by the most modern textile processes and consumer preferences. Ginning development provides efficient and effective machines for preservation of fiber characteristics. Cottonseed value is enhanced with biotechnology research to improve nutritional qualities and expand the animal food market.

- Research in fiber quality leads to improved fiber testing methodology and seasonal fiber analyses to bring better value both to growers and then mill customers.

- Computerized fiber management techniques result from in-depth fiber processing research.

- Product Development and Implementation operates programs leading to the commercialization of new finishes and improved energy and water conserving dyeing and finishing systems. New cotton fabrics are engineered -- wovens, circular knits, warp knits, and nonwovens -- that meet today's standards for performance.

- Technology Implementation provides comprehensive and customized professional assistance to the cotton industry and its customers -- textile mills and manufacturers.

- A fiber to yarn pilot spinning center allows full exploration of alternative methods of producing yarn for various products from cotton with specific fiber profiles.

- The Company operates its own dyeing and finishing laboratory, knitting laboratory, and a laboratory for physical testing of yarn, fabric, and fiber properties including High Volume Instrument testing capable of measuring micronaire, staple length, strength, uniformity, color, and trash content.

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