TECHNICAL BULLETIN

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TRI 3005

GARMENT WASHING TECHNIQUES

FOR COTTON APPAREL

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INTRODUCTION

Dramatic changes have occurred in the function and design of jean garments since the first pairs of jeans were created for gold miners during the California Gold Rush. The evolution of the jeans' market led to the development of some unique and creative methods for the processing of denim garments. Originally, jeans were marketed and sold as workwear with primary emphasis on their durability and practicality. But when jeans were discovered and appreciated by consumers as general casual wear, they became fashionable, and new techniques were developed to enhance denim garments and make them more unique. These techniques include garment washing, stone washing, stone washing with chlorine, ice washing, and cellulase enzyme washing. Basically, all of these techniques involve the processing of garments in rotary drum machines.

The first generation of indigo jeans was stiff and uncomfortable when first purchased, due to the finishing techniques used for denim fabrics. Normally after weaving, greige denim is singed, finished with starch and a lubricant, and then mechanically shrunk. This mechanical shrinking did "break" the hand somewhat, but no other processing techniques were employed to provide a soft handle. Usually, consumers would take a newly purchased pair of jeans home and soften them by washing once or several times before the first wearing. Denim fabric continues to be processed using the same basic finishing system, but after being cut and sewn, denim garments may undergo additional processing.

The second generation of the jeans' market evolution produced pre-washed jeans by the manufacturer. These jeans had a slightly faded appearance and a softer hand that felt comfortable, as though they had been laundered several times. This trend became fashionable as well, and consumers were willing to pay the extra cost involved for this additional processing. Consumers no longer had to bother "breaking-in" their jeans themselves with the added benefit that the jeans were already shrunk to size with little or no residual shrinkage.

Not long after the introduction of pre-washed jeans, the idea of using abrasive stones to accelerate the aging process was developed and "stone washing" was born, creating an even more "broken-in" look. Next, chlorine bleach was incorporated in these wash techniques and a whole new paler blue denim family evolved. Then, ice washing was developed, in which the porous stones are soaked in a bleaching agent and then tumbled with dry or slightly damp garments. This process has been given many names, including acid wash, snow wash, white wash, frosted, etc. Actually, the term "acid wash" is a misnomer since acids alone should never be used for this process.

Most recently, a cellulase wash procedure was developed in which cellulase enzymes were used to accelerate color and fiber removal. A reduced quantity of stones can be used to create a desirable washed down appearance. This process can be more efficient; since with fewer stones, larger load sizes can be processed, and there is less of an abrasive effect on the inside of the rotary drum.

These garment washing techniques were originally developed for denim garments, but are now being used for a wide variety of different garment types. The mills and commission houses involved in garment processing continually search for ways to achieve unique new looks. Most of these garment processors have their own individual techniques, the details of which are not divulged. This technical bulletin describes the basic wash, stonewash, stonewash with chlorine, ice wash, and cellulase wash techniques used for cotton garments. Any of these procedures can be modified to fit a particular situation, depending upon garment type (i.e., heavyweight denim versus lightweight chambray), available equipment, and process flow. Also, some of these procedures yield garments suitable for overdyeing, which may create a whole new look.

GARMENT WASH

Indigo jeans were once the only item processed by the garment wash method, but this is no longer the case. A wide variety of different types of woven and knit fabrics dyed by different systems are now used in apparel that is garment washed before retail distribution. Emphasis is on comfort and softness. Also, some fashion trends favor the broken-in look and worn/faded seams that can only be achieved through garment processing.

PROCEDURE

1. Garments can be inverted to minimize unwanted abrasion streaks (especially useful when preset creases are present).
2. Load machine with garments.
3. Desize with alpha amylase enzyme and detergent.
4. Drain.
5. Rinse.
6. Fill machine with water and heat to 60◦C. The liquor ratio can range from 10:1 to 20:1. A number of synthetic detergents can be used. Also, alkaline products such as soda ash or caustic soda can be added in amounts ranging from 0.5 to 2.0 grams/liter. Some chemical suppliers offer special products that accelerate the washdown process, dependent upon the particular dyestuff used.
7. Wash/tumble action for 20-60 minutes, depending upon desired effect.
8. Drain and rinse.
9. Apply softener.
10. Tumble dry.
11. Invert garments, if previously turned.
12. Press, if required.

STONEWASH

In order to accelerate the garment wash effect and to give garments an even more unique appearance and softer hand, abrasive stones were introduced to the wash bath. A variety of natural and synthetic stones are available for stonewashing with perhaps the most widely used being pumice or volcanic rock. As the stones are used, they slowly disintegrate, reducing the severity of the stonewash effect over a period of time. The stones not only abrade the fabric but also gradually abrade the inside of the rotary drum. A machine used for stonewashing should not be used to dye delicate articles or when abrasion would be detrimental to the fabric.

PROCEDURE

1. Load stones into machine.
2. Load garments into machine (ratio usually 0.5 - 3.0 part weight stones:1 part weight garments).
3. Desize with alpha amylase enzyme and detergent. Liquor ratio approximately 5-8:1.
4. Rinse.
5. Refill and tumble with stones 30 to 90 minutes, depending upon desired effect. Liquor ratio 5-8:1 at 50-70◦C. Scouring additives can also be used.
6. Drain. Separate garments from stones (garments can be transferred to another machine).
7. Rinse.
8. Apply softener (garments can be transferred to another machine for softening).
9. Extract and unload.
10. De-stone and tumble dry.
11. Press, if required.

Softeners and/or lubricants can be added during steps three and five to reduce creasing potential. Steps 8, 9, and 10 may vary depending upon individual mill arrangement.

STONEWASH WITH CHLORINE

By incorporating chlorine in the stonewash procedure, a color reduction of the indigo (or other chlorine sensitive dyestuff) is obtained. It is very important that any residual chlorine be removed before drying to prevent fiber degradation. This is accomplished by using an antichlor step with sodium bisulfite or hydrogen peroxide.

PROCEDURE

1. Load stones into machine.
2. Load garments into machine (ratio usually 0.5 - 3.0 part weight stones:1 part garments).
3. Desize with alpha amylase enzyme and detergent (liquor ratio approximately 10:1).
4. Rinse.
*5. Refill and add sodium or calcium hypochlorite.
6. Heat to 55◦C.
7. Tumble 15 minutes.
8. Add second portion of sodium or calcium hypochlorite.
9. Tumble 15 minutes, maintaining temperature of 55◦C.
10. Drain.
11. Rinse well.
12. Antichlor with sodium bisulfite or hydrogen peroxide.
13. Drain. Separate garments from stones (garments can be transferred to another machine).
14. Rinse well.
15. Apply softener.
16. Extract and unload.
17. De-stone and tumble dry.
18. Press, if required.

* Amount of sodium or calcium hypochlorite required will vary depending upon desired level of bleach down and the sensitivity of the color to chlorine. Each addition can range from 0.075% to 0.225% available chlorine. pH should be kept above 9.0, preferably 10.5-11.0. This is accomplished with the addition of soda ash with each addition of hypochlorite.

ICE WASH

Either by accident or experimentation, a method was developed in which stones are used as a vehicle to deposit a chemical on garments to strip the color. This surface deposit of chemical removes the color only on the outer surface of the garment and produces a frosted appearance. Indigo and selected sulfur dyes are currently the most popular candidates for this procedure.

PROCEDURE

1. Soak stones in solutions of potassium permanganate for 1-2 hours. Concentrations ranging from 1.5% to 5% are being used commercially. (5% to 10% sodium hypochlorite can be substituted.)
2. Stones should be drained of excess liquor. This can be accomplished by placing stones in net or mesh fabric prior to soaking. Then the stones can be removed and the excess drained off. Another alternative is to place the stones in a rotary tumble machine along with "waste" fabric and tumbling for several minutes to remove the excess solution. A third alternative is to use any number of the pre-soaked stones or materials available from suppliers. These are available in many different shapes with varying levels of chemical and other additives that produce different effects. Trials should be conducted to determine the best method for achieving desired effects.
3. Place stones and garments in machine (garments should be scoured and/or desized and dry or slightly damp).
4. Tumble for 10-30 minutes or until desired effects are achieved. Results are dependent upon dyestuff, fabric, concentration of chemicals, stones, additives, and equipment.
5. In some cases, the stones can be reused for another load before resoaking, depending upon their porosity. It is advantageous to transfer the garments to another machine for washing, minimizing the number of machines used for the corrosive process of ice washing.

*6. If potassium permanganate is used, manganese dioxide will form (a brown/orange color) and must be removed by treatment with sodium bisulfite, hydroxylamine sulfate, or acidified hydrogen peroxide as the reducing agent. Fill the machine with water and add 1-5 g/l of the reducing agent. Heat to 50◦C and run for 20 minutes. The process is normally repeated twice to ensure complete removal of the manganese dioxide. When sodium hypochlorite is used, the residual chlorine should be removed with sodium bisulfite or hydrogen peroxide. Adding jeans to machine already charged with afterwash chemicals will increase contrast.

7. Rinse well.
8. Repeat step 6 if necessary.
9. Apply softener.
10. Tumble dry.
11. Press, if required.

* The selection of sodium hypochlorite versus potassium permanganate depends upon the dyestuff and desired effect. Also, consideration must be given to the safety aspects of handling either chemical.

CELLULASE WASH

Cellulase enzymes have gained acceptance in the garment wash industry as a means to achieve a washdown appearance without the use of stones or with reduced quantities of stones. These enzymes are different from the alpha amylase enzymes used for starch removal in that they are selective only to the cellulose and will not degrade starch. Under certain conditions, their ability to react with cellulose (cotton) will result in surface fiber removal (weight loss). This will give the garments a washed appearance and soft hand.

PROCEDURE

1. Load stones in machine (normally 0.5 - 2.0 part weight stones: 1 part weight garments) if applicable.
2. Load garments.
3. Desize with alpha amylase enzyme and detergent.
4. Rinse.
5. Add cellulase enzyme (amount, pH, temperature, and cycle time dependent upon type of fabric and desired effects; manufacturer's recommendations should be followed).
6. Adjust pH as recommended.
7. Tumble 30-90 minutes.
8. Drain.
*9. Rinse well (70◦C).
10. Drain.
11. Rinse well (70◦C).
12. Drain. Separate garments from stones if used (garments can be transferred to another machine).
13. Apply softener.
14. Extract and unload.
15. De-stone and tumble dry.
16. Press, if required.

After step 7, a chlorine bleach may be used as described in STONEWASH WITH CHLORINE.

* The increase in temperature serves to deactivate the cellulase. pH adjustment to 9.0-10.0 with soda ash can also be incorporated. Some operations use both the increases in pH and temperature.

SUPPLIERS OF ENZYME PRODUCTS FOR STONE WASHING/STONELESS STONEWASHING AND/OR ENXYMATIC DESIZING AGENTS

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Charlotte, NC 28216
(704) 395-6599

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140 Intracoastal Pr. Drive
Suite 404
Jupiter, FL 33477
(561) 743-8333

Icon International, Inc.
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Fountain Inn, SC 29644
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High Point, NC 27260
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(704) 588-8500

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PH: (312) 777-7477; or (800) 327-7430
Fax: (312) 777-9598

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Madad City, ID 83252
PH: (208) 766-4777

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El Paso, TX 79904
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(212) 563-3500

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El Paso, TX 79907
PH: (915) 591-5308

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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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