



QUESTIONS & ANSWERS

SUBTLE TO STRIPED: Sustainable Fashion With Cationic Cotton

CATIONIZATION

- **Is there any test to measure the level of cationization?**
- **How do you tell the cationization degree?**
- **When you talk about cationization degree, is it measure from 1 to 10? What is the range?**
- **What do you mean with the cationization degrees?**
- **Does the cationization have a due date?**

The methodology used to determine the level of cationization is by nitrogen analysis. The amount of nitrogen applied to the fabric can be calculated. The level of nitrogen fixed onto the cotton is determined by a Kjeldahl nitrogen test or by a combustion technique. The Kjeldahl technique is more accurate in my opinion. The higher concentration of cationization reagent applied and fixed onto the cotton, the higher percent of nitrogen is found on the cotton. I have not seen a percent of nitrogen over 0.5%. Once the cotton is cationized, the charge is permanently covalently bound and does not go away.

- **How is the cationization process done and how expensive is it?**
- **Which product do you use to do the cationization?**
- **Is the CHPTA available and, if so, can I do the cationization in my plant?**
- **What is the company we need to contact to get the CHPTAC?**
- **Can I do the cationization on a yarn package?**
- **Can I do a cationized yarn by using regular cotton?**

Cotton can be modified at any substrate stage; fiber, yarn, or fabric. Typically, the yarn supplier treats in fiber form. Exhaust treatment and cold pad batch treatments are the most common. The efficiency of the cationization is strongly dependent on the liquor ratio. Because of the small amount of water used in cold pad batch (~1:1 as compared to 8:1 or so in an exhaust treatment), the efficiency of the cold pad batch treatment is much higher and so the cost is less. CHPTAC or quat 188 is the cationization chemistry. It is easily obtained from Quab Chemical or Dow Chemical. We can provide contacts for both on request.

- **What is the cost of cationic cotton vs regular cotton and polyester?**

This is a complex question because cationic cotton can be made to use in the mill or bought from a supplier. For a baseline, if treating in the mill, a fair market price of \$1.50-2.00 a pound for CHPTAC can be utilized. There is an upfront cost to utilizing cationic cotton, but there is a potential for cost savings. A conventional piece dyed fabric can realize substantial cost savings, but of course this is dependent on the shade and dyes used, the equipment, and processes being used. Now that reactive dyes have seen a substantial price increase because of the crackdowns on dye intermediates, the potential for cost savings is even greater. We would encourage you to speak to the suppliers for exact costs, as Cotton Incorporated does not sell the yarn and cannot determine how much a mill charges for the technology. Please ask the mills what they charge for cationic yarn versus the same yarn in untreated, regular cotton for a fair price comparison. I would recommend reading this article we wrote on the topic: [Cationic Cotton, Reservations to Reality](#). One of the objectives of this paper was to try to quantify both the environmental and monetary savings from using cationic cotton. We did this by cationizing cotton and then dyeing it and comparing to conventional dyed cotton. It is more difficult to compare cost and consumables for producing fabrics with stripes, etc. because the processes are different.

- **How good is the reproducibility lot to lot when doing the cationization? How reproducible is in the shade and the color matching when using cationic cotton, in particular on solid shades?**
- **How controllable is the cationization degree from lot to lot as to ensure the same shade lot to lot?**

The cationization process is easily reproducible and controllable. However, like any process, the reproducibility is only as good as the control on process parameters from batch to batch. However, the caveat with cationic cotton is that if the cationization is not uniform, the dyeing will not be uniform. One advantage of cationic cotton fiber treatment is that bales of cationic fiber can be subsequently mixed as would a traditional lay down to obtain further uniformity of treated fiber.

- **Could the cationization process eliminate the barre problem due to RD?**

I have seen evidence that cationization process slightly improves the maturity of cotton fibers.

DYEING PROCESS

I recommend reading [this paper](#) we recently published about dyeing cationic cotton. We are working on the second part of this paper. We have identified an effective dye retarder for cationic cotton as well.

- **Does cationic cotton look differently on greige state than regular cotton? Is it whiter or the same tone? Is there a need to use a washable tint to differentiate it?**
- **How do I differentiate the regular vs the cationic cotton on greige state?**

Cationic and untreated cotton look the same. A fugitive tint such as a cationic dye is sometimes applied to cationic cotton to differentiate between untreated cotton. The cationic dye will wash off.

- **Do the scouring and bleaching processes adversely affect the cationic cotton?**
- **Since the cationic cotton has a positive charge, do I need to change my dispersant agent or any other chemistry used on the preparation to dye the yarn or the fabric?**

Peroxide bleaching of heavily cationized cotton does cause strength loss of the cationic cotton. Research is ongoing in this area. Other preparation processes such as scouring do not cause a problem. In general, there is not a need to change preparation chemistry.

- **Which is the average reduction in cationic dyeing time vs traditional time for a certain tone?**
- **How much in percentage is the reduction in energy when dyeing cationic vs regular cotton?**

The reduction in time and consumables such as water, steam, and energy are dye and machinery/process dependent. In general, I would say dye time may be cut by 1/3 or more depending on the dyes, process, and equipment used.

- **What happens when the cationic cotton is mercerized?**

I am not sure what would happen if cationic cotton is mercerized. Here are some papers we wrote on mercerization and cationization: [Paper 1](#), [Paper 2](#)

- **Do we need a specific type of reactive dyes from any specific dye company?**
- **Which cares should be taken for a tricomy or a bicomy?**
- **How is the cross dyeing - regular dyeing and the cationic dyeing on the same fabric? How do you avoid contamination?**

Regarding dyestuffs, directs, reactives, or even acid dyes can potentially be used. It is an experimentation process to evaluate fastness properties and dyeing performance on cationic cotton. For heather shades, no alkali should be used to prevent staining of the untreated cotton. Also, some dyes will stain untreated cotton more than others. In the case of full piece dyeings, we recommend some alkali to covalently bond the reactive dyes and improve colorfastness. Careful selection of dyes can minimize the staining that happens in the dyeing process when dyeing stripes or heathers.

- What happens if you first add a dye of certain color and then add a second dye of different color?
- When dyeing cationic cotton, isn't there any need to fix the color?
- Do we need to select specific ranges of reactive dyes (for example, VS, MCT) to ensure the reserve of the regular cotton when dyeing the cationic cotton? Because we can tint the regular cotton even when not using salt, so should we use VS or MCT dyes?

- Are there dyes to dye cationic cotton for denim?
- Which uses can this cationic fiber have on denim?
- Can I dye cationic cotton with indigo?
- Which are the potential advantages by using indigo dyes regarding the reduction of chemistry products?

The same dyes can be used for denim or heather or stripes or piece goods. Usually a cationic warp is prepared and then dyed while reserving the fill white. There is limited information on dyeing cationic cotton with indigo or other reduced dyestuffs.

- If I have different cationization degrees, how do I calculate the color percentage?

Matching the cationization level to the shade depth helps control the dye strike rate and also minimizes the treatment cost. If you are interested, please read this paper where we worked on a concept to predict the cationization treatment and dye formula to make cationic cotton versus conventional cotton: [Prediction of recipes for cotton cationisation and reactive dyeing to shade match conventionally dyed cotton](#)

- Can I strip the color from a cationic yarn? Can I do garment finishing?
- Can I over dye on a cationic yarn or do color stripping?

This would need to be investigated. I don't see a reason why cationic cotton could not be overdyed if needed, especially if the cationic cotton was overdyed with a conventional dyeing procedure with salt and alkali.

COLORS / TONES

- **Can cationic cotton be dyed on all types of colors and shades?** Yes, but some work is needed to develop full bleaches for bright shades on 100% cationic cotton that do not damage the cationic cotton strength.
- **Can the cationic cotton be dyed on all the colors?**
- **All the examples of your presentation were colored cationic cotton with a white regular cotton. Can I dye the regular cotton and the cationic cotton on the same fabric?** Yes, but not different colors. The cationic cotton would pick up more of the dye and have a tonal difference.

COST

- **Which is the cost increase/reduction with cationic cotton? In fiber? In dyeing?** There is a price difference for cationic yarns, but we would encourage you to speak to the suppliers for exact costs, as Cotton Incorporated does not sell the yarn and cannot determine how much a mill charges for the technology. Please ask the mills what they charge for cationic yarn versus same yarn in untreated, regular cotton for a fair price comparison. The up-front cost for the yarn can potentially be offset by cost savings in terms of less water, dye, or auxiliary chemicals (salt and alkali) used in typical cotton dyeing. There is also a potential cost savings in terms of quick replenishment of popular colors and the possibility to inventory a common supply of greige goods that can be dyed in small lots or garment dyed as needed.
- **Which is the cost difference at fiber level between regular and cationic cotton?**
- **How cheaper/more expensive is the cationic fiber vs the regular cotton?**
- **Which is the cost difference in US dollars and or percentage wise between regular, cationic and organic cotton?**
- **Comparable cost between regular and cationic cotton?**
- **Is the cost of cationic cotton competitive vs polyester?**

FASTNESS

- **Which are the color fastness levels for laundering with cationic cotton?** Colorfastness for cationic cotton is as good if not better than regular cotton. The only issues that come up are if a low depth of shade is dyed on a heavily cationized fabric, the dye is concentrated on the surface of the fiber and low lightfastness can result. Similarly, if a low depth of shade is dyed on a heavily cationized fabric, the dyed fabric may pick up fugitive color in laundering. We also recommend utilizing alkali to covalently bond reactive dyes to improve fastness properties on cationic cotton in full piece dyeings. Alkali should not be used on stripes or heathers
- **Have you tested the color fastness to laundering, crocking, and light?**

- **What is the color fastness to laundering, light, and sweat?**
- **What is the achievable color fastness level for laundering and light?**
- **What is the color fastness for laundering, crocking and light?**
- **How is the color fastness vs. regular cotton?**

where untreated cotton can be stained. On dark colors, the washfastness and crockfastness is generally better because the dyeing process is more efficient (less dye is required) and there is ionic and covalent bonding happening. In other words, there is less dye to remove and the dye that is fixed is attached by more than one mechanism.

IN-PROCESS PERFORMANCE

- **Does the cationic cotton run differently on the opening room, on carding or on the draw frame?**
- **What are potential problems on spinning when running this fiber?**
- **Do I need to control the cationic fiber as a regular cotton for a laydown?**
- **How the cationization process impact fiber properties such strength, neps, short fiber?**
- **Is the cationic fiber weaker than the regular one?**

Regarding opening and spinning etc., there have been no reported issues that I am aware of. The only potential issue would be contamination from untreated cotton. Having control of the lay down and further blending cationic cotton fiber would increase uniformity. I have seen evidence that the cationization of the fiber does remove some level of dust and trash and slightly improve the maturity. There is essentially no difference in strength of the cationic vs. untreated fiber.

- **Is it possible to use cationic yarns with spandex? Could the temperature affect the cationic yarn?**

This would need to be investigated, but I don't foresee any issue.

- **Does the cation fiber look different under the black light?**

No, not to my knowledge.

END-PRODUCT PERFORMANCE

- **Are the regular finishes the same for cationic cotton than for the regular cotton?**

Yes. I am aware of this paper by Morris, H., & Hauser, P. (2003): *The effects of a cationic reagent on typical finishes*. [AATCC Review](#), 3(11), 17-19. Here is the abstract: "The article studies the effects of the cationic reagent 3-chloro, 2-hydroxypropyltrimethylammonium chloride into the durable press finish or a solution of 80 percent active N, N'-dimethylol-4, 5-dihydroxyethylene urea and the flame

retardant finish or a solution of 78 percent active N-methyloldimethylphosphonopropionamide in cotton fabric. Test methods used are AATCC Test Method 110-1995 for whiteness determination, wrinkle recovery test, tear strength test, and flame retardancy. It shows that additional NaOH treatment increases the effectiveness of durable press finish while the strength and flame retardant treatment seems no effect. In addition, it emphasizes that the flame retardant finish mainly affects the yellowing of the fabric.” The only issue I would envision is the cationic cotton repelling a cationic softener.

- **Does cationic cotton offer the same hand, shine and drape as regular cotton?** Yes. Please see above article.
- **Does a garment having cationic cotton have the same comfort as a one having regular cotton?**
- **Is the hand the same? Can we apply all the finishes?**

- **Does the cationic cotton reduce fabric tear strength?** No. Please see above article.

- **Can we do TransDRY™ on cationic cotton?** This would need to be investigated.

- **Are the hydrophilicity and color fastness the same as regular cotton?** Cationic cotton maintains the same hydrophilic properties as regular untreated cotton.
- **Does the cationic cotton have a different hydrophilicity?**

- **Does the cationization affect the fabric shrinkage?** Not to my knowledge.

- **Does the cationization affect the bio polishing?** This would need to be investigated.