Sourcing the Best Cotton Products: Overcoming Shrinkage

WEBCAST QUESTION AND ANSWER

Can you explain about K-factors use to address shrinkage?	K-factors are based on the reference state of many fabrics of the same construction (i.e. single jersey), yarn type, fiber content, dyeing and finishing. If one knows the K-factor for this series of fabrics or others processed in a same manner, then the best fabric finished (delivered) weight and width can be chosen to achieve a particular shrinkage specification.
Isn't the shrinkage capabilities more visible on newer products that are freshly washed - as opposed to something older?	The first cycle of laundering and tumble drying will yield (reveal) about 90% of the shrinkage in a cotton or cotton blended product. After 5 cycles all the shrinkage in the product will be realized. A product should be dimensionally stable after those five launderings.
When you talk about cotton, is that specific to 100% cotton or cotton blend type products as well?	The impact of construction and the de-swelling of cotton with mechanical action in drying will affect cotton and cotton blends. In general, any blend at 50% and above of cotton will behave as 100% cotton in terms of shrinkage. However, the more the synthetic fiber (that does not swell), the less the shrinkage.
What are the main key factors to improve shrinkage in Rib 1X1, Rib 2X2 and Single Pique 100% cotton?	These ribs and pique fabrics differ by the type of knitted stitch that comprises the fabrics. In the ribs, the key factors in shrinkage control are a tighter stitch length, the proper yarn size to give a desired weight at that stitch length, and the proper finishing width to give a balance shrinkage. Determining the right stitch length and width are critical due to the tendency of ribs to distort due to their high extension in the width. With Single Pique, the use of held and tuck stitches cause the fabric to relax to a much wider than fabric without tuck stitches. This results in the need to finish at the width that will allow for balanced shrinkage. Stitch length, of course, is the most important aspect to control; however, in single pique the construction has feeds alternating all jersey stitches with feeds of jersey and tuck stitches. The ratio of the all jersey feed to the jersey/tuck feeds controls shrinkage, hand, appearance, weight, and strength. This fabric has very little elongation/stretch as compared to the ribs.
Most STRECH denims have spandex, so they are sensitive to heat. How much shrinkage factor above 1% (for normal yarns)?	Does normal mean non-stretch? If it does, then the use of corespun and other stretch yarns with spandex in the filling direction can greatly increase shrinkage. The level of shrinkage and of course the recovery/growth is affect by the heat setting conditions for the spandex. The level may be much more than 1%. If the garment is to be a 'skinny' jean or a silhouette fitting jean, the width shrinkage is not as critical
Denim with STRECH = Ideal Cover factor?	The ideal cover factor for any product is dependent on the desired finished weight and width. Adding stretch to the analysis as related to the 'fit' of the denim will greatly impact the 'ideal cover factor'.
Can you explain how to calculate cover factor again?	Fabric Cover Factor = Warp cover Factor + Weft Cover Factor Warp Cover Factor = EPI (Ends per inch)/Square Root of Warp Yarn Number) Weft Cover Factor = PPI (Picks per inch)/Square Root of Filling Yarn Number)

How to decide which is the optimum cover factor?	The optimum cover factor for a woven fabric is dependent on the weight of the fabric and the width of the fabric. Changing the cut-and-sew width to a wider spec. will result in a lower filling cover factor and therefore more width shrinkage and weight per square area. Reducing the number of filling yarns to improve production efficiency will lower the cover factor, decrease the weight, and increase length shrinkage. As a result, the optimum cover must be based on the desired specifications of weight and width.
How does the shrinkage concept play into knit garments than that of woven?	As discussed, knit fabrics are MORE OPEN than woven fabrics thereby yielding more shrinkage than wovens.
What is the optimum shrinkage expected in 100% cotton jersey, rib 1X1 and single pique fabrics, oz Wt between 4.0 to 6.0 Oz?	This is too broad of a range to choose an optimum shrinkage. The question should be, "What is the optimum weight and width for a specified shrinkage such as 5 x 5%. With a 5x5 spec, the proper yarn count and stitch length can then be chosen to achieve the desired weight and width. As mentioned in an earlier Q&A, Single jersey, ribs, and pique fabrics perform quite differently because of the types of stitches and the geometry of those stitches. The jersey and pique are single knits and the ribs are double knits. Potentially, the ribs have the most shrinkage, followed by the piques and then the jerseys. These fabrics cannot normally be finished at the same width for cut-and-sew to achieve the same shrinkage.
Recommendations to control shrinkage for 10% cotton rib fabric/ garments?	In my experience, the best way to finish rib fabrics to control shrinkage is to find the reference width (through the reference wales per inch and number of needles in the fabric) and finish the fabric for cut and sew that is 5% wider than the reference width. This will help control the growth in the width of the garment during wear. The stitch length should be tight to reduce the length shrinkage to meet the width and width shrinkage.
Is it possible to have zero shrinkage during the relaxed state?	It is very difficult to achieve 0% shrinkage from relax drying only. This is easy to prove in that the tumble dryer in testing labs and in consumer homes with all its mechanical action cannot take out all the shrinkage in one cycle. Adding compaction to relax drying can achieve very low shrinkage numbers; however, it is not practical from a production yardage consideration to have 0% shrinkage as it would severely reduce the number of yards per pound of yarn.
I want to clarify, is it the mechanical agitation in a home washer/dryer that makes the fabric shrink, not the heat?	It is mechanical action in all forms of drying and not the heat that shrinks cotton and cotton blended fabrics. Fabrics containing spandex some shrinkage from heat as heat affects the spandex only.
In light fabric, we have noticed that the major loss of CPIS occurs on the pad, what do you recommend?	When fabrics go through a finish padder, the fabric changes directions many times during the fabric thread-up, immersion, and subsequent thread-up of the tenter or other dryer. To change the direction of the fabric it must turn around machine rollers, scroll rolls, and web openers. Each time this take place the fabric is used to turn these rollers. Wet fabrics will stretch in the length (lose CPI) before they exhibit enough force to turn the rollers resulting in a fabric further from it reference state. Therefore, more shrinkage. The lighter the fabric, the more stretch, the less the CPI, and the more the length shrinkage.
Is the shrinkage percentage an average of length & width?	Shrinkage numbers are for one direction only. Each direction must be measured and listed separately. These numbers are not added to each other to give the shrinkage. For example, 5x5% would mean 5% in the length and 5% in the width.
Is a cover factor of 24.7 applicable to all woven fabrics as a desirable level to minimize shrinkage? Is there a test for this available with testing institutes such as SGS etc.?	No, it would only relate to a specific construction that would be dependent on yarn numbers, thread counts, and finished width. Cover factor is used by mill people to produce the best product for them. Testing labs should be testing for weight, shrinkage, and other parameters such as strength. The cover factor shown in the presentation was for that plain weave with those yarn counts in the warp and filling, and not necessarily for other constructions and yarn sizes.

How can you control growth on 100% Rayon jersey?	This is not a cotton question; however, I suspect that due to the high elongation of rayon fibers and the lower cohesion of rayon fibers one-to-another, that the potential for growth would be increased.
Would it help to cut pique on the cross grain?	No.
If we receive a test report with shrinkage outside out tolerance, what is the 1st steps we should take with our suppliers? If fabric is already complete, what can the supplier do to really improve the shrinkage?	First question: if the test report is a production lot, how does the reference weight and stitch or thread counts differ from the reference weight and counts of the pre-production approval sample. If they are the same then the supplier must be told that the fabrics were not preshrunk as much as the approved sample. If the reference data for the pre-production and the lot out of tolerance are not the same then the supplier has changed the way the fabric is made which is causing the shrinkage problem. This should be communicated to the supplier that they have indeed changed the product and not in your favor. They should be told that the product should not be changed causing shrinkage problems. Second question: If the fabric is already finished, at the sewing plant but not cut and sewn, then the markers for cut-and-sew must be adjusted. This is the cheapest, fastest, and best option. If the goods are still at the mill, then they can be further compacted to reduce shrinkage. If they have already been cut-and-sewn, the garment washing is an option; however, the labeled sizing might not be accurate. In summary, to increase the shrinkage means more yards for cut-and-sew and more garments. Therefore, you must monitor the shrinkage and reference weight and thread/stitch counts to see if the production has been changed.
Can you explain why Sanforization consistently works to prevent shrinkage?	Sanforizing is a tradename for compressive shrinkage, and this term is now been used to cover compaction in general. This is a physical process that forces the fabric to shrink upon itself. If done properly, the fabric surface will not be changed. It has been my experience that the use of compaction cannot be the only means to control shrinkage as it generally will not remove much more than 50% of the shrinkage in the fabric prior to the process. Another way to look at this is that compaction is the increasing of the cover factor of the woven and the tightness of the knitted fabric.
Can you discuss how fabric relaxation after spreading for cutting affects shrinkage? How is shrinkage best controlled in the cutting room?	Question 1: in order to spread (roll out) the fabric on a cutting table, there normally is some gain in length (stretching) and loss of width. As the layers are placed one on top of the other, the ones on top will relax more in the width than the ones underneath. It is recommended that a little linear tension as possible should be placed on the fabric during spreading. Also, at least 8 hours (12 preferred) be allowed for the fabric layer stack be allowed to relax from the spreading stresses. Also, this will allow for moisture regain which allows for better sewing efficiency. Some cutters are 'die' cutters that punch one set of markers at a time (often used in t-shirt plants. These machines cut one layer at a time and are often more consistent in distortion. Question 2: In addition to the above, it is preferred to cut tubular knits in a folded configuration and all others from rolls. It is best to not do roll-to-roll inspection (after finishing) of knitted fabrics since this often applies significant linear stretching in the fabric and more length shrinkage and loss of width. Also, determining the best width for cut-and-sew is critical for balance shrinkage.

How can we can control the shrinkage on fabric filling 88 PE / 12 Elastane because during sanforizing we have different shrinkage along the fabric?	Since the type of fabric (woven design, yarn dyed or piece dyed, cotton warp or other fiber) is not stated, it is very difficult to make many observations. However, several general observations can be made. - Sanforizing does not improve filling shrinkage on any fiber content. - Variant shrinkage in the warp after compaction often relates to the fabric not having uniform moisture going into the compaction range. The proper level and consistency of moisture is critical for proper compaction. Residual moisture in the fabric after compaction can also be important. Another impact of inconsistent moisture in the fabric is a 'slip/stick' phenomenon that results in short term inconsistency in shrinkage. - Improper application of softener can also have an effect on inconsistency. - The addition of a 88/12 PE/Elastane filling yarn (depending of the fabric) could contribute to the problem due to the synthetic fibers not absorbing moisture. It might also affect the application of softener and type of softener. - Is the fabric compacted on the warp side or the filling side (plain weave, twill, etc.) Again, we need more information on what type of fabric is being compacted.
Can cotton be set at a certain temp. like polyester?	As stated in the webinar, cotton is not stabilized by heat. Heat in drying has no impact on cotton shrinkage. High levels of heat in heatsetting blends of PE and Nylon with cotton has no impact of shrinkage or shape retention; however, high levels of heat can cause cotton to have reduced absorbency, can cause yellowing, and can cause a drier hand.
Is there an optimum process route and cross linking softener that sold be used to reduce shrinkage?	There are so many different types of processes and machines that can be used to process cotton and other fabrics that no particular sequence can be given unless a product is defined. However, in all processes the linear tensions must be reduced to the lowest levels to keep the fabrics as close as possible to their reference state. After relaxed drying, the goods can be compacted with simple softeners, or they can be crosslinked with a resin and catalyst system which are not softeners. If crosslinking is used to prevent shrinkage and give other desirable properties, it is done on fabric after all other processing has been completed. It is critical to realize that crosslinking is not a 'magical potion'. Typically, crosslinking will not remove more than 60-70% of the moisture going to the process.
What is a standard shrinkage allowances for 100% cotton?	Impossible to give a standard for all the sundry types of cotton products.
Do you have an opinion on whether it's better to launder before or after cut & sew?	If laundering means to wash in a relaxed state and tumble dry, this is not practical for piece goods due to the high costs and labor involved. However, this is commonly done by people who buy fabric from fabric stores and do their own 'cottage' cut-and-sew.
How can we know how much the yarn affects shrinkage....what happens if the yarn mill gives more stretch to the elastane on corespun?	First part: cotton yarn shrinkage is not a factor in fabric shrinkage. The application of yarns that are heat settable like polyester, nylon, and elastane can affect shrinkage. Second part: in spinning, knitting and weaving, it is common for the elastane to be stretched or drawn before and during use. When the stress is removed the elastane shrinks or compresses to a planned degree and results in desired stretch and recovery properties. In making a corespun yarn, the more it is stretched (drawn) in spinning the better the recovery from use; however, the greater the shrinkage when relaxed. The use of heatsetting of fabric made from these yarns can render a reproducible result.

How much shrinkage variance is there between a sample load and stock load (using the same exact fabric, wash method and chemicals)?	It is assumed that 'load' means washing machine load. If so, AATCC, ISO and other testing organizations have performed very exact case studies and 'round-robin' evaluation that have determined that in order to get consistent results the load size (specimen and ballast) is clearly defined. My actual experience is that overloading the dryer with too much fabric can affect the level of shrinkage of the tumbling. It is highly recommended that only specimens of the same fabric type are processed together.
Can you explain what type of cross linking chemicals can you use to improve shrinkage? Can you strip the dye stuff if you need to rework the batch due to a dyeing defect?	The most common crosslinking agent used is DMDHEU in a capped form. It is a glyoxal type resin containing formaldehyde. The levels of formaldehyde release is extremely small if used properly. To be used, a catalyst must be added. Since it is compatible to most softeners, a wide range of softeners can be used. 'Stripping' of dyestuff is a common procedure for dye lots that are off shade. If the shade is not reparable, it can be overdyed to a darker shade, usually black.
How important is it to test each and every fabric lot to understand the complexity of the shrinkage and the importance of creating a new pattern and/or marker if needed?	Testing of the development sample, the pre-production and first production lots is critical to understand where the relaxed state of the fabric is. If there is variance between these lots, then there is a problem with that supply chain of company(ies). The last thing you want is to have to change the markers every time you get a new lot. As was stated in the webinar, when a lot is tested for shrinkage, the washed samples should have the relaxed weight measured as well as the stitch or thread counts.
Thermo heating relation with shrinkage in spandex fabric, could you explain it please.	In these blends, heat setting is only effective on the spandex; however, there is normally not enough spandex in the product to stabilize the fabric against shrinkage. The amount of heat and time can drastically affect the stretch and growth properties of the fabric. As stated, the heat does not affect the shrinkage of the cotton product.
What if the shrinkage is within tolerance in Fabric form; but then the garment shrinkage is outside of tolerance after cut-and-sew?	If the garment is sewn from the same lot of fabric that was tested, then the cut-and-sew process is stretching the fabric creating shrinkage. This could also happen if the markers were not properly oversized. Also, some lots of finished fabrics have a wide range of shrinkage within the same lot due to non-control of tensions in processing.
Can you tell by looking at the tightness of the stitch whether the garment will shrink?	No. The tightness factor is based solely on the yarn count and stitch length of a fabric at knitting. It is an indication as to the openness of the fabric. It does not include the impact of processing tensions or chemical interaction with the fabric. Also, it does not tell the reference state, only the delivered state. Therefore, the knitted state is not the fully relaxed state. One would have to know what the delivered state and the reference state to determine the amount of shrinkage. Further, if I have two fabrics made with the same yarn but with difference stitch lengths I can expect the tighter fabric to have less length shrinkage and heavier reference weight.
We make woven shirts. The mills guarantee us +-3%. To further eliminate shrinkage at consumer level, we garment wash. Is there a difference between warm wash/warm tumble or hot wash/hot tumble. Will the later gives us more shrinkage?	This means you oversize then garment wash planning to get the correct weight and shrinkage. Hot washing 100% cotton fabrics does not result in more relaxation than lower temperatures. Neither does hot tumbling. Heat has no impact on the amount of shrinkage, it only controls the time it takes for the fabric/garment to dry. The amount of shrinkage is determined by de-swelling in a tension free state with large amounts of tumbling (mechanical action). Also, hot washing only uses more energy.

What about shrinking after line dryng when flat versus on a hanger?	Most consumers know that if a garment is allowed to flat-dry or hang-dry versus being tumble dried that the product will shrink less. This is because there is no mechanical action to consolidate the fabric in the garment. Hang drying allows for the moisture in the garment to evaporate more quickly but not shrink more or less. Sweaters can be exceptions to more/less shrinkage in flat or hang drying as the weight of the sweater may elongate the fabric in a vertically dried garment.
Do you believe that an enzymatic process performed in garment after a pigmentation dyeing could shrink more than a t-shirt that didn't suffer this enzymatic process?	Certainly if the garment that is enzyme treated is tumble dried, it will have less shrinkage than a garment not tumble dried. I have seen comparisons of a garment not enzyme treated compared to one that was enzyme treated showing less shrinkage due to the enzyme; however, at Cotton Incorporated we put one shirt through the enzyme and another through the same process but without the enzyme and found not difference in the shrinkage; however, the weight was reduced due to the enzymatic action.
Can I reverse shrinkage caused by over-drying?	Shrinkage is not caused by over-drying, it is caused by the de-swelling and mechanical action in the dryer. Other than physically pulling a fabric/garment to return them to the delivered state before drying, I know of no way to 'un-shrink' a fabric. Even if one was successful in restoring the fabric, it would only shrink back to its reference state when subsequently washed and tumble dried.
Can you achieve a better garment shrinkage vs. what the fabric was delivered at with no wash/tumble...for instance, just through proper handling of the fabric, as well as proper pattern making. For example...if you fabric is delivered at 5x5, what is garment??	Normally, garment manufacturing does not improve the shrinkage of the fabric, nor should it significantly increase the shrinkage. If a fabric shrinks 5x5%, then the garment process with proper tension free handling and some oversizing should keep the garment at 5x5 or lower. A big problem in getting garments to very low shrinkages is that both the mill and the apparel manufacturer want as many garments as possible from the yardage they buy.
If zero shrinkage is not possible to cotton product, what will be the minimum shrinkage that's commercially possible?	It is possible to get satisfactory shrinkages, but it requires more costs and attention to construction and processing. For most knits a 5 to 8
why do garments not completely shrink during first wash and instead continue to shrink after several cycles?	It is the fabrics that shrink, and the first wetting and tumble drying cannot provide enough mechanical action to remove all the shrinkage. However at least 90% is removed. After three cycles of wetting and tumble drying will remove over 98% of the shrinkage.
Is a cross linking durable softener as effective in controlling shrinkage as the cross linking resin you mentioned?	There are softeners that can be reacted with cotton such as epoxy silicones, reactant silicones and others, but the reaction only makes the cotton softer with durability, but do not control the fiber swelling that leads to more crimping and shrinkage in the presence of mechanical action. Cross linking resins prevent the high levels of fiber swelling thereby controlling the shrinkage.
We use a conveyor dryer and suction drum dryer. We see good results in the rib and jersey fabrics as far as length. Our jersey however exhibits more torque. Should we stay with the suction dryer as far as jersey fabrics?	I would always stay with the relaxation dryers because they do shrink the fabric. The skewness is related to the relaxation of the twist in the yarns causing the loops in a knit fabric to distort and lean. This skewing has its own reference state and will get there with <u>any</u> wet process and does not need drying to cause it to happen. Any single knit fabric with singles spun yarns will torque. Rib however is a double knit and torqueing is less of a problem. Torque becomes a problem when the fabric is not allowed to torque or the torque is taken out usually on a tenter frame. The torque does not show up in garment manufacturing but certainly will occur in laundering. Cotton Incorporated has an excellent technical bulletin, TRI-2002 Knit Fabrics and the Reduction of Torque and can be downloaded at www.cottoninc.com under products – technical bulletins.

If you already wash a product which would be the expected shrinkage if you need to reprocess?	Are you talking about a fabric lot failing shrinkage and you rework that lot? Or are you talking about a garment that has already been garment washed, what would be the shrinkage after reworking? In either case, washed fabric if tumble dried would be a 'delivered' state and not the reference state. If reworked it could be either closer or further away from the reference state and the shrinkage could be better or worse.
For the question posed- how does this work for accessories like ties? Can fabrication for ties be washed before produced?	Whether a tie or some other product, if made of cotton, the same shrinkage dynamics take place. If the washing does not affect the surface appearance of the tie, the lower shrinkage would take place. By the way, who washes ties?
Why if the fabric growths first time you washed it, does it continue to grow the next time you wash it?	1. Growth almost always occurs in the width and almost always occurs when a fabric is finished below (less than) its reference state. This is normally caused by an improper width specified for cut-and-sew. 2. It can also occur on fabrics that have a very high length shrinkage which can force the width of the fabric to grow. In this latter case, the high length shrinkage pushes the width out. Normally with subsequent washing, the fabric will exhibit some width shrinkage. This is typical of some pique knits that have a large number of tuck stitches. However, these types of knits are often finished at or below their reference state making it hard to reduce the length shrinkage.