WOOL AND COTTON BLENDED PRODUCTS TECHNOLOGY AND MARKET REVIEW

Parvez Mehta
American Wool Council
Englewood, CO

Abstract

Technical refinements in the production of wool/cotton blended fabrics are reviewed. The major challenges facing industry today are not in the technical aspects of production but in creating consumer awareness through brand promotion and in merchandising innovative products at a acceptable value-added price point.

Introduction

Wool and cotton are two of the most widely used natural fibers in apparel today. Cotton is known for soft touch and next to the body comfort. Wool is known for shape retention, durability and warmth. Blending of these two most desirable fibers in a apparel product offers marketing opportunities to expand consumer demand for both fibers. Because of the fibers' very diverse chemical properties and physical characteristics, wool/cotton blended fabrics present a technical and manufacturing challenge to industry. Nevertheless, wool/cotton blended fabrics have been produced commercially for a very long time and are available at retail today in an increasing number of innovative products. This paper reviews some of the commercial options available to manufacturing industry today.

Review

US Production of Wool Fiber

Wool is produced in all 50 states of America to 62mlbs annually. This (34mlbs on clean weight basis) represents about 40% of the domestic mill demand. Most of the wool produced is sold through a close bid auction by warehouses and wool pools during April through July period. The wool types produced range from very fine (18micron) to quite coarse diameter (35micron) fibers but the bulk of production is in the 19-26 micron range which is suitable for lightweight apparel products.

Wool Fiber for Short Staple Industry

Some 9-12mlbs of wool is used annually by the short staple processing industry in the US where wool is blended with other fibers such as polyester, viscose and cotton.

The primary suppliers of appropriate length wools suitable for short staple spinning are the commission wool top makers. The wool is first scoured and converted into top. It is either then cut or stretch broken to a 2" staple length. The average fiber length so produced is 1½ inches. Because of the additional process of cutting or stretch breaking involved, this route is obviously more expensive than producing short fibers by more frequent shearing of sheep. Sheep sheared twice a year or three times in two years offer staple lengths of around 2 inches. This method however is not widely practiced due to a lack of broad market demand. Short fibers are produced mainly in Texas for a specialized felt trade at the present time. The former option has the advantage of a more consistent fiber supply and of being free of vegetable matter.

The presence of vegetable matter in shorn wools is an obvious disadvantage for blending with cellulosic fibers such as cotton or viscose as such impurities cannot be removed from the blend by acid carbonizing. A recent study at Texas Tech.University has shown that carding of VM contaminated wool on a Tandem cotton card removes almost all of the vegetable matter. The residual VM measured was as low as 0.008 percentage. Alternatively, early shorn wools may be scoured and carbonized before blending with cotton.

Wool in Short Staple Spinning

Wool introduced in cotton by blending in a blow room is currently the most widely used procedure. This method is also most cost effective when the production run at a given blend level is large (10000lb lot). The other approach is blending wool and cotton fibers in the draw frame. The draw blend approach offers flexibility in blend composition and is more suitable for short production runs. Stretch broken wool top would be the preferred choice for blending in the draw frame. Three passages through draw frame are required for a uniform blending of wool and cotton.

There is substantial expertise available on settings required for cards and draw frames and will be happy to provide details if required. With either of the above two blending systems, a higher concentration of antistat and moisture will improve production efficiency. The blended rowing can be spun on any of the available spinning systems such as ring, open-end, air jet or friction. Although wool in 100% form can be spun on the short staple ring spinning system, usually wool is a minority component (20-40%) in the blend with other fibers in short staple spinning. Depending on the blend composition and the spinning system used, yarns as fine as 36Ne are produced and successfully woven as singles both in warp and in filling.

Two other methods of producing blended yarns are worthy of mention here. One is plying of wool yarn with cotton yarn. The combination of twist levels and the direction of twist in plying, offer a variety of novelty yarns in a multicolor twist effect. Another interesting option is to introduce fine cotton yarn during spinning of wool yarn. The cotton yarn is introduced behind the front roller of the

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:767-769 (1998)
National Cotton Council, Memphis TN

ring spinning frame. Some worsted wool spinning mills successfully exploits this option.

Wool and Cotton Woven Fabrics

Wool/cotton intimately blended yarns are significantly weaker in strength than all cotton yarns. However, in spite of this weakness the yarns weave quite satisfactorily because of much higher value of elongation at break of the blended yarns.

The singles warp is usually sized either with a 100% PVA size or with a 50/50 PVA/modified starch mixer. This allows for easy removal of size in hot water without resorting to a high alkaline desizing procedure usually required for all starch size. The size is applied either on a section warp or on a traditional beam to beam slasher to a slightly higher concentration of size than that used for cotton warp yarns. Plied yarns may be woven satisfactorily without sizing.

A majority of commercial wool/cotton fabrics available today uses 2/20Ne count yarn in warp and in filling for bottom weight apparel, a shirting weight fabric using 1/36Ne yarn is worthy of consideration.

Another popular option for wool/cotton blended fabrics is the use of 100% cotton warp yarn with 100% wool yarn in the filling. This is a much more cost-effective option as it uses readily available yarns without resorting to special upstream procedures in blended yarn manufacture. Additionally in fancy woven fabrics using package dyed yarns, the use of more complex dye formulations can be avoided.

Wool/cotton Fabric Finishing

The fabric-finishing route would depend on the amount of wool present in the blended fabric. Wool deforms easily when wet and requires a high-pressure steam treatment for setting. If the wool component in the blend is 20% or less, then the fabric is usually processed as a all cotton fabric as long as the concentration of alkali in the bath does not exceed pH of 11 over a prolonged period. For fabrics of higher wool content, it is recommended that the fabric be scoured in a neutral or a slightly alkaline bath and desized in a open width scouring range. If fabric bleaching is required, hydrogen peroxide bleach as opposed to hypochlorite bleach is used. A shallow beck, a soft flow jet, or a pad batch range can be used for fabric piece dyeing. Since fabric distortions occur relatively easily in wet wool fabrics, frame drier with good length overfeeds is more appropriate than can drier. Fabric shearing is necessary to maintain pristine appearance in use although pilling is not a problem in wool/cotton woven fabrics.

Finally, some form of final steam finishing such as sanforizing or decatizing would improve fabric drape and touch.

Optional Finishes for Wool/Cotton Blended Fabrics

Liquid ammonia treatment (Sanforset Process) developed for cotton to improve strength, dye uptake, crease recovery, dimensional stability and luster by creating intra-fibrillar swelling and redistribution of hydrogen bonds in cellulose can be applied to wool/cotton blended fabrics.

In a study where a 100% wool fabric was subjected to liquid ammonia treatment, the results showed no deleterious effect on wool and as expected a substantial improvement in properties of a 50/50 wool/cotton blended fabric. The fabric showed a marked increase in tensile strength and abrasion resistance and a significant increase in crease recovery and dimensional stability.

Durable Press Finishes available for cotton fabrics can also be applied to wool/cotton blended fabrics. All resin types were found suitable giving a high durable press rating values. Whilst 10% resin solids is a typical application level for cotton, the amount of resin can be reduced with increasing wool content in the blended fabric. Resin systems that cure at lower temperature (less than 320 F) are preferred to reduce thermal damage to wool.

The most important consideration in the application of resins is the type and concentration of the catalyst used. Wool is a scavenger for acids; therefore, either a higher concentration of catalyst or addition of citric acid is required in the resin pad bath. Of the hydroxy acids tried, the best results were obtained with magnesium chloride in combination with citric acid.

Machine Washable Finishes. Of the various shrink resist processes available for application on wool fabrics, Synthappret BAP (Bayer) is widely used. The resin is a self cross-linking polymer containing carbamoyl sulfonate groups that react readily under alkaline conditions. Such resins are equally effective on wool/cotton blended fabrics when the wool component is greater than 40%. With 20% wool in the blend, the resin types more appropriate for cotton is recommended.

Summary

There are several options available to industry for producing wool/cotton blended fabrics. Such fabrics are produced globally and are available at retail. Industry and trade associations for wool and cotton have been active in refining technology and developing innovative product ideas. However, consumer awareness for such products continues to be low. The future success of this consumer desired natural blend would depend more on product marketing and promotion at the consumer level than on additional efforts in refining available technology for wool and cotton blended products.

Effect of Liquid Ammonia Treatment on Fabric Properties

	All wool		50/50 wool/cotton	
	Untreated	Treated	Untreated	Treated
Tensile Strength, g	203	202	185	243
Extn. at Break, %	31	38	19	29
Abrasion Resistance, rubs	43000	43000	17000	28000
Crease recovery, angle	335	332	270	290
Shrinkage (10 washes), %	5.0 x 3.0	3.5 x 2.0	2.0 x 4.0	2,5 x 0.0

Effect of Catalyst Type and Concentration on DP Rating

Catalyst		DP Rating (AATCC 128/1980)
Type	Conc.	
None	0	1.9
Zinc nitrate	0.7	2.2
Zinc nitrate	1.5	2.8
Magnesium Chloride	3	3
Magnesium Chloride plus Citric acid	3.0 + 0.14	3.3
Magnesium Chloride plus Glycolic acid	3.0 + 0.14	3.5