Utilization of Short Wool on the Cotton System of Yarn Manufacturing

By

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The consumption of wool in the United States has dropped from 317.5 million kilograms (700 million pounds) in 1950 to a scant 49.9 million kilograms (110 million pounds) in 1978. In the last decade the wool consumption of U.S. mills has declined from 108.9 million kilograms (240 million pounds) in 1970 to 49.0 million kilograms (108 million pounds) in 1977. Domestic production of wool has dropped from 73.3 million kilograms (161.6 million pounds) in 1970 to 45.9 million kilograms (101.3 million pounds) in 1978. One consoling fact that emerges in this brief overview of the state of the U.S. wool industry is that wool has managed to maintain a fairly constant share of the total fiber consumption since 1973, this being approximately 1%. (See Table 1.)

It is noteworthy that from 1974 to the present time, the total of all fibers as well as the fiber ratios processed on U.S. woolen and worsted systems has also been fairly constant. In order for the U.S. textile industry to consume more wool in future years, it appears that one or more of the following conditions must be caused to prevail. First, wool must control a larger share of the existing capacities of woolen and worsted mills; secondly, the woolen and worsted industries must

TABLE I

U.S. FIBER CONSUMPTION, 1950-1978*
(Millions of Pounds)†

FIBER TYPE	1950	1960	1970	1978
Non-Cellulosics	135	650	3800	7750
Cellulosics (Man-Made)	1400	1100	1600	860
Cotton	4800	4200	3900	3045
Wool (Scoured)	700	490	280	110

*Source: *Modern Textiles*, Vol. LX, No. 3, p. 40 (March, 1979)
†Multiply by 0.4536 to obtain millions of kilograms

TABLE II

RAW MATERIAL CHARACTERISTICS

Wool:

FIBER PROPERTY	TEST METHOD	CUT TOP	6 MO. SHORT SHORN
Mean Diameter (μm)	Maturimeter	22.07	22.15
Mean Diameter (μm)	Microprojection (ASTM D2130)	21.95	22.03
Coefficient of Variation of F.D. (%)		21.05	21.03
Mean Length (mm[in])	(ASTM D519)	25.9 [1.02]	30.2 [1.19]
Coefficient of Variation of Mean Length (%)		31.6	55.1
Solvent Extractables (%)	Benzene/Methanol Solvent (ASTM D1574)	1.79	1.54
Vegetable Matter (%)	(ASTM D584)	0.03	1.89

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expand to accommodate more wool, the ratio of fibers used being assumed to stay constant; thirdly, non-traditional uses for wool must be found; finally, wool must gain a larger share of the total fiber consumption by being spun on nontraditional systems. It has been to this last possibility that this and numerous other groups of researchers have addressed their efforts.

One possibility being studied is the adaptation of wool processing to the short staple cotton system. Some of the problems that have been encountered when wool is processed on the short staple system in 100% form are: (1) It has been impossible to make a suitable full lap using pure wool on the cotton picker, and (2) due to the inability of the sliver lapper to make a suitable product for presentation of fibers to the cotton comb, it is not possible to comb 100% wool using a cotton comb. Using the Heltra breaker, picking and short staple carding were eliminated and good quality yarns were spun using ring spinning (33 mg/m; 18/1 N_c) and open-end spinning (50 mg/m; 12/1 N_c). The favorable spinning conditions were arrived at by the application of drawing oil (2.95%) to the slivers.

A recent technical/economic feasibility study performed by the International Wool Secretariat (IWS) concluded that there are five strong reasons why wool processing on the short staple system may be desirable in the future. These are: textile production is gravitating towards low labor cost countries whose machinery installations are predominately short staple; a possible downturn in the manufacture of conventional wool processing equipment due to the poor share of wool in the total fiber market; the availability of significant quantities of wool fiber of suitable length for processing on the short staple system, whether this be shorn, cut, or stretch broken; it could help the demand for wool fiber from newly emerging producer countries who might otherwise use man-made fibers; and finally, it could expand the product base for wool, particularly in lighter weight fabrics using singles yarns. IWS also reported there may be a slight cost advantage in favor of this system of processing.

We at the Textile Research Center are also convinced that a major opportunity for wool exists in its greater utilization on the short staple system.

Many cotton manufacturers over the last 30 years have made serious efforts to process wool on short staple machines, particularly with cotton and polyester in wool-poor blends. Wool has been blended on the cotton system with other fibers for several reasons. Primarily, the addition of small quantities of wool to either cotton or polyester provides improved aesthetics, drape and hand as well as other characteristics that cannot be obtained by using one

TABLE III

YARN CHARACTERISTICS – 49.2 MG/M (12/1 N_C) YARN

Nominal Yarn Composition	60/40 Cut Wool/Polyester	60/40 Short Shorn Wool/Polyester
Nominal Yarn Number (mg/m[Nc])	49.2 [12/1]	49.2 [12/1]
Twist Multiplier	4.00	4.00
Uster:		
Yarn Non-Uniformity (CV%)	19.82	22.22
IPI Count, Thin	165	297
IPI Count, Thick	186	613
IPI Count, Neps	22	604
Elongation Rupture (%)	17.8	15.9
Single Yarn Strength (g)	501.0	411.0
Yarn Strength Variation (CV%)	12.0	15.3
Yarn Tensile Strength (Rkm)	9.65	9.05
ASTM Yarn Grade	A	B+
Skein:		
Actual Yarn Number (g/m[Nc])	53.6 [11.02/1]	48.5 [12.18/1]
Yarn Number Variation (CV%)	1.39	1.45
Strength (kg[lbs])	57.1 [126.0]	44.5 [98.2]
Strength Variation (CV%)	3.28	11.19
Count Strength Product (mg/m x kg [Nc x lbs])	3060.6 [1371.6]	2158.2 [1199.3]
CSP Variation (CV%)	2.64	11.63

TABLE IV

GREIGE FABRIC CHARACTERISTICS
(49.2 MG/M WARP X 49.2 MG/M FILLING [12/1 N_C])

Fabric Property	60/40 Cut Wool/Polyester	60/40 Short Shorn Wool/Polyester
Grab Strength (Kg[lbs])		
Warp Direction	46.36[102.2]	40.10[88.4]
Filling Direction	34.38[75.8]	31.39[69.2]
Weight per Unit Area (g/m^2 [oz/yd^2])	193.3[5.70]	179.7[5.30]
Width (m[ins])	1.105[43.5]	1.079[42.5]
Elmendorf Tear Strength (Kg[lbs])		
Warp Direction	4.00[8.81]	3.87[8.54]
Filling Direction	3.06[6.75]	3.17[6.99]
Flex Abrasion (cycles)		
Warp Direction	2421	1717
Filling Direction	2058	1248
Pick Count (pick/cm [picks/in])	15.0[38.2]	15.7[39.8]
End Count (ends/cm [ends/ins])	19.0[48.4]	19.4[49.4]
Shrinkage after 3 Wash-Tumble Dry (AATCC 143 Condition II) Cycles (%)		
Warp Direction	2.3	7.1
Filling Direction	5.4	4.3
Durable Press Rating	3.00	3.00
Pilling Resistance (Random Tumble)	4.0	3.0

fiber alone. Similarly, additions of relatively small quantities of cotton and synthetic fibers allows the production of stronger wool-rich yarns with increased utility, using the short staple system. The physical properties relating to durability and comfort are combined to obtain the best from both fiber types, while at the same time, poorer properties of the individual fibers are suppressed. The most well-known producer of wool/cotton blends in the United Kingdom is undoubtedly Viyella who uses a modified short staple system and produces 55/45 and 20/80 wool/cotton blends. Following the IWS study, a UK spinner and weaver is now commercially producing a light weight wool/polyester fabric for use in women's dresses and blouses. Several firms in Germany are currently utilizing worsted top on the short staple system in various products. Italian and Taiwanese firms are also offering wool/polyester fabrics produced on the short staple system. Here in the U.S., the Directory of American Wool Spinners, compiled by the Wool Bureau Inc., currently lists eight companies as American Short Staple or Cotton System Spinners of Wool. Extensive development work involving the use of wool in blends with both cotton and polyester on the short staple system is currently in progress in Germany, France, Australia, Italy, Spain, Japan, South Africa and the USA.

The IWS estimates that approximately 3% (50 million kilograms per year [110 million pounds]) of the world wool clip would be suitable for processing on the short staple system without further fiber modification. Shortages of suitable wools could result if the development (i.e. wool on the cotton system) were extremely sucsessful. Consequently, approaches utilizing cut and stretch broken fibers are being investigated. More frequent shearing has been deemed economically inviable in countries without cheap labor and there have been numerous biological as well as economic objections to this particular practice.

The following information is presented to partially overcome some of these objections. In some areas of Texas, it is necessary for both the health of the sheep and the quality of the fleeces that the sheep be shorn twice a year. This is done on both 8 month/4 month and 6 month/6 month cycles. In May 1979, the auction price of this type of wool (64's, 30.5 mm [1.2 ins.] mean fiber length) in the grease was $2.56/kg ($1.16/lb.). At that same time, a comparable cut top wool was being sold for processing on short staple systems for $6.39/kg ($2.90/lb.).

If a financial advantage when using short shorn wool instead of cut top wool were to be demonstrated, then wool on the cotton system presumably could be an even more attractive proposition than it currently is. It should be added that a parallel study is presently being conducted at Texas A&M University on the biological effects (particularly on lambing traits) of shearing sheep twice a year.

The objectives of this particular study were twofold. First, to obtain further data concerning the processing of short wools on the cotton system. Secondly, to ascertain if the more expensive cut wool top can be replaced with a six-month shorn wool to yield comparable products. More specifically, *this research was designed to compare the performances of these two raw materials when utilized in a 60/40* wool/polyester blend in both apparel and home furnishing types of product.

Tables II, III and IV give some of the results that have come from this comparison of cut wool top and six-month shorn wool when processed side by side into yarns and fabrics. ▪