Wool, Mohair & Other Fibers

AS 1124

HISTORY OF WOOL

• Sheep domesticated in Asia Minor during the Stone Age about 10,000 years ago.

HISTORY OF WOOL

• The Saracens, nomadic people of the Syrian-Arabian deserts, conquered Spain in the eighth century and established a widespread wool export trade with North Africa, Greece, Egypt and Constantinople.
HISTORY OF WOOL

- The Romans took sheep everywhere as they built their Empire in what is now Spain, North Africa, and on the British Isles. They established a wool plant in what is now Winchester, England as early as 50 AD.

HISTORY OF WOOL

- During the twelfth century, weaving in Florence, Genoa and Venice was stimulated by the Norman conquest of Greece.

HISTORY OF WOOL

- Back in Spain a thriving wool trade helped finance the voyages of Columbus and the Conquistadors. Guarding its wealth closely, Spain levied the death penalty or anyone exporting sheep until 1786.
HISTORY OF WOOL
• In 1786, King Louis XVI imported 386 Merino ewes to cross with sheep on his estate at Rambouillet in Northern France.

HISTORY OF WOOL
• Just like Spain, England froze its borders to raw wool exports. In 1377 England’s King Edward III, "the royal wool merchant," stopped woven-goods imports and the domestic weaving of foreign wools and invited Flemish weavers fleeing the Spanish invasion to settle in England where the industry thrived.

HISTORY OF WOOL
• By 1660 wool textile exports were two-thirds of England’s foreign commerce.
HISTORY OF WOOL

• Columbus brought sheep to Cuba and Santo Domingo on his second voyage in 1493, and Cortez took their descendants along when he explored what is now Mexico and the southwestern United States.

HISTORY OF WOOL

• England’s "empire of wool" peaked during the 1509-47 reign of King Henry VIII. He seized the flocks of the monasteries and redistributed them to court favorites.
• This caused unemployed shepherds to immigrate to America.

HISTORY OF WOOL

• Despite the fact that England tried to discourage a wool industry in North America, a few smuggled sheep had multiplied to about 1000,000 by 1665. Massachusetts even passed a law requiring young people to spin and weave.
HISTORY OF WOOL

• King George III of England made wool trading in the Colonies a punishable offense. Cutting off the offender’s right hand was the chosen punishment.

HISTORY OF WOOL

• Despite the King’s attempts to disrupt wool commerce, the wool industry flourished in America. Both Washington and Jefferson maintained flocks of sheep.

HISTORY OF WOOL

• Sheep moved West with civilization and beyond; at the turn of the 18th century small flocks in the hands of pioneers started the industry in Australia, New Zealand and South Africa.
WOOL PROPERTIES

• Fiber Absorbency
• Resistance to Flame
• Dyeability
• Durability
• Natural Felting Properties
• Resistance to Compression

Fiber Absorbency

• Wool is a hygroscopic fiber; it takes up moisture in vapor form. Tiny pores in the epicuticle make the fiber semi-permeable, allowing vapor to pass through to the heart of the fiber. Wool can easily absorb up to 30% of its weight in moisture without feeling damp or clammy.

Fiber Absorbency

• Wool absorbs perspiration; thus it keeps a layer of dry air next to the skin which, in turn, helps to hold in body heat. The same principle of moisture contact on the skin acts to protect against hot weather as well. The body cools itself naturally with the evaporation of perspiration. Wool expedites this process by absorbing perspiration and keeping the same dry air next to the skin.
Resistance to Flame

- Because wool contains moisture in every fiber, it resists flame without chemical treatment. Instead of burning freely when touched by flame, wool chars and stops burning when it is removed from the source of the flame. Wool is self-extinguishing; it will not support combustion.

Dyeability

- Wool absorbs many different dyes deeply, uniformly and directly without the use of combining chemicals. Wool is an amphoteric, which means it reacts with both acids and bases; thus it accepts both acid and basic dyestuffs.

Dyeability

- Dyes penetrate into the inner medulla core of the fiber where a chemical reaction occurs making the color change permanent except under extreme and prolonged fading conditions.
Durability

• Each wool fiber is a molecular coil-spring making the fiber remarkably elastic. Nature has folded the chemical polypeptide chains back upon themselves in such a way that they act like a coiled spring, which elongates when it is extended and retracts when it is released.

Durability

• This molecular crimp, along with the 3-dimensional fiber, allows wool fibers to be stretched up to 50% when wet and 30% when dry, and still bounce back to their original shape when stress is released.

Durability

• The flexibility of the wool fiber also makes it more durable. A wool fiber can be bent back on itself more than 20,000 times without breaking, compared to about 3,000 times for cotton and 2,000 times for silk.
Natural Felting Properties

- The outer layer of wool is made up of small scales that contribute to wool’s property of felting. Agitation, friction and pressure along with heat and moisture cause the edges of wool fibers to interlock, preventing the fiber from returning to its original position. This shrinkage which occurs is irreversible.

Natural Felting Properties

- The felting property of wool is both an advantage and a disadvantage. In a controlled situation, the felting process is called "fulling" or "milling" and creates a softer finish for woven wool fabrics. Felting is also crucial to the production of a wide variety of non-woven wool fabrics for hats and industrial uses.

Resistance to Compression

- Resistance to compression values is useful in assessing the suitability of wool for specific end uses. Resistance to compression (R to C) is the force per unit area required to compress a fixed mass of wool to a fixed volume. Resistance to compression is related to fiber diameter and the form and frequency of crimp.
Resistance to Compression

- For instance, low and medium R to C wools tend to be softer, more susceptible to felting, easier to process and produce strong fabrics. On the other hand, high R to C wools have a harsher handle, are resistant to felting and are bulkier.

WOOL PROCESSING

- Shearing & Grading
- Washing & Scouring
- Blending & Dyeing
- Carding
- Spinning
- Weaving

SHEARING AND GRADING

- The first step in processing wool takes place on the farm or ranch with shearing, usually in the springtime just before lambing.
SHEARING AND GRADING

• A skillful shearer can shear a sheep in about 5 minutes. The shearer uses long, smooth strokes close to the skin to preserve the length of the fiber. The shearer usually peels the fleece off in one piece.

SHEARING AND GRADING

• Next come the buyers. They will take core samples of the bags of wool in order to measure fiber length, diameter, and amounts of dirt, plastic, and vegetable matter.

SHEARING AND GRADING

• Fine and medium-fine wools of longer staple lengths (more than three inches) usually go to make lightweight worsted suit and dress fabrics. Coarser and shorter fibers, less than three inches long, usually go into bulky sweater and carpet yarns.
WOOL GRADING

• There are several factors that affect wool quality:
  – Fiber diameter
  – Crimps
  – Fiber length
  – Purity

Blood Grade System

• The blood grade system is originally based on the percentage of Merino blood that was in the animal's pedigree.
• It included the following grades:
  – Fine
  – Half blood
  – Three eighths blood
  – One quarter blood
  – Low one quarter blood
  – Common or braid

Spinning Count System

• The spinning count system is based on the number of hanks (560 yards of fine yarn) that can be spun from 1 pound of clean wool.

<table>
<thead>
<tr>
<th>Blood Grade</th>
<th>Spinning Count</th>
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<tbody>
<tr>
<td>Fine</td>
<td>80, 70, 64, 62</td>
</tr>
<tr>
<td>½</td>
<td>60, 58</td>
</tr>
<tr>
<td>3/8</td>
<td>56, 54</td>
</tr>
<tr>
<td>¼</td>
<td>50, 48</td>
</tr>
<tr>
<td>low ¼</td>
<td>46</td>
</tr>
<tr>
<td>Common/braid</td>
<td>44, 40, 36</td>
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</tbody>
</table>
Micron System

- The micron system is based on the diameter of individual wool fibers, measured in microns.

<table>
<thead>
<tr>
<th>Blood Grade</th>
<th>Micron</th>
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<tbody>
<tr>
<td>Fine</td>
<td>17 - 22</td>
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<tr>
<td>1/2</td>
<td>22 - 25</td>
</tr>
<tr>
<td>3/8</td>
<td>25 - 28</td>
</tr>
<tr>
<td>1/4</td>
<td>28 - 31</td>
</tr>
<tr>
<td>Low 1/4</td>
<td>31 - 36</td>
</tr>
<tr>
<td>Common/braid</td>
<td>&gt; 36</td>
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</tbody>
</table>

WASHING AND SCOURING

- The next step in the process is washing (scouring) the wool to remove grease (unrefined lanolin), vegetable matter and other impurities which gather in the wool from the range, feedlot, or shearing floor.

WASHING AND SCOURING

- Impurities can weigh from 30 to 70 percent of raw (unscoured) fleece.

- The grease in wool is called lanolin. It is separated from the wash water, purified, and used in creams, soaps, cosmetics, and other products.
BLENDING AND DYEING

• Clean wools from several different batches or lots are often blended-mixed mechanically—at this stage. Blending unifies the slightly different basic colors of raw wool, and also helps to standardize staple length and diameter for uniform quality.

BLENDING AND DYEING

• Wool dyed immediately after it is scoured (washed) and blended is stock-dyed. Spin it into yarn first and then it’s yarn-dyed. Weave it into a piece of fabric and then it is piece-dyed. To weave a patterned fabric, use either stock-dyed or yarn-dyed threads. Plain-colored fabrics are usually piece-dyed.

CARDING

• The carding process passes the clean and dry wool through a system of wire rollers to straighten the fibers and remove any remaining vegetable matter.
CARDING

• The rollers vary in diameter and turn at different speeds in order to form a thin web of aligned fibers. Smooth steel fingers then divide the web and roll the strands over onto one another to create narrow continuous ropes of fibers called "slivers".

CARDING

• If the batch of wool is of coarser fiber and shorter staple length (three inches or less), the machinery gently twists the slivers into ropelike strands called "roving", and winds the roving into balls ready for spinning into woolen yarns.

CARDING

• If the batch is of finer fiber and longer staple length (longer than three inches), the slivers usually go to the combing and drawings steps which prepare them for spinning into worsted yarn.
SPINNING

- Roving for both woolen and worsted yarns goes through the spinning process for yarn formation, making it suitable for weaving or knitting.

SPINNING

- After spools of roving are in place on the spinning frame, the ends of the roving are drawn through small rollers to extend the wool fibers still further.

- Then the spinning machines twist and retwist the roving into yarns of a wide variety of qualities including strength, firmness, size and ply.

WEAVING OR KNITTING

- Weaving produces cloth by interlacing two sets of yarn at right angles. Yarns running lengthwise in the loom are the "warp", while yarns running crosswise form the filling or "weft".
WEAVING OR KNITTING

• As each warp yarn passes through the loom, it is raised and lowered by a wire eyelet through which it is threaded.

• As yarns are raised and lowered by cycles of the loom, a weft yarn is carried by a shuttle, (rapier or air jet) through the opening created by the warp yarns.

WEAVING OR KNITTING

• Knitted fabrics are produced by interlocking rows of yarns and loops. As new loops are formed, they are drawn through those previously shaped. This inter-looping and the continued formation of new loops produce knit fabric.

WOOL FABRICS

• WOOLEN OR WORSTED
  – Woolen and Worsted are two major classifications for wool yarns and fabrics.
Processing

• Woolens
  – spun from shorter wool fibers—one to three inches in length
  – spun from fibers of a medium or course diameter
  – fibers are washed, scoured and carded.

• Worsted
  – spun from longer wool fibers—longer than three inches in length
  – spun from fibers of fine diameter
  – fibers are washed, scoured, carded, combed and drawn

Yarn

• Woolens
  – bulky, uneven low to medium slack twist
  – tensile strength lower than worsted

• Worsted
  – fine, smooth, even tighter twist
  – higher tensile strength

Fabric Appearance

• Woolens
  – soft, fuzzy
  – thick, heavier weight

• Worsted
  – Crisp smooth, clear-faced
  – lighter weight
Characteristics

- Woolens
  - more insulatory due to trapped air
  - not as durable as worsteds
  - nap reduces shine
  - does not hold a crease well

- Worsteds
  - less insulatory
  - more durable than woolens
  - may become shiny with use where abraded during wear
  - holds creases and shape

Uses

- Woolens
  - sweater, carpets tweeds

- Worsteds
  - suits, dresses gabardines, crepes

WOOLEN Summary

- Woolen fabrics are characterized as being fuzzy, thick and bulky. They are made from fibers that are one to three inches in length that have been carded only (worsted yarns are carded and combed). After the carding process the woolen "sliver" is twisted by machine into rope-like strands called "roving" and wound onto reels for spinning.
WOOLEN Summary

- Woolen yarns are fluffy, relatively loosely twisted, and are used in weaving fabrics such as tweeds, blanket cloth and meltons. Woolen fabrics and yarns are traditionally made into bulky garments such as coats, heavy jackets and sweaters.

WORSTED Summary

- Worsted yarns are spun from longer (three inches and longer) fibers that have been carded, combed and drawn. Combing machines further straighten the wool sliver making the individual fibers lie parallel.

• The combing process also eliminates "noils" or shorter fibers, which grow mostly on the belly of the sheep. (Noils are used in the production of less expensive woolen fabrics and for the manufacturing of felt, a non-woven fabric).
WORSTED Summary

- The drawing process takes the worsted sliver, doubles it over onto itself and draws it out again to a thinner, more uniform diameter to insure that all wool fibers are parallel. Worsted yarns are twisted tighter and thinner in the spinning process and are manufactured into lightweight fabrics such as gabardine and crepe.

US Sheep Inventory

- 1994 9,836,000
- 1995 8,989,000
- 1996 8,465,000
- 1997 8,024,000
- 1998 7,825,000
- 1999 7,215,000
- 2000 7,026,000
- 2001 6,915,000
- 2002 6,685,000
- 2003 6,231,000
- 2004 6,090,000
- 2005 6,135,000
- 2006 6,230,000

State Sheep Inventory

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