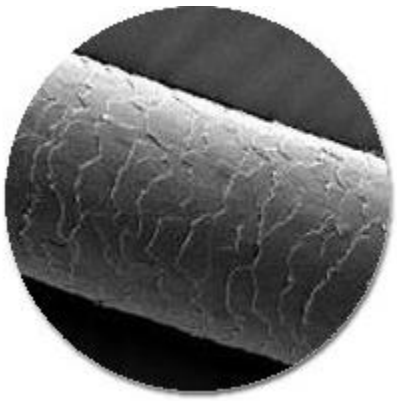
Wool vs Synthetic – A Clothing Primer

Wool has a naturally high specific heat coefficient, which translates in practical terms to mean that it impedes heat transfer or “retains heat”. This article focuses on why wool is the better clothing choice for outdoor activities such as camping, as compared to synthetics.

Firstly, some basic concepts need to be covered:

Wool

Wool is similar to hair or fur (hair covering non-human mammals) in that all three have scales.



Wool differs specifically from hair or fur in that it is also elastic (can expand and contract from stretching) due to being naturally crimped (this is why sheep have curl looking fibers). The number of crimps and the diameter of the wool fiber (measured in microns) defines the quality of wool. The larger the number of crimps the higher the quality of wool. The thinner the wool fiber the softer the wool will feel on the skin. Wool fiber length also plays a factor in the strength of the final fabric produced.

For example, the highly sought-after Merino wool from New Zealand and Australia have upwards of 100 crimps per inch while being less than 23 microns in diameter. The long fiber length of quality Merino wool is between 3-5 inches. The gold standard in the wool industry is known as “1PP” bales of wool, which translates to “ultrafine” (less than 15.5 microns) or “superfine” (less than 18.8 microns) categories. Ultimately, wool clothing that is based on Merino wool that is less than 16.9 microns in diameter will be the most expensive, and softest wool you can purchase, but may pile more-so than coarser (larger diameter) wool found in items like military wool blankets.

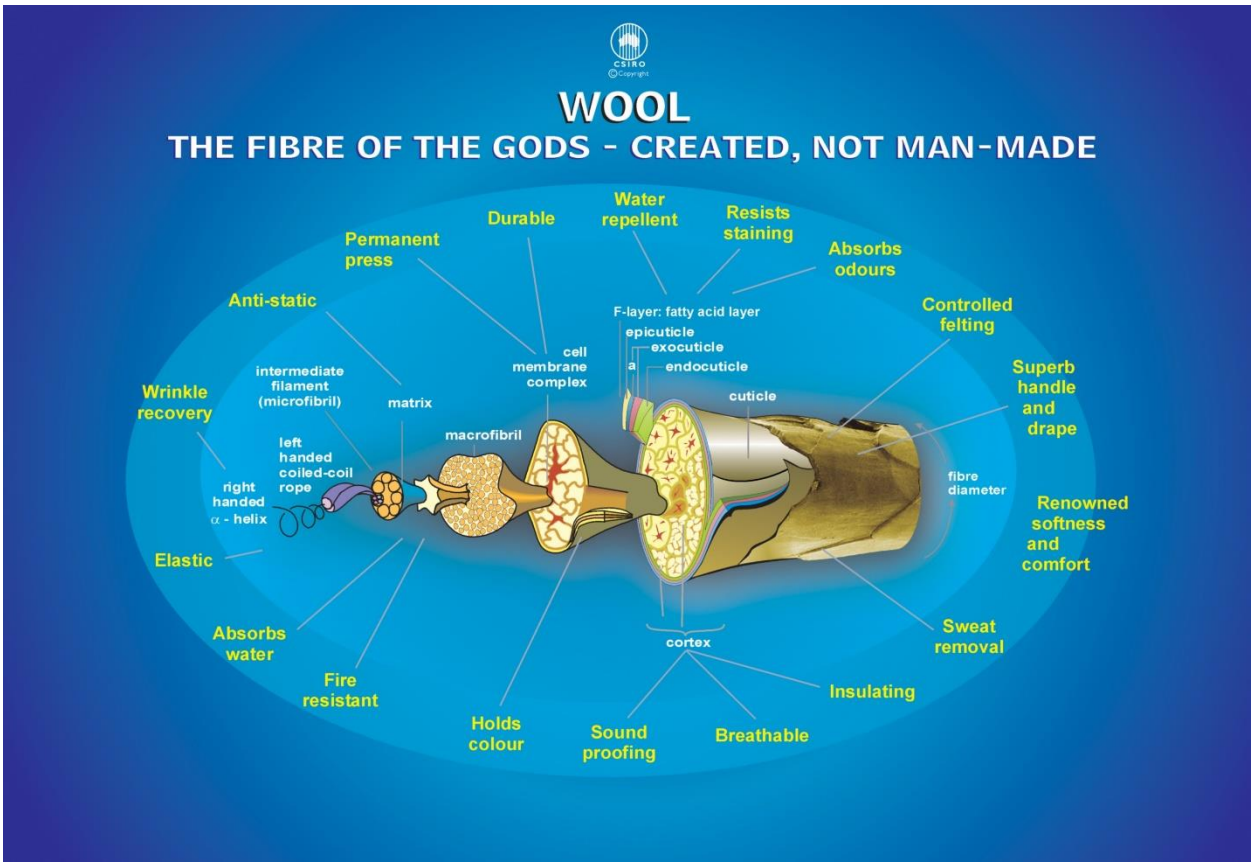
Synthetics

The creation of synthetic fibers can be traced back to the 1880's. The primary purpose of developing a synthetic fiber was to improve on natural animal or plant fiber properties.

The continued development of a synthetic fiber is driven economically to either produce a profit, lower a cost compared to the natural fiber, and/or reduce dependence on the corresponding natural fiber.

In particular, the textile industry has been trying to mimic the properties of natural wool (cashmere and mohair) for several decades now, primarily using full synthetic or semi-synthetic polymers such as nylon, polyester, polypropylene, olefin fibers and rayon, to name just a few.

Categories of Comparison



WEIGHT – Synthetics have come a long way in terms of textile engineering, and currently are lighter than most wool clothing, but do not necessarily win when it comes to the warmth-weight ratio, which this article focuses on. Wool clothing is traditionally matched to winter weather, as it is bulky and heavier than synthetic fabrics such as fleece, which focus on primarily trapping as much air as possible in the fibers. Synthetics are also paired up with a variety of low density plied synthetic fibers like Primaloft® or even down/feathersto produce jackets, quilts and sleeping bags, in order to re-create the warmth factor, but at a lighter weight, that wool inheriently posesses.

WARMTH – wool retains 80% of its ability to keep you warm, even when soaking wet, even though the additional water weight makes the clothing that much heavier on your body. This remarkable property is one of the primary reasons wool clothing is superior to synthetic clothing in the great outdoors.

From a perspiration perspective, both wool and many synthetics have wicking features, which allows wool clothing to also be worn during the summer.

COST – wool comes from sheep raised primarily on farms, and that product-delivery-chain-to-final textile-fabric costs money. Other factors such as the health and welfare of the sheep require industry intervention, which has attracted animal rights organizations. Consequently, this natural product will always be more expensive than synthetic products, which are made from the by-products of existing petrochemical industries and do not attract as much controversy.

COMFORT – with advances in textile engineering, both wool and synthetics have come a long way in terms of the fabrics that can be produced. Milano sheep wool from New Zealand started to win over fans with their super soft wool, but cashmere, angora, and other more exotic wools like from the llamas and alpacas have a superb handle and drape and resist wrinkling, all while being quite durable.

Synthetic fibers have similar properties, but care is required when ironing.

Softness has been improved for both wool and synthetics to the point where companies such as Icebreaker and Smartwool now offer a variety of undergarments to compete with those from Patagonia, Outbound, Arctyex and other synthetic clothes manufactures.

COLOR OPTIONS – Due to the assortment of options in fabric types and color fastness that can be generated from synthetics, the clear winner in this category is synthetics. Although wool holds color, the variety is towards more muted color tones.

STRENGTH – wool can be strengthened by usually adding a strong synthetic fiber such as nylon into the fabric weave. Army blankets range anywhere from 20% to 50% synthetic wool mixes, while a quality wool shirt or pants will be woven with the longest wool fibers available to make it stronger. Synthetics usually rely on "rip-stop" weaving technologies, while wool's elasticity woven into fabric allows for equal stretch in all directions. Both wool and synthetics weaken under point loads over time, although a cut in wool is more mendable with a needle and thread than a synthetic which usually requires a sewn or thermally bonded patch.

BREATHABILITY – wool is a natural fiber. Various densities can be achieved depending on the source of the wool (TO DO: describe various sheep and regional wools), but in all cases, the weave density, will always allow for wool garments to remain breathable. Synthetics such as polyester or olefin garments along with DWR treatments of garments choose to try to reduce breathability for waterproofness or windproofness by reducing the pore size, while other fabrics such as fleece are quite breathable. Gortex is an example of a breathable but waterproof synthetic fabric.

SMELL – Before we discuss why smells get absorb into our clothes, we need a quick primer on the make up of wool. Wool fiber exteriors are hydrophobic (repel water) due to natural lanolin found on the surface, while the interior of the wool fiber is hygroscopic (attracts water). Wool is not hollow but can absorb upwards of 1/3 its weight of water because of the amount of surface area produced by crimping.

Since wool does not quickly absorb the waste by-products our bodies eliminate via water-borne sweat, it does not build up a smell as quickly as some synthetic fibers do, which do not have this built-in hydrophobic coating. Being partially hydrophobic has the advantage of washing the clothing fewer times, hence maintaining the fabric strength for longer periods of time.

A popular term called Superwash, was developed by industry to deal the care of wool garments. Washing of Superwash-treated garments requires no special methods to prevent shrinkage when using gentle detergents. Shrinkage occurs only if too much of the lanolin is

stripped from the Superwash (lanolin) treated wool fabric either via a harsh detergent or heat. Conversely, no application of an additional spray or re-coating of the wool fabric is required.

Some synthetics have been battling this smell problem because the synthetic fiber has too many hooks to capture waste by-product, which penetrates deep into the fabric and consequently allows the odor-producing bacteria to multiple like a Petrie dish. The issue has been partially solved with fabric treatments such as wash-in, or spray on coatings. Some manufacturers have introduced synthetic fabrics with silver weaved into their clothing to compete in this area. Threads developed from metals such as silver and copper have an oligodynamic property, which means they kill germs (biocidal effect).

FIRE RETARDANT – many folks have who have sat around a campfire can attest to the holes created in their synthetic clothing from a stray spark or ember. Wool on the other hand, does not generally burn on contact, or at least has the advantage of a few seconds longer of intense heat contact before starting to smolder. Synthetic products such as tents have many warning labels about not being brought close to a flame since they appear to have a lower combustion or melting point than wool. Fire retardants have started to be introduced to some of the synthetic products, usually based on organic halides (haloalkanes), but this family of chemicals is highly toxic under prolonged exposure, so have not been introduced into clothing.

QUIETNESS – wool has been a staple of the hunting community for centuries. It is very quiet when moving about.

WATER REPELLENT – the synthetics definitely win in this category with DRW coatings, but due to wools lanolin (oil) content, it does partially shed water, while continuing to keep in about 80% of your body heat, when wet. The tight crimping of wool fibers also prevents droplets of water from “sticking” to wool.

ALLERGIC REACTION – some people have allergic reactions to wool, but wool is considered hypoallergenic by the medical profession.

ELECTRICAL CONDUCTIVITY – wool does not conduct electricity and was frequently used as an insulator at the beginning of the 19th century. You may develop some static with synthetic clothing because it is essentially plastic.