ARMADILLO
MERINO

PERFORMANCE

MOISTURE MANAGEMENT

This fact sheet covers ZQ Merino's unique moisture management properties

made from

ZQ™
MERINO FIBRE
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MOISTURE MANAGEMENT

INTRODUCTION

The ability of a textile to manage moisture is an important factor in enhancing wearer comfort and physical performance. Textiles that are effective at moisture management actively move excess moisture away from the body and transfer it to the external environment. This process of managing the environment between the skin and inner fabric surface enables heat and moisture to be buffered to acceptable levels, providing a micro-climate for the body.

If moisture is not managed effectively, a number of factors come into play that directly affect the comfort of the wearer and can in turn have ramifications on the wearer's performance (Laing et al, 2007). These factors include the build up of free liquid, which can leave the fabric and skin feeling wet. When the wearer ceases physical exertion and begins to cool down, this free liquid leaves the skin feeling clammy and cold.

Water vapour absorption is an intrinsic fibre quality and is therefore independent of fabric structure (Massie and Mehta, 1980). Hydroscopic fibres have the ability to absorb, transport and desorb moisture to and from the vapour phase (Benisek et al, 1987), as opposed to non-hydroscopic fibres. Hydroscopic fibres also have the ability to store moisture within their fibre structure in reasonably significant quantities, which can then act as a reservoir to buffer variations in the humidity of the surrounding environment.

Some fabric systems are superior at moisture management than others, due to the three principle modes of moisture (either liquid or vapour) flow that occur in textiles (Massie and Mehta, 1980):

- Water vapour transport through fibres (by absorption/desorption). This is an intrinsic property of hydroscopic fibres and the active mechanism of the fibre's ability to absorb, transport and desorb moisture vapour.
- Water vapour transport through air spaces in the fabric structure. This is the mechanism by which moisture vapour diffuses through the gaps within a fabric, usually occurring in open structure type fabrics via convection or ventilation. This is facilitated better by fabrics of a loose or open construction as opposed to tightly constructed fabrics.
- Liquid water transport through fabrics. This is the process where free water is transported along the fibre surface via capillary action and is usually a function of hydrophilic fibre fabrics.

WHY MOISTURE MANAGEMENT IS IMPORTANT

The ability of a garment to adjust the moisture gradient between the wearer's skin surface and the external environment is a key factor in the provision of wearer comfort, and can have a direct impact on wearer performance.

During physical activity or in hot environments the body produces sweat as an evaporative mechanism to cool the skin surface, and thus regulate core body temperature. This is an extremely important function of comfort maintenance and directly impacts the body's ability to maintain physical performance.

Sweating is the principal mechanism by which the body cools itself down by allowing excess heat to dissipate as the moisture reaches the skin surface. Sweat is released by eccrine sweat glands, which are distributed over the entire body surface. Sweat is composed primarily of water (99%) and various salts. The primary function of sweat glands is to regulate body temperature and these glands are controlled by nerves, which are in turn controlled by a centre in the hypothalamus that senses core temperature directly.

While the body has an extremely efficient moisture management system, this can be severely impacted if the garment system does not work in synergy with the body. Therefore, it is extremely important for a garment system to be capable of actively managing moisture in a way that is complementary to the body.

Clothing that prevents moisture evaporation effectively prevents the body from maintaining a healthy core temperature and, as a result, can have a significant impact on human comfort, performance and endurance.

Garments enable moisture transfer in two key ways;

Wicking is the process of moving liquid from the skin surface to the outside surface of the garment. This allows the moisture to then evaporate. Unfortunately, while this process will help wearer comfort and reduce the feeling of being physically wet, the evaporative cooling effect of liquid changing state to vapour is applied to the garment surface rather than the skin surface, denying the body its natural cooling mechanism.

Absorption involves the uptake of moisture vapour into the internal structure of the individual fibres directly from the skin surface, before it condenses into liquid. This process allows evaporative cooling to occur on the skin surface and thus helps regulate core body temperature. It also removes the potential for liquid 'wetness' to be experienced, until such time as the fibres themselves become saturated. This process is unique to wool, although some man-made fibres attempt to replicate what wool achieves naturally.

The moisture transfer requirements of a garment will vary greatly, depending on the intended use. By way of example, sedentary activity in a cold environment will require moisture transfer performance quite different to that required of a garment designed for sporting use in a warm or temperate climate. Generally, active and performance-wear fabrics are designed to promote moisture flows away from the body.

Studies have proven that the moisture-transfer rate of clothing material is an important factor affecting the thermoregulatory responses during exercise (Zhang et al, 2001). This work demonstrated that relative humidity and absolute humidity of the clothing microclimate as a result of exercise induced increases of core, leg and mean skin temperatures, and the salivary lactic acid level, were all significantly lower where garments had a higher moisture-transfer rate.

PREVIOUS OPTIONS

(LIMITATIONS OF OTHER FIBRES)

Synthetic materials such as nylon and polyester are commonly used as apparel fabrics for high performance wear due to their ability to dry quickly after laundering. However, this is directly related to their very poor moisture absorption properties.

The degree of water repellence of a fibre is determined by its surface energy, with higher surface energies found in fibres that are more easily wetted and promote the wicking of water along their surfaces. Polyester, acrylic and nylon all have higher surface energy values than wool (Leeder 1984), but a lesser capacity for moisture absorbance (Figure 1).

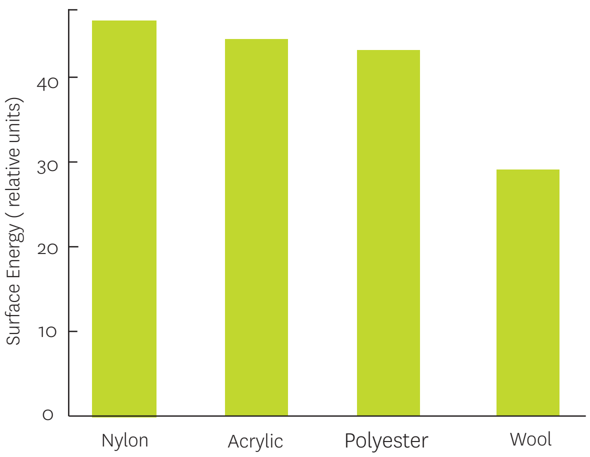

Figure 1. Fibre surface energies for various fibres (Leeder, 1984)

The weight of water in the fibre expressed as a percentage of the dry weight is known as the regain. There is a fixed relationship between regain and the prevailing conditions in the surrounding air, particularly with regard to relative humidity and to a lesser extent, temperature and air flow. For wool, regain varies from almost zero in dry air up to a maximum of approximately 35% in 100% humidity or saturated air. The saturation regain for cotton, the next most hydroscopic fibre, is in the order of 24%. In comparison, most synthetic fibres have saturation regains below 10%. Conventional polyester fibre absorbs less than 1% water at saturation.

Table 1. Fibre surface energies for various fibres (Leeder, 1984)

Fibre	Saturation Regain (%)
Wool	35
Cotton	24
Polyamide	7
Polyester	1

MERINO FIBRE SOLUTION

Merino fibre is able to actively absorb moisture from the atmosphere and/or body, with its absorption properties being much greater than most synthetic fibres (Table 1).

Merino owes it absorption characteristics to its chemical building blocks, amino acids, which are hydrophilic (water loving). This means they attract water molecules and absorb them into the internal structure of the fibre. This interaction with water occurs because the hydrogen bonds that bind water molecules are reversible, water can also be released in a process known as desorption. This means that merino fibre can actively manage moisture by absorbing from the skin and then desorbing to the atmosphere, leaving the wearer dryer and more comfortable. Secondly a merino fibre will absorb up to 35% of its own weight in water at a high humidity before feeling wet, Figure 2 (Leeder 1984; Collie and Johnson 1998).

In a practical sense, this means that merino fibre systems are always seeking to maintain equilibrium with the environment around them.

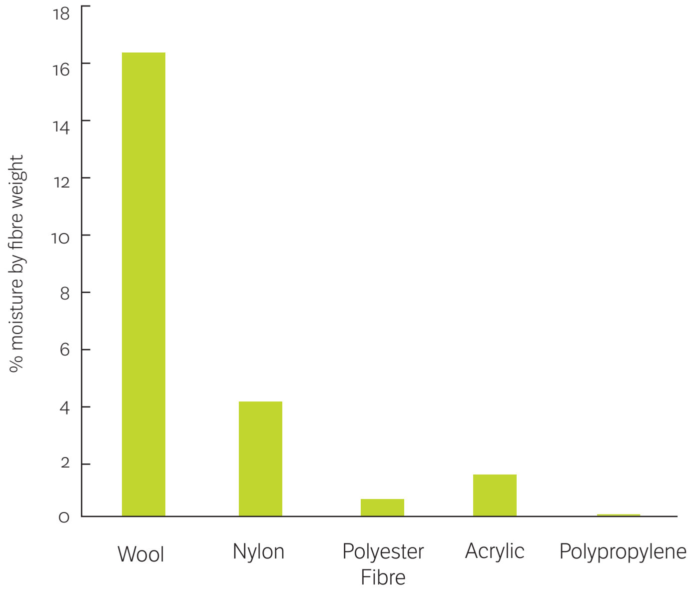

Figure 2. Moisture absorbance of wool and synthetic fibres (Collie and Johnson, 1998)

SUMMARY

Merino fibre has a hydrophobic (water repelling) exterior and hydrophilic (water loving) interior, which provide outstanding moisture management capabilities.

Merino fibre, by absorbing water vapour from the skin surface and allowing effective evaporative cooling of the skin to occur, assists with maintaining a healthy core body temperature.

Merino fibre also has the capacity to absorb large amounts (up to 35% of its own weight) of moisture before the fibre even begins to feel wet.

Merino's chemical structure means that it has the ability to actively absorb and desorb moisture, and gain and release heat, depending on the external and internal environment, thus buffering a wearer against environmental changes.

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