

What are clothes for?

It is hard to consider human beings as "unfinished beings". Perhaps the cynics amongst *WSA* readers would tell us they know of a few politicians around the world who have a few bits and pieces that are missing, but this is about the anthropological point of view. Simply put "we construct not only our environments, but also ourselves" according to Peter Elsner, an eminent dermatologist and one of the authors of "Textiles and the Skin" and a number of other books and papers that bridge the spheres of dermatology and textile engineering.

The essential point is that mankind has learned how to use garments to allow survival in climates from the desert to the ice caps. "Textiles have the function of a 'second skin', substituting for the biological properties that other animals have evolved to cope with specific environments on this planet. Thanks to textiles, humans have even been able to enter the most extreme and inhospitable environments, such as interplanetary space".

Fashion statement in space

This is not just a throw-away line. Milan's Politecnico di Milano highlighted the world of space crew garments when reporting on two spaceflights flown by Italian astronaut Lt. Col. Roberto Vittori in 2005 and 2002. The Industrial Design Department at the Politecnico conducted research into the design, engineering, and fabrication of the crew's clothing. Working with Benetton to actually produce the garments, they covered the full array of technologies that we have become used to in activewear – thermoregulation, including thermoregulating fibres and fabrics; capillary action fibres to wick perspiration away from the skin; antibacterial, thermal, and capillary properties and their effect on hygiene; yarn technology, with phase-change microcapsules for thermal stability; weaving technology; fabric treatments; garment manufacturing; adherence and elasticity; and the ergonomics and biomechanics of movement in microgravity.

Never before have we had such a move towards "smart textiles" as we are seeing now as biochemistry and nanotechnology converge

Performance clothing is needed for many tough activities

Omniflex

upon us. These fabrics are capable of sensing changes in environmental conditions or body functions and to respond to them. They are able to absorb substances from the skin or to release therapeutic or cosmetic compounds. For instance, they can be used in underwear with an integrated cardio-online system or as textiles with carrier molecules. One focal point of interest in bio-functional textiles lies currently in the use of textiles supporting therapy and prevention in dermatology. There is history here, as wet dressings have been used for a long time to treat injuries. Aloe Vera has been used by dermatologists since before Alexander the Great. He needed it to help mend the wounds of his soldiers and captured the island of Socotra in the Indian Ocean just to gain access to a large supply of the plants. Increasingly this has been applied via inclusion in textiles and fabrics.

Antibacteria and UV protection

There are some major areas where textiles have a role. Thermal control is the most obvious, as is protection against rain and snow. Increasingly we are refining textiles to help with bacterial activity and UV protection. Over the last fifteen years the increase in UV-related skin problems, especially melanoma and non-melanoma skin cancer, has created considerable interest in the use of fabrics as photo-protective materials. According to Elsner, we define an ultraviolet protection factor (UPF) based on the wavelength dependent transmission of the fabric, the solar UV spectrum and the erythemal (capillary dilation) action spectrum in the wavelength region 290–400 nm. Standardised test methods have been developed for Australia and New Zealand, the USA and Great Britain. UPF values range from 2 (poor protection) to 50 and beyond (high protection).

UV protection has become important in swimwear and this we look at in this issue in a little more detail. This is relevant as two factors which have an influence on the UPF are fabric moisture content and tension. Cotton and other cellulose fabrics show great differences in UPF when they are wet (lower values) and dry (higher values). Elastane-containing 'stretch fabrics' also show considerable differences in transmission, with a reduction in UPF when the fabric is stretched because 'holes' develop in it.

Antimicrobial textiles

Bacteria exist and are not actually a bad thing per se; rather it is the wrong number of the wrong type in the wrong place that creates problems. Some approaches go for annihilation of bacteria and others for birth control to slow the geometric progression of their multiplication. Elsner points out that textiles can be endowed with antibacterial activity in a variety of ways. Soil-repellent fluoropolymers have hydrophobic properties which reduce soiling on textiles and, secondarily, microbial growth. Small molecules such as silver, zinc, copper and quarternary ammonium compounds show antibacterial activity. Antibacterial agents may be added to synthetic fibers in the spinning process, but they can also be fixated to supramolecular compounds on the textile surface. Cyclodextrins are ring-like carbohydrates which form complexes with 'guest' substances. They can be used as transdermal collector systems in toxicological monitoring, but also to diminish bacterial contamination at sweat-prone sites (so-called odour-controlling textiles) or as antibacterial textiles. The efficacy of antimicrobial textiles may be very diverse and much careful testing is still required to identify those clinical settings where they may be used effectively.



VisaEndurance, a silver ion-impregnated polyester developed by Milliken and Company.

Milliken and Company

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Increasingly the trend is now to try and put a variety of benefits within a single material. What use to be 'order winners', such as moisture management, are increasingly now seen as 'order qualifiers'. Increasingly these are 'table-stakes' or requirements to allow the fabric or yarn producer to sit at the table. Consider materials such as aio from Unifi, which combine UV protection with antibacterial yarns and moisture management. Similarly for some time Dri-release moisture wicking technology has come together with Freshguard odour neutraliser.

In developing these complex new materials, most of them working in base layers next to the skin, Elsner argues that we must recognise that the interaction between textiles and the skin is a close and reciprocal one. "As more new and innovative textiles come onto the market for recreational, industrial or military purposes, a mutual exchange must also be established and maintained between those who create textiles and those who apply them in clinical settings and/or treat the skin: textile engineers must understand basic skin anatomy, physiology and microbiology, and the pathogenesis of skin reactions; dermatologists need to know about the structure and characteristics of fibre and fabric types, dyes and finishes and clothing physiology."

As in many other areas of life and the sciences, an interdisciplinary approach to the skin and textiles will provide the basis for the development of both more sophisticated and more sensitive textiles for the benefit of human health, comfort, and pleasure.