Functional sports wear is mainly produced from man-made fibres. No matter whether polyester, polyamide or polypropylene, just go out for a run, a hike, a ride or a climb and quicker than you think - you could smell like a skunk. But worse, even in everyday life perspiration can be a real problem. The textile industry continues to come up with new solutions to bad odour. But with some, you could smell a rat.

Turn on or turn off

Do you remember the John Cleese film 'A Fish Called Wanda'? The cinema was roaring with laughter (I think to cover the disgust most people imagined) every time Kevin Kline took a deep breath from his armpits to find the right stimulation for going after Jaimie Lee Curtis. Body odour can be an aphrodisiac and some people really are attracted by the smell of their partners – maybe some kind of animalistic instinct we have retained during evolution. No youngster would ever think of washing his favourite football or basketball hero's jersey and a mom washing it would certainly trigger off a major family crisis. But these are exceptions, body odour – perspiration – mostly is just considered plainly repulsive, especially if older and already turned stale. Modern societies, as advertising tells us, will not tolerate any form of stench. They favour the smell of synthetic detergents, deodorants, soap and eau de toilette, going for complete sterility of life. And we, as consumers, react to a demand for increased freshness and hygiene in any situation.

On the other hand, perspiration is a normal body process. Perspiration is the reaction to overheating. The body cools down by evaporating the dampness on the skin surface. That's essential for healthy living. The technical target thus cannot be eliminating perspiration, but reducing the odour deriving from it. Accepting that fact, one needs to understand when and why perspiration turns malodorous.

Perspiration contains water, trace elements (such as sodium chloride), fatty acids and bacteria (standard gram-positive and standard gram-negative bacteria). Warm and humid conditions favour the process of fermentation, rapidly multiplying bacteria and producing malodour. That's the starting point for anti-microbial textiles: stopping or reducing the growth and extension of bacteria.

The easiest and most common way to combat bacterial proliferation and strong odour is washing. But, and it might be considered as a direct result of our environmental behaviour, lower washing temperatures and reduced washing detergents cannot kill all bacteria in a garment, especially if it's mainly cotton. With man-made fibres most bacteria are killed at 60°C – but alas, the washing instructions often say 'cold wash only' or 'wash in lukewarm water only'.

Similarly it is not always possible to change clothes several times during a day or to grab a quick shower. Bacteria regenerate very quickly as the body gives them warmth and moisture. That leaves some three possibilities for managing odour in textiles. 1) natural odour inhibitors, 2) artificial disinfectants, 3) pure silver.



Gonso's bike and activewear range employs Nylstar's Meryl SkinLife fabrics.

Natural odour inhibition

The last fifty years have been the decades of the chemical industry. Synthetic fibres have largely replaced the natural fibres that were in common use. Wool, in particular, lost credibility with the consumer because of its perceived and comparative discomfort. Nevertheless, if you survey the sports textiles market, you will stumble across some brands that have kept the merino wool flag flying through the years. Recently a couple of fresh companies have joined the band. The Swedish brand Ullfrotté from Triconor AB in Östersund produces functional next-to-skin wear made from a 67% merino/33% polyamide (PA) knit. The merino is on the inside absorbing and wicking humidity from the skin. Ullfrotté socks are recommended by W.L. Gore for use with Gore-Tex shoes. And one can assume that Ullfrotté would be a good next-to-skin layer beneath a Gore-Tex shell.

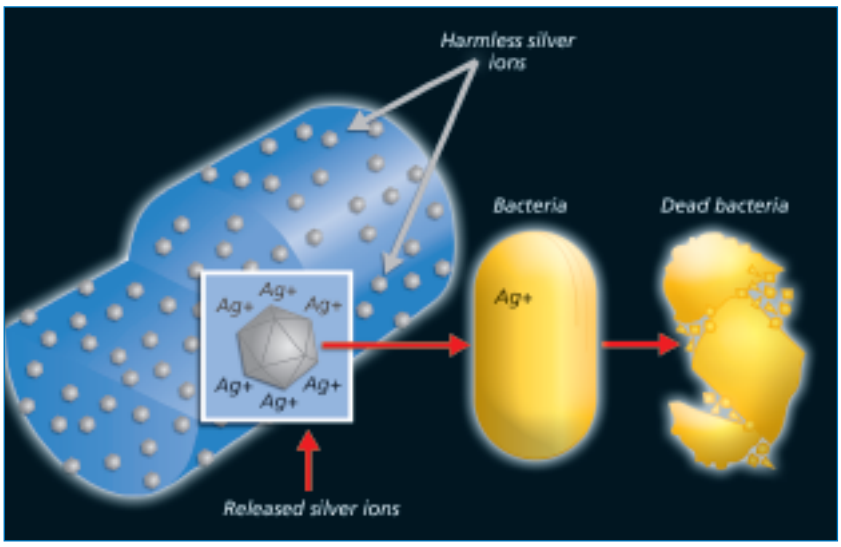
Icebreaker from New Zealand is another merino brand. Its product range covers base-layer, mid-layer and outer-layer made from pure merino, using five different weights.

Smartwool from the United States and Ortovox Lanatex from Austria are others who rely on merino to challenge perspiration. These companies know what retailers and consumers have long forgotten: merino wool has natural anti-microbial properties. It is an extremely fine fibre – about 12-18 µm in diameter, and the overlapping scales on the fibre shaft make it hard for quantities of bacteria to cling to it. And because of its hygroscopic ability to absorb humidity (up to 35-40% of its own weight) without it feeling wet, merino creates a more hostile environment for bacteria than do synthetic fibres, preventing odour for a long time.

Icebreaker mentions outrageous endurance tests using merino for up to 90 days without washing and yet not smelling of sweat. Ullfrotté mentions similar periods of time that their base-layer has been used by the military or by crews on oilrigs in the North Sea. And of course merino wool regulates temperature as no man-made fibre can accomplish. It delivers an outstanding warmth even when wet, doesn't itch, is anti-static, fire resistant, has a natural ultra-violet protection factor (UPF), wicks rapidly and is highly breathable. That's a total of functional properties that synthetic fibres can rarely, if at all, achieve.

Artificial inhibitors

As quickly as we have forgotten about the anti-microbial properties of merino wool, so did chemical treatments turn up in the last half of the 20th century. Meanwhile, research has revealed that around half of British consumers would purchase clothing treated with an anti-microbial finish rather than choose the untreated version. That was the outcome of a survey conducted by the Gallup Organisation in 2001. With home textiles the pros towards anti-microbial treatment even outnumber the cons by 2:1. We can assume similar results for all Western Europe and North America. Additionally, the chemical industry is benefiting from the movement towards washing at lower temperatures with less water and using less detergents. As the quest for lower environmental impact leads to higher levels of bacteria in textiles, the need for anti-microbials rises.



The antibacterial effect of silver. Released silver ions damage the cell organisms of bacteria which then die.

Two years ago, Avecia Protection and Hygiene launched Purista, a new consumer branded anti-microbial: 'Pure, clean and fresh' were the keywords and the message was boiled down to the benefit "fresher for longer". The main ingredient of Purista is a chemical known as PHMB (polyhexamethylenebiguandine) that has been used for over 25 years in a number of consumer applications such as contact lens solutions or swimming pool sanitisation. Purista, a colourless and non-smelling chemical, is said to bind naturally to the textiles and does not migrate onto the skin (the bacteriostatic effect). The advantage is self-evident. Whilst it keeps bacteria and malodour out of the textile, it does not affect the bacteria naturally found on the skin.

This seems to be a tremendous advantage, since a main competitor, triclosan, is having a hard time. Triclosan, a chlorinated phenoxyl compound, is a bactericide, which means that it will destroy the bacteria instead of just stopping their spread. It is being used by various companies (Ciba Tinosan, Sanitized T96-20/ TPL 20-02, Amicor declares it as triclosan).

Producers see no problems ahead, emphasising its good properties: its favourable human toxicological profile and its track record in delivering improved hygiene to consumers. Nevertheless, in the United States physicians and dermatologists fear the proliferation of consumer products containing antibacterial agents, since tests have shown rising bacterial resistance to triclosan. Possible side effects cannot be excluded. The scientific discourse has come to definite conclusions, pleading for

a moratorium on the use of common anti-microbials in consumer products, unless data emerges to conclusively show that such resistance has no effect on public health.

'The perceived benefits are not evident, yet the potential negative consequences are,' writes Stuart Levy in the editorial in the Archives of Dermatology (Vol. 138, No. 8, August 2002). Specialists are asking the Food & Drug Administration to regulate the use of anti-microbial substances, in particular triclosan. In Europe the 'Öko-Tex Standard 100' allows triclosan only in the fourth category i.e. home textiles, but not in any baby clothing or next-to-skin wear. Obviously these possible problems with triclosan have had consequences on the textile market and a new category of anti-microbials has been developed that attack the problem from a different angle.

Silver ions as an anti-microbial

Historically, silver has long been recognised for its medical and therapeutic benefits. The Romans are said to have used silver for covering wounds as an aid to cleanliness and faster healing, and there are many more historical anecdotes and positive references to be found. Today, silver is widely used in medical and everyday health issues: newly born children in the Western world are treated with silver nitrate eye drops to prevent infection. When we go out into the wilderness, we put silver (Katadyn, Certisil or Drinkwell) into our water to render it pure and safe to drink.

In textiles, pure silver is either used as a fibre interwoven with others or permanently bonded into the base fibre. This pure silver continuously releases silver ions, which bind and eliminate bacteria by adding up the molecular structure of ammonia and denatured proteins. In contrast to chemical anti-microbials, this process is rapid, taking less than an hour from exposure – and it is an endless process, lasting for the life of the garment. Pure silver fibres have been tested for more than 250 washes without any loss in performance, while many chemical additives wash out after approximately 30-50 washings. But silver is not only a good anti-microbial; it is anti-static and has conductive properties with therapeutic benefits. Pure silver is natural, non-toxic and does not lead to skin irritation. Though some people may think they are allergic to silver, they are actually allergic to a silver alloy called sterling silver that is used in jewellery. And, last but not least, silver is perfectly suited for heat transfer. It cools in summer due to thermal conductivity whereas it warms in winter by reflecting heat back to its source or storing it.

X-Static from Noble Fibre Technologies is the pioneer product for silver usage in clothing. Deriving from medical use, X-Static in textiles was introduced in 1997 and has become the highest distributed silver fibre in the marketplace. Depending on the specific use, it generally contains about 15% pure silver that is permanently and irreversibly bound to the surface of the fibre and cannot wear off. X-static is combined with polyester and can be used in knits, wovens and non-wovens, as a filament or as a spun yarn.



Gonso clothing. The German bike-wear specialist makes extensive use of anti-microbial processed fibres.

In the wake of the demand for safety and freshness, many other companies have developed and commercialised silver fabrics. In 2001, Nylstar launched Meryl Skinlife, the first bacteriostatic polyamide 6.6 fibre and one with a convincingly soft handle. Nylstar claims that, in addition to the classic silver advantages, it has other functional virtues: it is lightweight, breathable and dries exceptionally fast.

At the same time, Trevira presented Bioactive as another anti-microbial. Bioactive contains a special silver additive that is permanently locked into the fibre and, like all silver fibres, it is bacteriostatic and does not migrate to the skin, thus maintaining the natural and healthy skin flora. Meryl Skinlife and Trevira Bioactive have been tested and certified by the Hohenstein Institute, an internationally respected centre for textile testing.

Coming from Italy, there are two more silver fibres in the marketplace. The weaver Trerè is responsible for SilverNODOR, and Indas produces NOSTATEX Pure Silver. Whereas NOSTATEX is very similar to the fibres mentioned above, SilverNODOR differs in the way it is processed. The silver is not interwoven with conventional fibres, but rather used as an independent yarn. This yarn is knitted into 'Terry Loops' on the body side of a double face fabric forming a link between the faces and releasing a larger amount of silver ions than any comparable woven blends. This offers an additional functional advantage. Since silver does not absorb moisture, the sweat is wicked

away to the outer side of the fabric, leaving the body perfectly dry. This also avoids developing an environment favourable to the production of odour.

Professor Dr. Bodo Lambertz, director of the High Teach Institut in Herdecke/Germany – a scientific think-tank devoted to the development of high-tech apparel – and inventor of SilverNODOR, is convinced that no other silver fabric has the same amount of contact with the body. Eighty per cent of the skin surface is in direct contact with the pure silver, thus blocking absolutely any growth of bacteria and bad odour. Lambertz believes that other applications resemble a homeopathic dose compared to SilverNODOR: "If you dissolve an aspirin in a swimming pool, you can cure a headache. All you have to do is drink the whole pool," is Lambertz' favourite comparison. SilverNODOR consists of a polyamide core and an irreversible pure silver mantle. Processing the fibre by the 'Terry-Loop' technology develops another big advantage in that its use can be confined to those parts of the body that are responsible for the sweat production, thus keeping the overall price of the anti-microbial garment low. SilverNODOR is used in X-Underwear and X-Socks, an own-brand of baselayer garments developed by the think tank and knitted at Trerè – an Italian knitting factory near Asola.

Supply of Anti-Microbials Increasing

In future, consumers will be choosing from an even greater supply of anti-microbials. In August 2002, after research covering a period of six years, Milliken & Company launched a smart fabric called VisaEndurance. A compromise of several technologies (one being silver ions, the others not yet revealed due to the pending grant of patents) integrated into one fabric with one aim: to successfully reduce bacteria and odour no matter how long the garment is worn or how high the level of activity. As test and laboratory reports showed, there were significant differences between the two. To everyone's surprise, the laboratory tests did not correlate to consumer perception in respect of the control of body odour on garments. So the test period was extended. By the time VisaEndurance was finally launched, 5000 wearer reports had substantially changed the technology employed in the fabric. Today, Milliken uses three methods of keeping bacteria from multiplying: odour decomposition, odour absorption and anti-microbials. And the synergistic effect of this multiple approach to odour reduction is the novel technology that, from Milliken's view, led to the superior results from VisaEndurance. Terramar (Spring '03) and Mountain Hardwear (Fall '03) will be the first companies offering VisaEndurance products in the sports and outdoor industries.

Nano-technology, a technique that can alter the polymer of a fibre at the molecular level to add new properties, is Burlington Worldwide's answer to the market demand. Nano-Fresh, as it will be called, is already in the stage of intensive testing and will be launched shortly. Nano-Fresh too favours the bacteriostatic approach as anti-microbial, excluding any health risks.

Yes, the commitment to an uncompromising health standard for anti-microbials is what the market needs and what the consumers want. As long as the industry accepts this, the consumers' preference for anti-microbial function in textiles will continue at a high level – to the benefit of all.

Ralf Stefan Beppler