

The Quickwick Papers

If ever an observation describes almost exactly the performance of the moisture transporting fibres and textile processes made available to the sports market, it is that uttered by the Charles Dickens character Mr Tony Weller to his offspring Samuel in chapter 8 of *Pickwick Papers*: 'Wery good power o' suction, Sammy ... You'd ha' made an uncommon fine oyster, Sammy, if you'd been born in that station o' life.'

The Weller family's ability to move large quantities of liquid at short notice occupied many paragraphs in Dickens's collection of stories set in Victorian England. If wicking fabrics had been available at the time, then the Wellers would have been much more comfortable in themselves and to be in their close company would probably have been much more pleasant.

The control of the personal microclimate has, for athletes and active leisure devotees, become something of a religion because optimum performance depends to a large degree on the skin being kept warm, dry and comfortable. This is particularly important when the external conditions are cold and wet but no less relevant when they are warm and humid. In the case of the latter, there is a growing branch of MVT (moisture vapour transmission) technology that is concerned with 'cool and dry' although it is doubtful whether many activists would take things as far as the England World Cup 2002 football squad and wear a sleeveless white ice-jacket that will allegedly improve the players' stamina and enable them to run faster, sweat less and avoid dehydration.

Traditional cotton is undoubtedly the fabric of choice in day-to-day circumstances but, once the perspiration level rises, only an MVT-efficient fabric can provide a layer of clothing which is not clammy next to the skin, sticky in the heat and will not chill when the wearer stops moving. A low skin temperature is uncomfortable in the majority of circumstances and causes the body to use vital energy to keep warm, energy that could be better employed in enhancing personal performance.

All wicking fabrics rely on capillary action to move moisture from the skin to the outside of the fabric. Most are some form of polyester because of its extreme limitations in moisture take-up (approximately 2%), the only major exceptions being polypropylene (which positively dislikes moisture) and chlorofibre. Microfibres play a large part in the production of MVT fabrics where a finer hand is required.

Two caveats exist that are rarely explained by retailers to the purchasers of base layer

Nike Sphere technology

garments. First, capillary action will attract water from locations where it is abundant and transport it to areas where it is less abundant. When all parts of a garment are equally wet capillary action ceases, which is the reason that the garment manufacturers insist on fibres with the greatest possible surface area on the outer surface to ensure the maximum spread of moisture and the fastest evaporation – preferably at a rate faster than the initial take up. But the human physiology extends to widely differing metabolic rates and, more often than might be appreciated, greater than average levels of perspiration output.

Second, in winter it is not unusual to find the outer garment saturated on the inside face (even with the most efficient of breathable shell clothing) and the inner layer comparatively dry. This is because, unless it is warm enough for evaporation to take place, the outer layer is as far as water transport can go before colder temperatures slow it down. This saturation will eventually work backwards, building water closer and closer to the wearer's skin and creating a cold layer when the level of physical output drops or ceases. Experienced users are aware of this limitation and adjust their clothing layers accordingly; others complain to the shell clothing manufacturers.

Granddad's undies

A recently reported survey in the British *Daily Telegraph* showed that the death rate in Britain in winter is 40,000 higher than in summer. In the world's coldest city – Yakutsk, Siberia – winter mortality rates are no different to those in summer. The report suggested that this is because Britons do not know what to wear in winter, whereas Russians layer up and overlay with substantial topcoats to boot. 'The British consistently underdress – with catastrophic results' continued the report.

It is entirely likely that such requirements were very much in mind when Norwegian manufacturer Helly Hansen first introduced its Lifa base layer ranges many years ago. In making statements concerning longevity one should always take care because there is bound to be another who knows better - however I believe it is reasonably safe to say that Lifa was one of the earliest, if not the first, brand names to hit the MVT market.

HH is one of the few companies to use polypropylene knit fabric, which some would argue is not the most efficient means of transporting moisture because of the low evaporative rates. But the company has stuck to its technical 'guns' and, with a brand that is consistently in the top sales echelon, can hardly be said to have made a mistake in doing so. Currently there are three performance levels: Sport pique knit – with high MVT rates, short drying times and extreme elasticity; Active rib knit – lower MVT rates and drying times but a higher retained warmth factor; Therma-base, where the polyolefin fibres are mixed with wool to produce a yarn that is a major insulator for use in moderate activity in extremely cold conditions.

Nike's Advanced Innovation Team followed up its derivative work with the Standoff Singlet by developing another structured fabric designed to create air spaces that bring specific benefits to athletes under competitive pressure. The result is the Nike Sphere group of products, of which there are four: Sphere Cool, Sphere Thermal, Sphere Dry and Sphere Pro.

Sphere Cool and Sphere Dry are the most relevant products to our subject, the former using the structure of the material and design of the garment to create space between it and the body. Holes in the fabric allow air to flow in and circulate in the space, flowing over sweat on the skin to maximise evaporation.

Sphere Dry on the other hand uses a structure on the back of the material as an aid in pulling sweat from the skin to the outer face, where it evaporates quickly. The fabric structure also holds the surface of the material away from the skin, reducing the chance that it will cling and keep the athlete from moving freely.

The British Risol Group, owner of the Craghoppers outdoor brand, has developed a series of fabric innovations that are said to work in tune with the body, and given them the title 'Response Technology'. In Craghoppers' Next to Skin products this takes the form of bonding an activated carbon compound to polyester fibre – giving it an absorption factor said to be three times greater than silica gel and with an equally improved MVT rate. The absorption process also generates heat (rather in the manner of natural wool) to further promote evaporation.

It is eight years since managing director Nick Brown converted a brain wave into reality and produced Parameta S fabric for the Paramo range of outdoor clothing. The British-based company is an offshoot of chemical protection specialist Nikwax, and the fabric continues to show a striking example of the thinking behind the original concept of environmentally sustainable products being produced for functions that are not usually associated with such aspirations. Parameta S is a fully reversible fabric – from warm to cool and back again – with a striking facility for wash 'n dry in the shortest possible time. The company suggests that it is possible to wash a garment, wring out the surplus water and wear it immediately. Such confidence.

Impossible achievements – until now

Textile engineering really comes into its own in the base layer sector of the sports apparel industry by inducing MVT in fibres and fabrics that would otherwise absorb and hold water with minimal release. Nano-technology, chemical processes and molecular adjustment are the global descriptions for work that often redefines what some may have considered being the natural order for textile performance.



Lifa base layer ranges by Norwegian manufacturer Helly Hansen



Left, from the Nike Sphere group of products

Keeping the body cool in high ambient temperatures is a problem for adventure racing competitors and trekkers in tropical climes. Rudolf Chemie, of Geretsried, Germany, has developed its Feran Ice process for synthetic fibres in a two-layer fabric. This is a hydrophilic coating which promotes fast MVT to the outer face, where an optimum evaporative effect creates a textile heat exchanger. Rudolf says that the wearer's skin temperature is lowered to achieve a level of comfort and ensure continued physical performance in even the hottest conditions.

Working to a similar brief, the Lintrend division of Trend Technology Limited of Larne, Northern Ireland, has recently announced details of its Coolfix process. Although developed with linen and cotton fabrics in mind, the company says that Coolfix can be applied to a number of fibre blends such as cellulosics with polyester or nylon.

In addition to a number of cosmetic benefits, Lintrend describes the cooling effect as 'similar to putting alcohol on the skin'. The chemical bond of the Coolfix process is said to be permanent under normal laundering conditions and it has the additional benefit of an anti-bacterial element to combat the build up of body odour.

The Gelanots brand is the name more often associated with the Osaka-based Tomen Corporation, but its Technofine polyester fibres are a particularly interesting development in the approach to fast wicking and evaporation. These use a multi-faceted shape in the form of a letter 'W' in cross section. The overlap of the "W" shape speeds up a fabric's ability to transport water away from the skin and the increased external surface area increases the evaporation rate. Tomen says that Technofine yarns are available in a variety of formats, including knits, meshes, jerseys, wovens, yarn-dyed wovens and tricots.

For cold weather base layer apparel Tomen's EKS-finished yarns could be the answer to the requirement for additional dry heat as well as MVT. EKS uses kinetic technology whereby the act of absorption generates heat at the same time as speeding the water vapour molecules on their way.

'Feel-good technology' is description applied by Schoeller Textil AG to its 3XDRY process, which is also said to be multi-functional in application. Conferring the ability to dry out faster than other processed fabrics, base layer garments in 3XDRY-treated fabrics should have hit the retail shelves in Spring 2002.

Nano-Texx LLC of North Carolina describes itself as 'an advanced materials company using proprietary technology to create, change and improve textiles at the molecular level to enhance the way we live'. Its Nano-Dry fabrics were launched a couple of years ago and the company says that the process can be applied to base layer fabrics as readily as it is to outerwear.

In November 2001 a gift of patents from Procter & Gamble gave Clemson University in South Carolina a virtual lock on a new wave of fibre and film technologies with wide-reaching MVT potential. The donation of P&G's proprietary capillary channel film and fibre (CCF) technology to Clemson is invaluable when paired with the university's existing patents, because together they have the potential to make Clemson a leader in absorbent materials technology. The grooves created by CCF are said to be able to provide moisture management functions in a variety of performance fabrics regularly used in sports apparel and athletic garments. Other potential active leisure and health applications include the ability to trap allergens in air-filtration systems or deliver antibiotics through wound-care dressings.

From its headquarters in Chatanooga, Tennessee, the Intera Corporation's multi-application fabric process is, according to its advertising, 'only limited by the imagination'. Applied at the fabric finishing stage, Intera modifes the individual fibres in situ to produce a level of MVT and an evaporation rate that is said to guarantee a dry skin regardless of ambient temperatures or levels of humidity.

Can it fly?

Optimer Performance Fibers' Dri-release fabric technology is a proprietary blend that includes 85% co-polyester and 15% long-staple cotton. A value-added extra is a built-in odour eliminator known as Freshguard. As a sportswear product it is said to have a double life – as a base layer in cold weather and as a singular outer when temperatures rise.

After a scientist at Optimer invented Dri-release, the marketing team at its Wilmington, Delaware, headquarters had to find the answers to two questions:

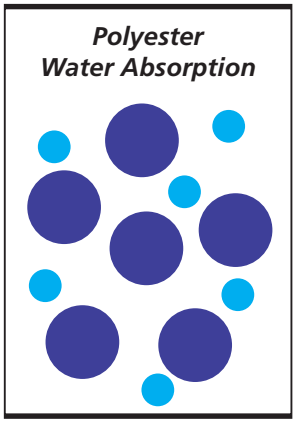
- *Did consumers value the benefits of the product?*
- *How could they get the product to market?*

In retrospect the solution seems almost too easy. A local race director of a triathlon event was persuaded to offer a Dri-release shirt to all the entrants and they were asked to complete a survey card to record just how they rated the product against other performance garments. The results were collected and tabulated by the Institute for Public Opinion Research:



Shirt from new Silver Hawk range with Coolfix finish by Glenden Shirts





Technofine Finish - sweat without wet

- *Was Dri-release as comfortable as cotton when dry?* 93% Agreed
- *Dri-release did not retain odour like other performance shirts?* 94% Agreed
- *Would you consider buying Dri-release products?* 94% said yes

For Optimer the business of selling Dri-release race shirts for marathons and triathlons has become a major business with over 500,000 shirts being sold globally in events that include Ironman Japan, USA Triathlon National Championship and all Xterra North America venues. Optimer argues that the reason this is so important is that it created credibility for the product and that then resulted in adoption by major brands.

Two of the first to adopt Dri-release were Brooks and Irongirl (a brand targeted at triathlons) and today over 30 brands globally have adopted Dri-release. Optimer says that in 2001 Dri-release was the main volume selling garment in Nike's Dri-FIT collection.

In September 2001 a licensing deal with Fujibo of Japan opened up the Dri-release yarn and garment package availability to Indonesia, Thailand and Japan. This has had the effect of allowing major brands to expand their use of Dri-release. A further major investment by Mitsui expanded the product availability to China and Türkiye – and also established Optimer Performance Fibers as a global specialist fabric marketing entity.

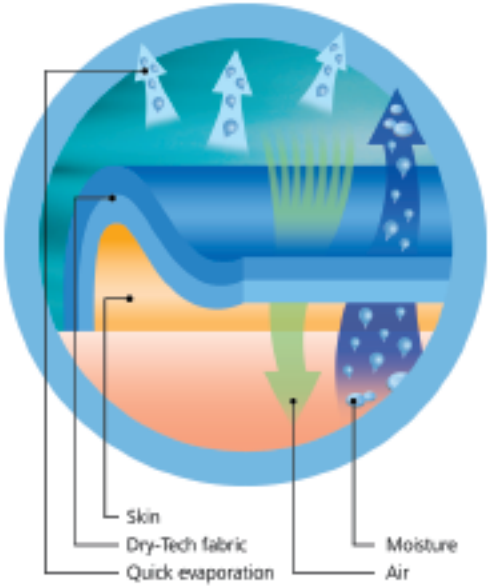
We've got the power

Despite the well-publicised problems that assaulted Malden Mills in 2001, the company's products remain close to the top of the wish list for most sports activists. And as a base layer fabric the company describes Polartec Power Dry as 'the state-of-the-art for the outdoor market'. Certainly the recent addition of spandex in the Comfort Stretch version has caught the imagination of the retail element, and it is suggested that the appropriately closer garment fit will enhance the MVT performance to a very high degree.

With three fabric weights available plus the expansion into the high performance 'grid back' sector and the popularity of its Thermal Pro Special Edition fabrics, Malden says that a number of technical brands will be presenting new Polartec products for the Autumn/Winter season ahead.

Gore-Tex fabrics are ubiquitous – well, almost. They are also more often associated with shell garments and mid-layer wear, so it might be a surprise to find that W L Gore has a product that it says is suitable for base layer products. Not only that but the suggestion is that the consumer could wear less clothing and still remain warm and dry at all times.

Gore Windstopper N2S (Next to Skin) fabrics use Windstopper membrane laminated to the MVT efficiency of polyester knit. The finished product, says Gore, is a functional garment that combines mid and base layer in one and furnishes additional warmth as a result.



Dry-Tech Comfort System

Dry-Tech Comfort System fabrics are the product of the Westcot Company, based in Hong Kong. A selection of double-faced synthetic knits, the operational abilities are entirely based on the relative properties in the presence of moisture without, apparently, any chemical or mechanical intervention. The company publishes a chart showing relative moisture release between cotton knit and Dry-Tech fabrics at fifteen-minute intervals. Needless to say that the brand comes out comfortably ahead at all stages.

'Moisture management plus breathability equals total comfort' says DuPont of its CoolMax fabrics, that it also asserts 'contain almost 100% of the company's proprietary engineered polyester fibres'. It is one of a very few fabrics which continues to operate effectively whether it is deployed at base, mid or outer layer thanks to the channelled flat cross section that provides breathability at all times.

The same structure is said to maximise the wicking ability when used in its optimum role as a next-to-skin product. For this application DuPont recommends CoolMax Extreme as an aid to lowering the user's physiological load.

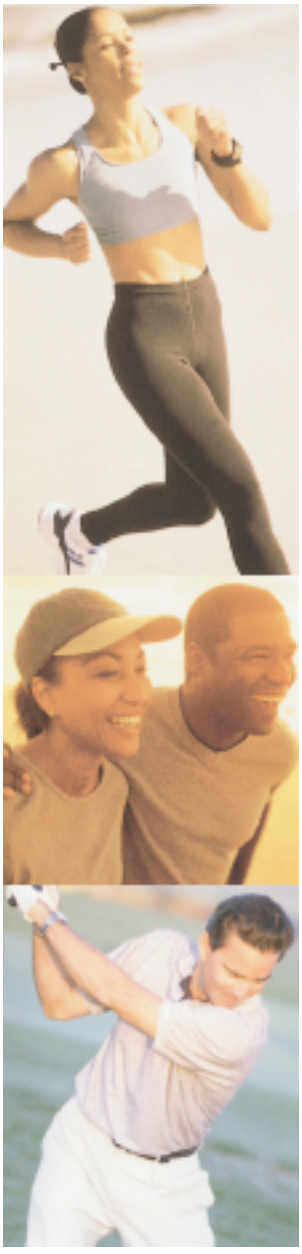
The stable mate to CoolMax fabrics is Thermolite Base, a lightweight product that is nevertheless said to provide heavy-duty performance and uses DuPont's hollow-core fibres to trap air as an insulating barrier. Hollow-core fibre technology provides the greatest warmth for the least weight, says DuPont.

A substantially larger surface area than competing fibres allows rapid evaporation and an enhanced MVT rate. The company's laboratory tests show a 20% faster drying rate than other insulating fabrics and 50% faster than cotton.

Yarning away

Fabric manufacturers often make much of 'the feel good factor' of the end product, and give little credit to the origins and the engineering of the yarns from which they are

Optimer Dri-release fabric



constructed. Yarn manufacturers and technicians will, however, agree with the suggestion that any fabric is only as good as the engineering of the raw material.

One long-term supplier of performance fibres is the French company Rhovyl SA. Its Rhovyl'UP yarns are combinations of chlorofibre (PVC) and either cellulose or silk and appear as own-brands in a number of well-known clothing ranges, although the company does operate a labelling certification programme as a guarantee of quality.

Specifically developed for the sports market, Rhovyl'UP may be found throughout the layered clothing system, but its wicking abilities matched to a fast evaporative action suggest that its main forte is in the base layer, says Rhovyl.

Aquafil Dryarn is a polypropylene yarn produced at the company's plant sited near Parma in Italy. Even with a wide variety of possible end uses, it is nevertheless the apparel market that attracts the majority of the technical input. Aquafil says that with a high surface tension, water vapour is rapidly transported to areas where it can be dispersed and evaporated – and its extreme stability under a variety of mechanical stresses should make it interesting to sports clothing manufacturers.

Unifi manufactures Sorbtek yarns, which it describes as 'a revolution in performance yarns and moisture management technology'. The suggestion is that they are suitable for any level of required MVT performance which places performance base layers firmly in the frame as a suitable application.

Finished fabrics are said to be lightweight, shrink resistant, easy care and highly breathable. The company uses the slogan 'Catch. Move. Release.' to illustrate the main capabilities of its range.

Cushioned wickability

Whilst the majority of this discussion concerns base layer apparel and fabrics, there are some aspects of sporting activities where the protective clothing requirements offer greater potential for discomfort than the injuries from which they protect.

The Rogers Corporation is based in Connecticut, USA, and specialises in the manufacture of urethane foams and foam structures. Many of these are intended for the protection of sportsmen in some of the more 'heavyweight' pastimes where the perspiration output is considerable.

The company has recently launched the Poron ProZorb series of products that are designed to afford maximum MVT and cushioned protection. The foams have an open-cell structure and a level of integrity that ensures compression set resistance and long-lasting cushioning without loss of moisture management.

Rogers' main preoccupation has developed within the footwear industry but, what the Dickens, an idle thought might suggest that the company may have a future in other directions.

Derryck Draper



Women's Powerdry turtleneck by Sprayway