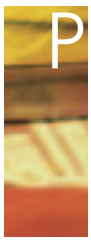
It's not necessarily magic, but...

Harry Potter, the schoolboy hero of British author J K Rowling's books, practises magic at apprentice level and has a cloak that renders him invisible. In an adult world, where sadly the majority no longer considers such possibilities believable, it's technology that makes magic out of logic and only the military-minded who attempt to render the visible invisible.

Fortunately, there are some technologists who still believe in true magic and attempt to recreate its effects for adults anywhere. In this, the round-up of tomorrow's textile technology, we look at the fibres, fabrics and related developments that might just have a place in Harry Potter's world. Anyone for quidditch?

Abracadabrrrrrrr... the temperature shift



Perhaps it is inevitable, in the light of the threat of global-warming, that one of the prime areas for consideration should be high temperatures and how to control them. Phase change materials (PCMs) gave the option of heat storage and release to maintain an optimum temperature, but much of the latest R&D is concentrating on lowering temperature as an aid to improvements in personal performance.

This was the project undertaken by Norway's Helly Hansen development team, backed as it is by over a century of in-house fabric research, in looking for a heat reduction factor in the company's new V-concept clothing range. The surprising result, surprising that is to anyone who knows Helly Hansen well, is that it will be using a fabric developed outside of either Scandinavia or the USA. Called EVOH, the source is Japanese. It is a totally hydrophobic polymer matched to polyester yarns in a double-faced knit, and it works by channelling moisture away from the skin to leave it dry and cool. So cool in fact that the Helly Hansen technologists claim that a hand placed on a block of the new polymer will be noticeably lower in surface temperature than its mate in a matter of seconds. Spring 2002 is the release date for the first garments to use EVOH for multi-functional activities.

The requirements for the American National Aeronautics and Space Administration (NASA) programmes have led to many beneficial developments in the sports and active leisure industry. How long will it be before the latest efforts to keep astronauts cool are seen in the pre-event clothing worn by our athletes? Designated as a smart spacesuit, it is intended to hold an optimum working temperature for astronauts operating in extremes of intense sunlight or a chill-producing shade. Hamilton Sundstrand Space Systems, of Connecticut, USA, has developed a suit that measures the level of infrared radiation given off by the wearer and varies the thickness of the fabric to control the level of insulation. It does so by modifying the suit's textile content with the addition of electro-chromic polymer yarns that use a low voltage to alter their absorption of infrared radiation from the skin. Between the layers of fabric, Hamilton inserts another layer of polymer-based muscles that expand or contract as a voltage is applied to regulate the thickness of the suit according to the level of insulation required.

Not apparently of immediate value to sports activists, until you consider the recent availability of hydrator packs for mountaineers and adventure racers, is one of the latest developments from the US Army Soldier Systems Center at Natick, Massachusetts. Helicopter

aircrews wear multi-layered flight suits for both protection and insulation. The current cooling system circulates two litres of iced water through a piped cooling garment until the liquid loses its ability to take up any more heat - at which time the wearer replaces the container. It is a simple fact of operational life that some crew members, most particularly the pilot, have difficulty in replacing the container at the appropriate time because it is usually the most inappropriate time for them.

A new, lightweight, microclimate cooling system has been developed which combines just six fluid ounces of water (175 ml), a battery-driven refrigeration unit and a cooling garment. And the cooling garment is the outcome of a mixture of applied textile technology and the designer's skill. Essentially, it is two shells laminated around 130 feet of small bore tubing in ten parallel circuits spread around the upper torso. A variety of fabrics may be used according to requirement and the whole garment weighs less than two pounds (907 gms).

Ongoing development has brought the total personal package down to the size of a two-pint container (1.14 l), with more reductions in view. Given the successful outcome for that work, perhaps it is not too much to envisage a similar system being available to trekkers and mountaineers in tropical climes - after all it is standard practice nowadays to take a laptop computer and a satellite link telephone to the top of Mt Everest.

Natick has also developed a new lightweight wet/dry suit that can be worn in water and on land without the necessity to change garments. The objective was to provide a low-cost, lightweight single garment that can be used on or off the shore

"The suit protects users in a wide variety of environments," said Quoc Truong, a physical scientist who is a research, development, test and evaluation programme manager at Natick. "The suit contains a shape memory polymer membrane along with special insulation material that is designed to keep users warm in sea water, but not hinder the perspiration process."

He said the membrane adapts to the change in the water or air temperature, opening or closing its molecular pores to either cool down the user or slow his heat loss.

Kinetic magic

Using the unseen, but tangible, magic of kinetic energy, Japan's Toray Industries has developed a fabric that generates heat by the absorption and dispersal of moisture vapour.

Water molecules from perspiration are absorbed into the inner layer of a three-element fabric called Warmsensor. This layer is a knit structure to which has been applied a new polymer finish, also developed by Toray. The polymer absorbs moisture and releases the heat generated by the kinetic energy of the water molecules, as they are absorbed. The heat is held in the second trapped air layer of the fabric and is retained by the outer layer, which minimises heat loss but releases the moisture at a speed that Toray claims to be "...very close to natural wool".

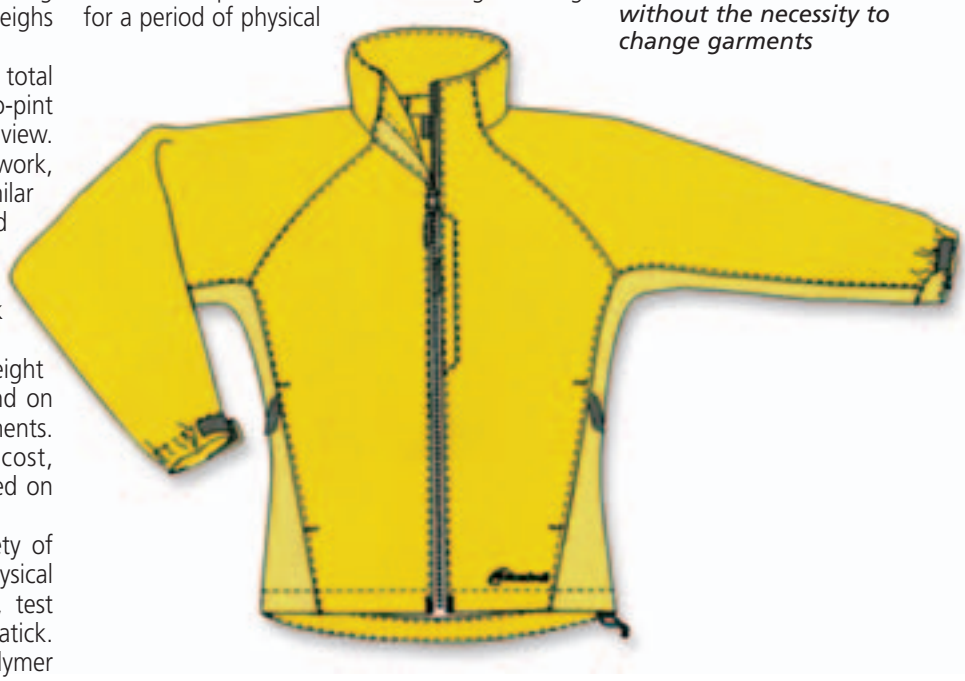
Figures also released by the company suggest that a temperature rise of about 2°C is sustained at skin level wearing Warmsensor underwear, while an outer garment in the fabric produced a 3-5°C improvement on the surface of the inner layer when compared with a similar garment made with a standard, unprocessed textile. Intended for use in winter sports wear and post-exercise, warm-down kit, Warmsensor is presently available on the Japanese home market, but is included in the Cloudveil Spring/Summer 2002 Collection in its Cascade jacket.

Wet cotton can be a killer in the wrong environment. For that reason it has been bypassed by most outdoor activists conscious of the hazard potential when selecting clothing for a period of physical activity away from base. The Epic by Nextec process has been well documented by this and other magazines, but few - including WSA - have made much of the fact that the product range includes a wide selection of cotton fabrics that resist water absorption and retain their repellency for a considerable period of time. At last it appears possible to have the superb comfort of cotton and remain safe in the outdoors.

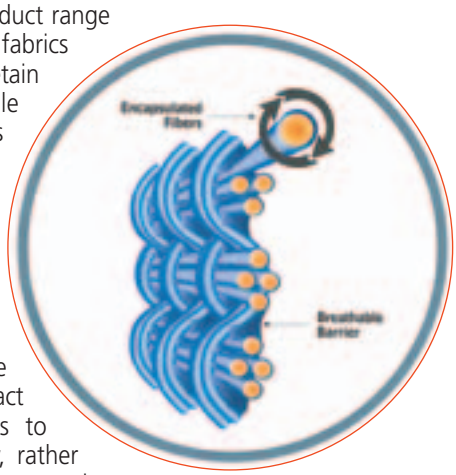
Selective permeability is apparently the next move in the moisture vapour transmission (MVT) membrane market. Very little information is available on the operation of the concept, but the fact that it is possible for membranes to perform at levels varied by density, rather than thickness, has been with us for some time. As is so often the case, the development is being driven by demand from the military and



Natick Amphibio lightweight wet/dry suit that can be worn in water and on land without the necessity to change garments



Cloudveil's women's Cascade jacket



EPIC by Nextec. It isn't just part of the fabric, it is the fabric

emergency services for clothing that will maintain personal comfort, and therefore efficiency, for long periods of operation. Long-term research has shown that the human body transpires at different rates by location. It follows that the ability of clothing to deal with different levels of required MVT must result in improved comfort, and by using body-mapping techniques similar to those developed for the active sports market, it should be possible for fabric manufacturers and processors to produce laminated textiles with areas selected by required performance values matched to the garment designs.

Both cellulose- and amine-based selectively permeable membranes have been developed by the market leaders who were faced with a requirement to develop a membrane that would block all known harmful agents, whether delivered by liquid immersion, aerosol or vapour and still retain the MVT properties. The extension of selectivity to include MVT performance is an unasked for bonus that could extend the benefits well beyond the original market sector into active leisure and outdoor pursuits.

Raising the temperature inside and preventing an excess of heat from penetrating from the outside are just two of many goals attained by the development function at Malden Mills. First, and faced with the possibility of its fleece products not being warm enough, the laboratories came across with Polartec Heat Technology. This is a battery-powered heat source consisting of elements incorporated into flexible panels and capable of a multitude of applications, including what Malden calls non-apparel. Remembering the company's early involvement with the transportation industry, the last factor raises a number of interesting possibilities. An electronic panel offering three options controls the output from the lithium battery pack: full power; oscillation mode (for extended battery life); power off. Battery life ranges from two to five hours depending on the mode selected.

Cold and wet Formula I pit teams are no longer a problem with Polartec Thermal FR. Malden Mills has collaborated with DuPont's Nomex division to produce an equivalent of Polartec 200 series fleece combined with the industry's standard for flame resistance. Thermal FR is said not to melt nor drip under the most intense heat and yet still offers all the insulation and comfort benefits traditionally associated with polyester fleece. The qualities are also said to withstand repeated laundering.

Evolon, a new sportswear fabric developed and produced by Freudenberg Nonwovens of Weidenheim, Germany, is constructed from endless microfilaments and is manufactured from polymer granulate in one continuous process. The fabric production process is a tripartite affair, combining spun continuous filament, bi-component filament and hydro-entangled technologies. With individual filaments having a micro-measurement ranging from 0.5 dtex through to 2.5 dtex, they are finer than standard microfibers, which considerably improves the hand and drape of the finished garments.

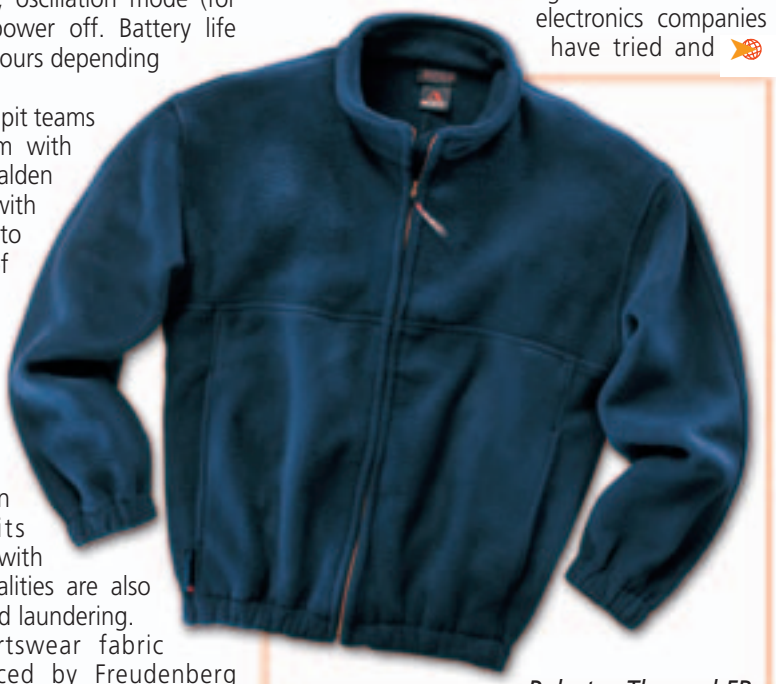
Freudenberg says that Evolon revolutionises garment production. The endless filaments create a fabric that does not fray and, as a result, it can be cut and sewn without seams or hemming. Even after several washes, cut edges remain smooth and clean. The physical conferred benefits are said to be low weight, exceptionable breathability and a high warmth/weight ratio.

Zyflex nonwovens, we are told, are ultra-microfibres held in place with continuous nylon and spandex yarns to give a lightweight fabric that moves with the body and traps a greater volume of air than traditionally produced products of the same thickness. DuPont was the original brand holder, but the intellectual property and patent rights have now been passed to the Zyflex company that produces both fabric and garments.

Control is everything

As any competent child will advise, to practise magic you need a potion, an incantation or a sign made with a wand. In other words, a switching device. And it's not just a case of simple On/Off - there are occasions when you want to control the desired effect and so you need a proportional response switching device.

The translation of the requirement into textile terms is a level of research that has been hovering on the brink of possibility for far too long. A number of electronics companies have tried and

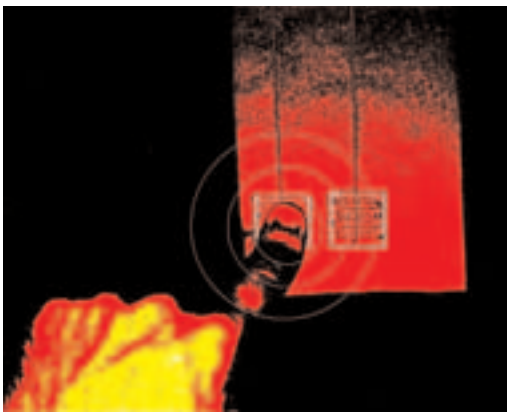


Polartec Thermal FR



Cropped top with matching briefs (and wrap skirt) in Welbeck's changeant fabric which has been encapsulated with a citrus aroma. Welbeck's range now includes around forty fruit, floral and spice fragrances as well as aloe vera moisturiser.

Micro capsules containing the fragrance and moisturiser are supplied in suspension adhesive and are thermally fixed as part of the finishing process so they become a semi-permanent part of the fabric - lasting for up to 20 machine washes on a gentle programme. There are around one million capsules per square centimetre and these release the contents by friction of the body - i.e. as the capsules break through natural movement.









SOFTswitch is a flexible electronic interface that is soft, tactile and can be used in combination with any type of fabric

partially succeeded, but possibly failed to understand the nature of the textile technology involved. A little over a year ago an exhibit at the annual Inventors Fair in London set fingertips twitching. Softswitch had arrived.

Softswitch is a flexible electronic interface that is soft, tactile and said to be the ultimate in user-friendliness. The product is the result of collaboration between materials technology specialists Peratech Ltd, and WRONZ Inc, an international textile R&D organisation whose origins track back to the New Zealand wool industry. Both are based in northern England. Peratech is the inventor of a quantum tunnelling composite (QTC) used as the signal delivery component of the Softswitch system. WRONZ is the expert in the field of smart textiles and has been working for a number of years on the development of highly functional electronic fabrics. Together they have formed Softswitch Ltd as a UK-based electronic fabric technology company.

QTC has unique pressure-controllable switching properties, and it can be woven. In their normal state, Softswitch fabrics are insulators until pressure is applied, at which point the resistance decreases until the fabric achieves conductivity akin to a copper wire, but infinitely controllable. For example, the pressure of a finger will reduce the resistance from billions of ohms to less than one ohm. The function lends itself to many applications where proportional control of electronic devices is required and it is possible to extend the process into areas such as GPS-based locating devices, microwave communications or personal computing on the move.

The technology can be used in combination with any type of fabric and is not restricted by size or shape. Softswitch says that the system is a complete textile solution from the fabric interface to the textile data bus and connectivity. Dr Dianne Jones of WRONZ Euralab, who delighted the audience with the Softswitch capability at The Summit, the joint venture WSA/DuPont Cordura international conference, by switching lights on and off from a jacket sleeve, was asked to comment on the possibility of a developed Softswitch textile being capable of supporting sensors that could diagnose the condition of a mountain rescue evacuee before the rescue team had left the mountain. "There shouldn't be any problems with the textile," she said. "All it requires is the technology to link with."

Schoeller Textil, of Switzerland, is also working on wearable communications and control fabrics and has suggested that a further development will be protection, interacting with the environment to provide warnings of potential hazard from extremes in temperature or physiological condition. The company is developing further its existing PCM technology licensed from ComforTemp and is conducting research on glow-in-dark technology as a safety feature.

Of course any electronic gizmo is only as valid as its power source. Three products featured in these columns demand battery power in one form or another and all batteries are finite in capacity and output. Weight is another important factor, particularly so when the user is self-propelled, and it is this issue which has exercised the research talents of two companies in particular. Israel-based Power Paper has just released details of a new type of low-power battery that does not require a case and is thin enough to be printed on paper.

The new product consists of three layers, in total roughly 0.5 millimetres thick. The anode and cathode are conventional zinc manganese dioxide. Sandwiched in between them is the cell's chemical power source, the formula for which remains a closely guarded secret, producing 20 milliamp-hours at a terminal voltage of 1.5 volts for every square centimetre that is printed. Paper Power claims the material is non-toxic and non-corrosive, making the battery safe to use without a casing. If mass-produced, the Paper Power battery should cost just a few cents per square centimetre.

Aeronautics companies figure largely in these columns because of their dependence on textile technologies for much of what they achieve. But it is not often that one the size of Lockheed Martin graces our pages and it's not exactly the company to be associated with the development of a new power source. Engineer Laurence Williams was involved with the development of lightweight, remote controlled, reconnaissance airships that require an advanced power source to give them a long range and a high power/weight ratio. He decided he could solve the problem by bringing together fuel cell technology and the flexible polymers used for the skin of the airships - in effect making the aircraft its own battery. The technology is well known; hydrogen inside the capsule reacts with oxygen drawn from the air outside to produce electricity.

At the heart of the membrane is an acidic polymer layer that acts as the electrolyte. This separates oxygen and hydrogen but allows

hydrogen ions to pass through. Thin layers of platinum act as the catalyst and fine wire mesh layers over each surface are the electrodes. The ultimate reaction that produces electricity is beyond the scope of this feature, but suffice it to say that the intention is to produce an output of 200 watts and a range of around 700 kilometres. Now translate the concept into a polymer bubble located at base camp...

...and frogs make princes

With the benefit of 20/20 hindsight all those tales of princes being created from frogs by the kiss of a princess are merely the early benefit of the application of nanotechnology. The one-billionth-of-a-metre-sized nano bugs, applied as a chemical structure, smoothed the skin - increased the height and transformed two leaves into suitable garments!

Two companies are currently applying nano-processes to fabrics to change the molecular structure without affecting the hand, but conferring the benefits of moisture wicking, crease-resistance, water repellency and oil and dirt shedding. Nano-Tex LLC of Greensboro, North Carolina, has just added odour absorption to the list by attaching a receptor that attracts the odour-building bacteria and neutralises them. The first company in the world to employ nano-technology commercially, Nano-Tex states that it manipulates the architecture and chemistry of textiles and adjusts the molecular structure to produce the best aspects of polymer-based and natural fibres. With its part-owner, Burlington Performance Wear, three products are currently on offer - Nano-Dry, Nano-Care and Nano-Pel.

Schoeller Textil has given its nano-technology process the brand name NanoSphere and state that it conforms to the company's Bluesign Standard to demonstrate "...how the company promotes better living by careful use of resources and excluding harmful substances". NanoSphere is a dirt and water repellent adjustment of the fabric's surface; Schoeller compares it to several natural phenomena to highlight its anti-adhesive effect on surface contaminants.

Good bugs versus bad bugs

Health and textiles are interactive as well as indicative - clean clothes equals a healthy body. The past five years have seen a substantial improvement in, and rise in the use of, fibre encapsulation. In turn this has led to the ability to place beneficial microcapsules within the actual fibres to confer qualities not otherwise available. PCMs are possibly the best illustration of the technique.

A recently reported development came from the University of Massachusetts, where bioactive fabrics have been produced. Essentially these are textiles which have genetically-engineered bacteria sustained in bio-environments introduced into the fabric structure with the ability to generate and replenish chemical processes. Success was reported with the hollow fibres of the milkweed plant where the bioactivity meant that bacteria actively reduced odour producing contaminants and where the application of a further nutrient regenerated the bacteria in a continuous process. In effect, the end product could be self-cleaning clothes, but there is a long way to go - not least because at present the process depends on the availability of a hollow natural fibre and the milkweed plant is now only considered suitable for rope making.

Diana Irani, a textile research student at the UK's Royal College of Art, has just won a special innovation award for her work in developing clothing fabrics carrying encapsulated essences of natural medicines and herbal remedies. She has suggested that such a development could give relief in chronic conditions such as eczema and arthritis. The clothes can be washed several times before losing their healing properties and Ms Irani is working on a method of replenishing the medicines within the fabrics.

UK-based Craghoppers is offering an unusual revision on two of its leading ranges of travel clothing in that it is incorporating an insect repellent into the garments. Based on a synthetic version of the chemical pyrethroid - itself used as a safe method of repelling mosquitoes - the properties include the ability to repel a very wide range of insects and withstand up to 35 washes before requiring re-treatment. The impregnation has been independently tested to OECD standards for toxicity, skin irritation and corrosion.

Anything is possible

Now, to return to Harry Potter's cloak of invisibility: the author reports the garment as being fluid and silvery, gleaming in its folds, the handlike water woven into fabric. Examining the description we are possibly looking at a silk or cellulosic base fibre, with a silicon coating or some other form of process to ensure stain and water repellency. It has to withstand hard wear, possibly over several centuries, so it may be that an additional reprocessing is carried out at regular intervals - say every fifty years or so. Bear in mind the silvery sheen, however, and perhaps we should be considering a very early form of tri-lobal microfibre polyester. The sewing thread must be drawn from the same source as the fabric to ensure continuity of its properties throughout the garment.

Not an impossible specification and one worthy of most modern research laboratories. Should we watch this space?

Derryck Draper



Schoeller's Smart Materials, Salomon's outdoor clothing

With acknowledgements to J K Rowling, Bloomsbury Publishing and Warner Bros. Thanks also to Jem Gumussoy, aged 10, for specialist research

Fabric round-up

People with sensitive skins have the option of apparel which changes colour when exposed to excess sunshine or to the hole-in-the-ozone layer. Panty hose in anti-bacterial fibres that treat legs as if a moisturising lotion was being used, are also on the market. Japanese designer Junya Wataanabe showed apparel in a completely darkened room during a recent trade show to demonstrate the fluorescent qualities of the fabrics he is currently using. He is just one of several designers including Hussein Chalayan, Issey Miyake and Rei Kawakubo, who believe in intelligent fabrics taking precedence over the design and colour idiosyncrasies of everyday fashion, getting their inspiration purely from technological developments in fibre science.

Sportswear is also latching on to this trend: a football jersey, for example, which through its fibre construction transmits information detailing the physiological condition of a player to the team's doctor, who is then able to predict the possibility of, and prevent, the man cramping up at a crucial moment in the game; the sensor in a football boot which relays information about the power used in a goal shot and subsequently displays the information on a screen to spectators. These are just two of the myriad of uses opening up in this area of material technology.

Cold-weather underwear from the Finnish outdoor apparel company, Reima, has electrodes and sensors attached to it capable of warming up the wearer if needed. The textiles used are Aracon, embroidered with a heart-rate sensoring patch using intelligent thread, and electrically heated Gorix panels combined with temperature regulating Outlast technology. Worn with the company's 2-piece survival suit complete with water and windproof hypothermia sack, detachable cargo pockets which also function as water and flameproof snow-melting bags, pocket map with transparent window and integrated survival kits for fire lighting, first aid and self rescue from falling through ice, this is a suit that could have been designed by James Bond's equipment provider 'Q', and which 007 would not have turned down!



Reima smart clothing

Sympatex recently introduced its latest fabric for snowboarder apparel which it had developed exclusively for use by K2 Ski-Sport + Mode GmbH. The new membrane system is constructed in a two-and-a-half layer format comprising outer material, black Sympatex membrane and a unique lining pattern created in the finest of PA micro-fibres. Starting from the inside, the air in the inter-spatial spaces created by the nap pattern of the lining stores body warmth. Optimum climate control is achieved by the rapid absorption and fast transport of moisture vapour through the hydrophilic membrane, which has been reinforced with carbon fibre (hence the black colouring) to enhance the mechanical strength. With a 25 per cent weight reduction when compared with any similar product, the jacket feels cool and dry on the inside, cannot stick to the skin or the under layer of garments and is said to increase heat retention by a factor of 100 per cent.

Athletic participation in the development of active sportswear is a factor that no manufacturer can do without. An athlete's unique demands on functional apparel for training or competition use can be clearly identified and, together with fabric technicians, solutions sought to any specific problems. Bjorn Daehli is a Norwegian Olympic and World cross-country ski champion. Together with Swiss company Odlo - particularly noted for its state-of-the-art sports underwear collections - he has initiated developments in cross-country ski suits for the top end of the market. Odlo's Bodytec concept suit is one such product. Divided into zones on the body, three types of fabric are required to meet the required standards in breathability, stretch and protection. The basic knit fabric is Eurojersey's Sensitive Classic that is characterised by extremely high flexibility and used in those areas where stretch is all-important. Sensitive Ultra Light is placed under armpits and the upper back, the areas of highest transpiration, to guarantee effective moisture transport. Areas most subject to the effects of wind and snow combined, such as the arms, throat, abdomen and upper legs, are protected with Odlo Sensitive Power fabric. The pre-shaped fabrics combine together to work in a manner which is similar to muscles stretching and contracting when in use, so that the athlete gets the support when and where needed.

The 'Sidewinder SV' jacket, from Canadian manufacturer Arc'teryx, won first prize in the textile category of the ispo exhibitions Outdoor Award Winter 2001. A Gore-Tex XCR jacket which is not cut and sewn but sculptured and assembled, many of the seams, including those on zips, pits and pockets, are heat welded to save over 50% sewing on each garment while making them totally water-tight. The design of the front zip places the upper lock-off away from the chin so there is no friction between skin and zip. Single handed pulls for tightening both jacket and hood, laminated adjustable powder skirt and inner mesh zippered pockets are just some of the numerous innovative features of this extreme outdoor jacket.

Kay Turtle

