



From 'grunt' at the front to covert action behind enemy lines, from naval missile crew to airframe fitters, the clothing that is worn is often the only line of protection against a whole heap of 'nasties'. Modern textile developers carry an awesome responsibility in this market sector.

Operationally developed

War is not pretty, not sexy, not funny, not remotely desirable. Unfortunately there are times when it seems to be almost inevitable - a by-product of the human condition. And the by-product of the by-product is the necessity to maintain armies for defence and offence.

Governments take responsibility for supplying and regulating the personal equipment required for military personnel - some proving to be better than others in this particular context - and the modern 'fashion' for short term interdiction carried out by fast-moving forces has caused supply departments to become increasingly reliant on the output from the performance textiles industry. Lightweight, efficient clothing to keep service men and women warm, dry and comfortable falls precisely within the parameters established by athletes and outdoor activists throughout the world.

Discussing the situation with exhibitors at the recent Outdoor Retailer Winter Show in Salt Lake City, Utah, we were faced with a good many comments of the 'we can tell,

but then we'll have to kill you' variety. Fortunately there were a number of more sensible manufacturers who were proud of their products and realised that information given as a result of a wide ranging enquiry was not going to even remotely jeopardise military security. Economic strictures and self-protecting bureaucracy are likely to do far greater damage.

Opportunity revealed

Founded in 1971, the Venture Development Corporation (VDC) is a US-based technology market research and consulting company that specialises in industrial and commercial electronics, computing, communications, software and power systems markets. Coincidentally the company's address is Natick, Massachusetts, and therefore not a million marching steps away from the US Army Soldier Systems Center.

In November 2003 VDC published a paper entitled 'Smart fabrics and Interactive textiles (SFIT): Global market opportunity assessment' in which it predicated that the global market for SFIT-enabled solutions will reach \$720 million

by 2008. Military usage accounted for 10% of the annual and it is estimated that it will continue at this level for the foreseeable future. Most importantly, military applications will continue to drive developments and in turn offer significant opportunities for suppliers to the commercial markets.

SFIT-enabled solutions include garments, accessories, medical monitoring devices, wearable entertainment, fitness gear, and many other consumer, industrial and military systems. The paper noted that 'the most attractive near-term market opportunities for suppliers of SFIT-enabling technologies, and SFIT solutions are expected to include mission-critical military gear, certain medical information/monitoring and control systems, and luxury goods/elite athlete consumer products and niche [markets].'

Under the 'Biophysical Assistance and Protection' grouping, the sub-heading

(above) Custom Image Generation as applied to Pittards leather - in a Canadian camouflage pattern.

 Pittards

Textiles' logged three components;

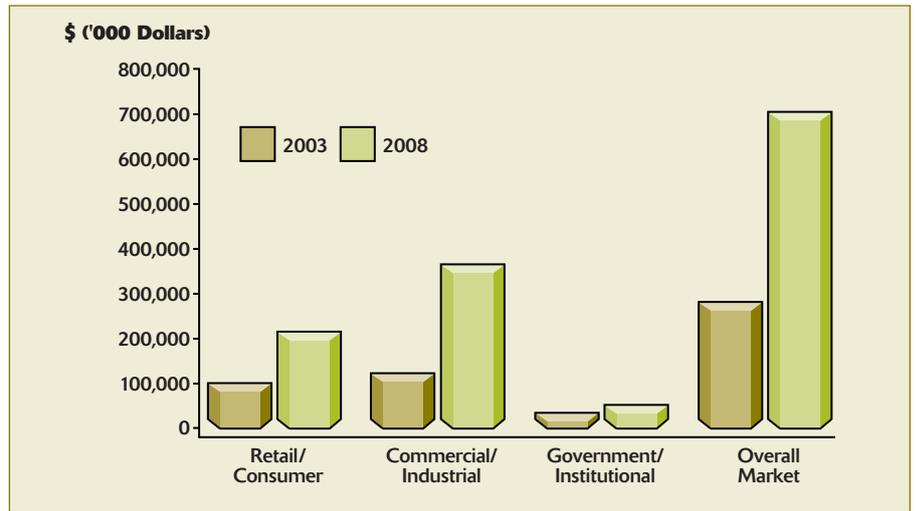
- Body armour/ damage limitation - density changing materials, impact-resistant nanotubes
- Responsive fabrics - contracting materials, nanofibres to filter bio-chemical agents
- Artificial muscles (nanotechnology)

Extrapolate from those into industrial and commercial applications and it easy to envisage the opportunities for successful long-term entrepreneurial activity.

Courage from the Dutch

In an extract from a report prepared by the Dutch research group TNO, it is suggested that a soldier in the Dutch army provides a good example of the demands placed on intelligent textiles. Soldiers these days tend to be posted abroad on peace-keeping rather than fighting missions. Nevertheless, they too can get caught up in violence. Added to that, the soldier must be able to operate in diverse climates, carrying out a range of tasks. The varied nature of the job is a vital aspect when designing military clothing. Ideally, the outfit must be light but also splinter- and bullet-proof, cool in hot climates and warm in cold weather. It must be ventilated but also able to offer protection against gas and biological weapons. In fact, the soldier's outfit must be able to handle anything and everything.

'The desires and requirements for this type of clothing are varied and sometimes contradictory,' says Anton Luiken, manager of textile research at TNO. 'The ideal outfit doesn't exist so we have plenty to keep us busy both improving products already on



Source: VDC

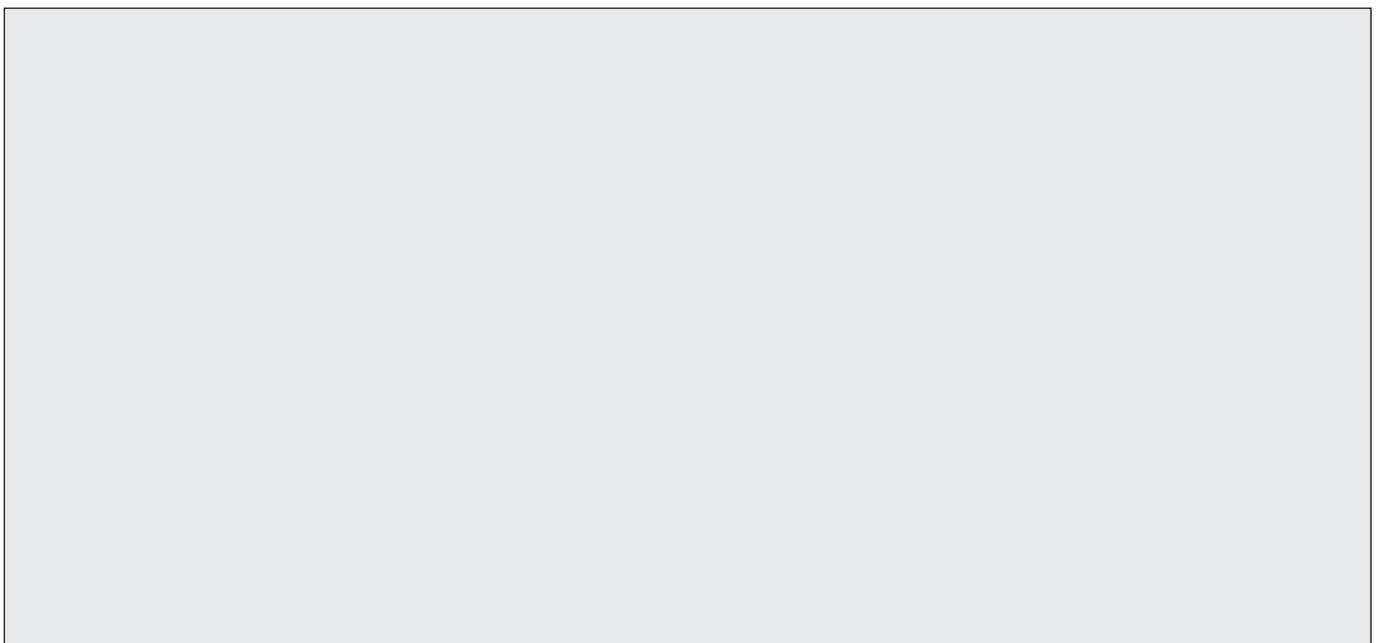
the market and enhancing products at an advanced stage of development.'

A piece of synthetic fabric illustrates Luiken's point about the flexibility required. 'Feel it. This fabric absorbs the hand's heat.' The principle behind the cloth is that it contains phase change materials, which melt at a pre-determined temperature. At that temperature the PCM absorbs heat and the fabric continues to feel comfortable for a long time. As it subsequently cools, energy is released and the heat is returned to the wearer.

In other cases, studies find that intelligent textiles do have something to offer. 'We are working on clothing that is less visible to thermal imaging cameras. You can track someone at a distance of a kilometre with one of these cameras, even in the dark. Intelligent textiles can make the target less vulnerable. We are thinking about reflective clothing and clothing that is equipped with a ventilation shaft.' This

last raises an interesting possibility for the cooling clothing referred to earlier by Luiken, in that it is possible for a pressure 'barrier' to be created in the space between the textile layers to hinder chemical and biological weapons.

Developments in the field of intelligent textiles often arise out of questions posed by the military. TNO's Dr Herman Schoo develops electronics made from conductive plastics that are suitable for making textiles intelligent. "Soldiers,' he says, 'use an increasing amount of technology. That increases their effectiveness and safety but it has its risks. The equipment is heavy, it must be unbreakable and it consumes energy.'" The electrical systems on which Schoo works replace the wires and boxes that a modern soldier has to carry around with systems integrated into the soldier's



clothing. He continues: "Textiles that transport data and energy. The circuits are easy to apply; we use a technique similar to modern printing techniques. Parallel circuits can also be imprinted in this way. That gives less chance of a power failure than wire circuits. Clothing seams, however, are still a weak point."

Commercial opportunity

The substantial development and supply contracts secured with the American military function by Malden Mills have undoubtedly made a major contribution to the survival of the polyester fleece producer in the context of its recent financial restructuring. Almost every aspect of the standard clothing element issued to both regular and special forces personnel now has a Polartec input - and all the items carry a Polartec label, a major concession by the US defence procurement agency in recognition of the part that the company plays in equipping the country's armed forces.

Some products are less obvious than jackets and hats - shipboard blankets for example are made from Polartec Thermal-FR fibre mixed with DuPont Nomex. These are replacing existing World War II issue to provide warmth without weight, extreme flame resistance and the ability to dry quickly in an essentially damp atmosphere.

Power Dry fabrics are used in a variety of configurations for underwear issued as part of the American Special Operations Forces Protective Combat Uniform. In one instance silver has been processed into the fibre to provide a permanent anti-odour specification - a useful attribute to



Polartec Power Dry with silver fiber is used in the Special Operations Forces' protective combat uniform.



a man who has been lying-up for several days in hostile open country and still has to remain undetected.

Shirts and pants for naval aviators and aircrew are produced in Malden's Powerstretch-FR with Nomex to provide active protection from flame, heat, wind and water. Known as the Multi-Climate Protection System, the set consists of seven garments acting operationally as a series of baselayers to cope with widely varying external conditions.

Stealth health

Chemical and fibre giant DuPont has long had a high tech relationship with military procurement and equipment development functions around the world. One of its main preoccupations at present is the provision of yarns and fibre that could provide a 'stealth' capability - that is masking the infra red signature given off by a human being. It is investigating fibres that can change shape, and even colour, under electronic control - possibly rendering combat clothing almost invisible in some circumstances.

We are also indebted to Malden Mills for the following explanation of just how IR masking is achieved with camouflage print: 'Basic IR wavelengths are achieved through dye selection. Dyestuff manufacturers know the reflectance of their dyestuffs and have developed dyes for each of the military colours. Each colour has a specific wavelength and then by mixing them into camouflage you get the blended effect of hiding someone's silhouette.'

UK-based Pittards found itself in a quandary when asked to supply glove and footwear leathers to a variety of countries - all with their own ideas of just what constitutes the ideal disruptive pattern camouflage. Camouflaged gloves one can perhaps appreciate - but boots! Nevertheless the point is proven by the fact that NATO air forces now paint training aircraft black for greater visibility. It is logical that black boots are more likely to destroy an attempt at invisibility at ground level.

To meet the specifications the company has pioneered a breakthrough in what it terms 'custom image generation' to enable camouflage patterning to be incorporated on to military glove and boot leathers. "And to do so without any loss of performance," said Mike Dodd, Pittards' marketing director. These very special products bring together dexterity, grip, water resistance, breathability, abrasion resistance and infra-red absorption into one multi-specification package for the benefit of foot-sloggers everywhere.



Polartec Thermal-FR with Nomex Shipboard Blanket is warm, light and extremely durable.



An advanced camouflage system has just been announced by the French fibre and fabric supplier Kermel. In association with DyStar it has produced what are described as 'exceptional flame-retardant camouflage fabrics' that meet current requirements for both visual and infrared detection - or lack of it. The combined approach permits both companies to create a wide range of camouflage fabrics, compliant with EN 531 (protection garments against heat and flames). The technology does not compromise the basic requirements of clothing fabrics, i.e. handle and comfort, nor the flame-retardant qualities of Kermel/FR viscose. The company guarantees a good colourfastness to light, laundries and abrasion. Appearance and all infrared reflectance characteristics are said to last for the life of the garment.

Kermel also produces a wide variety of fabrics, using a multi-mix approach to its basic fire-retardant fibre, that are intended to provide a far higher level of protection than a simple poly/cotton textile used in a high proportion of combat fatigue suits. Its V50 fabric, for example, is made with 50% Kermel and 50% FR viscose and is intended for permanent wear clothing. The moisture absorbency is said to approach that of cotton.

Sleep + efficiency

Despite the threat to personal health mentioned in the opening paragraphs, there is no hesitation in revealing that Albany International's Primaloft insulation system was developed at the behest of the American army to produce a combat-ready sleeping system. That it has continued to do so is a measure of product efficiency, and there have been a number of follow-up applications such as

Normal colour film



IR black and white film



 Kermel

These days, patterned camouflage uniforms are standard issue in most armies. The aim is to merge into the surroundings as far as possible by avoiding contrasts and blurring outlines, in both the visual and near infrared range. Modern surveillance technology can detect troops in conditions where the human eye struggles using infrared rays (electromagnetic radiation). The images obtained depend on the reflectance properties of the objects in the infrared range. On a black-and-white infrared film, high reflectance produces a bright image while low reflectance produces a dark image.

glove, clothing and footwear insulation to consolidate the original decisions.

Carinthia is an Austrian-based manufacturer of high-performance combat sleeping bags. Offering a choice of own-brand GLT hollow-fibre synthetic fill or 90/10 European goose down, the range of bags offers comfort ratings from +3 degrees C down to -55 degrees C. Not surprisingly the styles emulate the best in civilian products, with the exception of three products where mobility plays as much a part as comfort. These three incorporate sleeves, gloves and appropriately designed zippers to allow use as a coat when necessary.

The Austrians also offer a range of GoreTex Best Defense bivvy bags and

one-man tents – the latter also offering IR masking as standard.

Just in case someone misses that last option, W L Gore also produces its own Observer bivvy bag - 'designed for forces which also have a need for observing during operations'. Manufactured in Gas Permeable GoreTex, the bivvy is said to offer improved insulation operating at an apparent 13 degree differential ambient to internal temperatures. Some observers just get lucky one has to suppose.

Breathability is a key function of the military-targeted fabrics produced by South Africa's BreatheTex Corporation. Available in two or three layer laminates, the membranes can be hydrophilic or microporous in PTFE, PU, PES or blockamide base materials. Camouflage patterns to order.



 Polartec

An old soldier's view

Clothing and other textile-based equipment intended for military usage has an unfortunate cachet that is composed of part 'big boys playing with big boys toys' and part fear of the consequences if they do not. However, it has to be said that if young people are willing to fight for their ideals, their country and for freedom from tyranny – then they must be equipped for the job in hand with the best possible kit. Governments please take note. 

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