

# Innovations in intelligent apparel and technical textiles

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Technical textiles are the high performance fabrics specially manufactured for various industrial specialized individual applications. The market trends for traditional textiles are heavily inclined towards countries with cheap labor. In such an environment, technical textiles give an opportunity to the companies in the industrialized countries to survive the competition and to achieve sustainable growth due to their specialized skills, materials, processes and equipments. US and EU continue to be major manufacturers and consumers of technical textiles, the Asian countries like China and India have recently emerged as production centers of technical textiles. Russia is also an important market where the consumption of technical textiles is growing at a fast speed. Turkey's technical textiles market has also started to develop in the recent years. The total global sale of technical textiles is expected to touch US\$139 billion by 2012. Asia is fast emerging as the chief producer and to some degree consumer of technical textiles. This paper highlights and demonstrates the technical and their future contribution to the development of economics of newly developing countries, such as China, South East Asia, and North Africa etc. A special focus is placed on the innovations in intelligent apparel and technical textiles now span the whole market.

Technical textiles are high performance textiles that require special functionality. The market of technical textiles is significant and expanding as the products are being put to an ever-increasing number of end uses in various industries such as agriculture, clothing, construction, health care, transportation, packaging, sports, environmental protection, protective wear and many more although technical textiles have attracted considerable attention, the use of fibers, yarns and fabrics for applications other than clothing and furnishing is not new phenomenon. What is relatively new is a growing recognition of the economic and strategic potential of such textiles to the fiber and fabric manufacturing and processing industries. In some of the most developed markets technical products already account for as much as 50 % of all textile manufacturing activity and output.

The technical textiles supply chain is a long and complex one stretching from the manufacturers of polymers for technical fibers, coating and specialty membranes, through the converters and fabricators who incorporate technical textiles into finished products and use them as an essential part of their industrial operations.

World market for technical textiles at 21 million tonnes (US \$ 120 billion) during 2007-08 is expected to increase to 26 million tonnes (US \$139 billion) by 2012 with an average increase of 4% - 5% depending on the area of application. Presently, Japan, Germany, the US, the UK, France, Turkey China and India are the key producers of technical textiles. These countries except China and Turkey have practically abandoned producing conventional textile products.

The historical progress of technical textiles has seen the advance of alternative textile forming technologies, most prominently the broad family of nonwovens techniques, but also warp and weft knitting, stitch bonding and modern braiding methods. The use of loose fibres with sophisticated cross-sectional profiles for insulation, protection and fibrefill applications is another important growth area. On the other hand, the total value of yarns and fibres and of all technical products will grow slightly less fast than their volume because of changing mix of materials and technologies, especially reflecting the growth of nonwovens.

In machinery development, the trend will be towards automation in all stages including computer colour match prediction and composition of designs in printing. The evolution will be towards equipments using less and less of water like continuous dyeing, HT steaming and 'thermosoling' are expected to make rapid strides with increasing use of infra-red in many applications.

In fibre technology and development, emphasis will be on the fibre blends and modification in cellulose. Fibre with better dimensional stability, soft handle coupled with modified dyeing properties will be in demand. The share of synthetic fibres in the

technical textile sector will rise from 79% in 2000 to 81% by 2010. There will also be an increase in the share of nonwovens and will grow from 35% in 2000 to 39% by 2010 in weight terms. This increase will largely be at the expense of woven fabrics, whose share will decrease from 58% to 53%.

In finishing, functional knits, transparent fabrics weighing less than 100 g/m<sup>2</sup>, micro-fibbers, leisure wear, non-staining and easy care fabrics, fire proof, weather protection, free of harmful chemicals will be in demand. The tendency will be to evolve a "universal finish" which at one stage will impart easy care, flame retardant and bactericidal characteristics to the textile material. The development of synthetic polymer fibbers, production of high performance fibbers and high technology textiles will rapidly change the textile industry from science served to science based. Technical textiles are used in a wide range of end-use applications and markets, including agricultural; automotive; building/ construction/ engineering; medical and hygiene; packaging; protective clothing; sports and sportswear; and transport. According to the Techtex classification 12 main application areas for textiles have been defined as given below:

1. **Agrotech:** agriculture, horticulture, forestry and fishing.
2. **Buildtech:** Building and construction.
3. **Clothtech:** functional components of shoes and clothing
4. **Geotech:** geotextiles and civil engineering.
5. **Homotech:** products used in the home; components of furniture and floor coverings.
6. **Indutech:** filtration and other products used in industry.
7. **Medtech:** hygiene and medical.
8. **Mobiltech:** transportation, construction, equipment and furnishing.
9. **Oekotech:** environmental protection.
10. **Packotech:** packaging and storage.
11. **Protech:** personal and property protection.
12. **Sporttech:** sports and leisure technical components.

The sector-wise market size of technical textile is given in Table 1 and region-wise of consumption of technical textile is given in Table 2.

## World Consumption

World consumption of this sector is estimated 19.68 million tonnes in 2005 and will rise to 23.77 million tonnes in 2010 with an average growth rate of 3.8%. The largest application areas by value are transport, industrial and sports-related products. But the faster growing sectors up to 2010 will be the geo-textiles and medical and hygiene related products. Asia will accounts for 45% of the market by weight in 2010 compared with 23% in the case of Europe and 29% for the Americas. It is estimated that the volume growth of technical textiles in developing countries will average between 4% and 5% per annum to year 2010.

**Table 1: Market Size of Technical Textiles (sector wise)**

Quantity: 000 Tonnes  
Value: US : \$ Million

Sector	2005		2010	
	Quantity	Value	Quantity	Value
Agrotech	1,615	6,568	1,958	8,079
Buildtech	2,033	7,296	2,591	9,325
Clothtech	1,413	7,014	1,656	8,306
Geotech	319	927	413	1,203
Homotech	2,499	7,622	2,853	8,778
Indutech	2,624	16,687	3,257	21,528
Medtech	1,928	6,670	2,380	8,238
Mobiltech	2,828	26,861	3,338	29,282
Paktech	2,990	5,329	3,606	6,630
Protech	279	5,873	340	6,857
Sporttech	1,153	16,052	1,382	19,062
Oekotech	287	1,039	400	1,389
<b>Total</b>	<b>19,683</b>	<b>106,899</b>	<b>23,774</b>	<b>127,288</b>

Source: David Rigby Associates / Techtextil

**Table 2: Consumption of Technical Textiles (By Region)**

Quantity: 000 Tonnes  
Value: US : \$ Million

Region	2005		2010	
	Quantity	Value	Quantity	Value
West Europe	4,107	23,968	4,760	21,047
East Europe	666	4,583	817	5,225
North America	4,774	23,710	5,591	27,561
South America	1,004	6,348	1,230	7,255
Asia	8,091	47,075	10,156	65,156
Other Countries	1,041	1,215	1,220	1,044
<b>Total</b>	<b>19,683</b>	<b>106,899</b>	<b>23,774</b>	<b>127,288</b>

Source: Technical Textiles and Industrial Nonwovens: World Market forecast to 2010, David Rigby Associates

**Table 3: Fiber-wise Consumption**

Fiber	Consumption
Polyester	25 %
Polyolefins	25 %
Glass	15 %
Jute, etc	14 %
Cotton	7 %
Viscose	3 %
Other Cellulosics	3 %
Polyamide	7 %
Aramid and Carbon Fibres	1 %
<b>Total</b>	<b>100 %</b>

Source: David Rigby Associates / Techtextil

**Fibre Consumption:** Textile structures made of polylactic acid and polyglycolic acid fibres are being used as structures for cell growth. Human organic tissues like skin, cartilage, liver, pancreas and kidney can be grown on temporary bioresorbable textile supports. Smart fibres loaded with drugs and based on naturally occurring polymers as non-animal-based protein fibres and structures are being developed for the treatment of wounds and ulcers. Global fibre consumption is given in Table 3.

### New Innovations

From easy-care clothing to astronaut's suits, innovations in intelligent apparel and technical textiles now span the whole market, from everyday benefits that make the wearer's life easier to critical applications whose function is saving lives.

Apart from providing increased personal protection in all sorts of work environments, technical textiles for clothing end-uses are also becoming more comfortable, easier to wear and easier to care for. Most developments in wearable electronics are still aimed at the iPod or MP3 user, although the emergency services and military are exploring applications like built-in electric lighting within garments.

A new partnership between Naturally Twisted Ltd, a UK based textile technology developer, and Wera and Beverley Productions from New Zealand, has led to a new range of knitted innovations that combine conductive yarns, novel structures and smart electronics. The fully integrated textile structure is electrically heated and gives fabrics that are both soft and flexible for a range of active apparel and outdoor wear garments.

High performance yarns, such as Kevlar, are at the core of some other innovative knitted structures and products from Beverley Productions, designed to protect the body literally from top to toe. These include the comfort of a near seamless knitted anti-flash hood for protection against fire and disfiguring burns, and a lightweight boot that stops a chainsaw in less than one second.

### Technical workwear

The Chinese company Shanghai Talon Fibre Co Ltd has developed polysulfonamide, or PSA, a fire protective aromatic polyamide fibre that can withstand long-term temperatures of 250°C and short-term temperatures of 300°C.

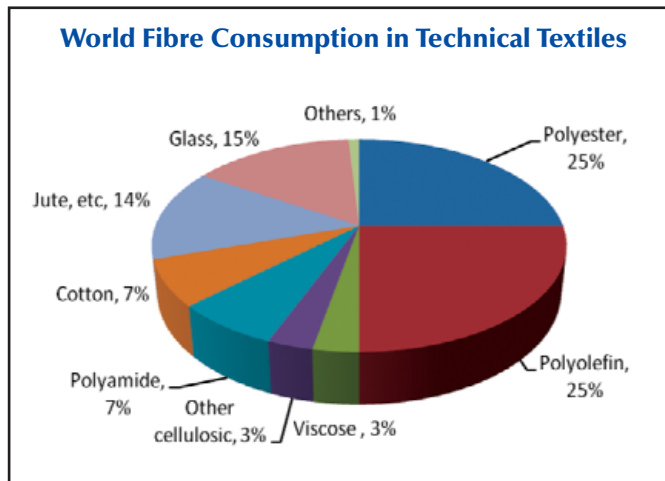
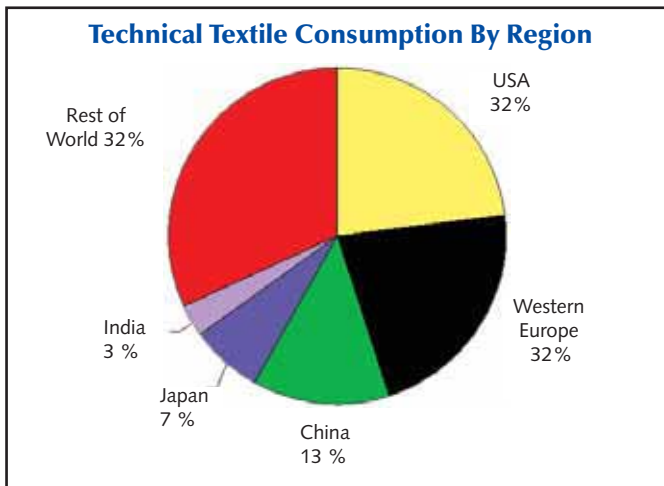
As a direct competitor to Nomex, applications include space suits, special military uniforms, fire-fighters' protective clothing, electric welding suits, furnace suits, oil field and refinery and chemical protective clothing. A new plant has been built to produce this new fibre with capacity for 1000 tonnes per year.

Successful products inevitably attract cheap imitations, although in the field of fire resistant personal protective clothing compromises are out of the question. Austrian company Lenzing works with selected quality partners worldwide. It's Lenzing FR flame resistant agent is incorporated directly into the fibre matrix before spinning, giving permanent flame resistance that is unaffected by washing or physical abrasion.

### Silver service

Silver is recognized by the medical community for its antimicrobial properties. One of the best-known fibres is X-Static, which uses pure silver to inhibit the growth of odor-causing bacteria and fungi, as well as dissipating electrical charges and electromagnetic interference.

The silver is irreversibly bonded to the fibres, making its benefits permanent and preventing it from washing or wearing off. Canadian company TIK Security Knits uses DuPont Nomex IIIA, X-Static and Lycra in its new Silver Security Knit double velour



fleece fabrics for garments and blankets. The fabric protects against flash fires and electric arcs.

The company also produces a DuPont Nomex IIIA flame resistant single sided fleece with 150% stretch in the width, and 80% stretch in the length. And its innovative engineered three-ply flame resistant stretch fleece laminate, called FlameResistor, is made from modified acrylic, cotton, polyester and X-Static, and is permanently flame resistant and will not melt nor drip.

Aluminised fabrics are a speciality of the US' Gentex, and are used in fire-fighting apparel to combat radiant heat from high-intensity fires, and to protect industrial workers from molten metal splashes. The five-layer textile structure is said to reflect 95% of infrared heat.

**Membrane technology**

Schoeller Textil from Switzerland has a new membrane technology called C-change which adapts its moisture vapour permeability in response to different weather conditions. The water and windproof 'Bionic Climate Membrane' opens its structure at high temperatures, or during periods of strenuous activity, so that excess heat can escape. During cold weather or periods of inactivity, the structure of the membrane closes, retaining body heat.

**Eco-friendly a key theme**

Cocona fabrics and yarns from Trap Tek in the US are made from coconut shells and provide evaporative cooling by pulling moisture away from the skin and spreading it across the fabric surface.

Activated carbon embedded within the yarns and fibres also absorbs harmful UV rays, and depending on fabric construction and Cocona content, up to 30 Ultraviolet Protection Factor (UPF) can be provided. Odour molecules, too, are trapped by the activated carbon, and are then released and the carbon refreshed by the heat from washing and drying.

Coconut activated carbon is a recycled, sustainable material, since coconut shells are a waste product from the food industry. Coconut yarns may be blended with cotton and wool as well as man-made fibres.



Medical and hygiene applications are more inclined towards single use disposable nonwovens.

**Barriers and antimicrobials**

Waterproof, windproof and breathable Skyair membranes from the UK Company Skymark are developed around the latest resin and manufacturing technology, and are recommended for both outdoor clothing and the health care field.

Skyair is a monolithic membrane and free from any pores; which means that it is an excellent bacterial barrier whilst also being breathable. In hospital environments and operating rooms it can protect staff from bacteria, viruses, blood and other fluids, whilst still being comfortable to wear.

Aegis Enhanced is a comprehensive range of antimicrobial chemical treatments developed by the Belgian Devan Group, which provide additional functionalities to enhance comfort and well being. These include a host of different chemical finishes for moisture management, stretch recovery, sensory management, shrink resist, flame retardant, and anti static technology - all of which are also antimicrobial.

**Conclusion**

Global markets of technical textiles and nonwovens continue to grow. World market for technical textiles at 21 million tonnes (US \$ 120 billion) during 2007-08 is expected to increase to 26 million tonnes (US \$139 billion) by 2012.

The future development of the technical textiles markets and products will largely be centered upon new materials, new processes and new applications operating on a global basis for the development of economies of scale in production and product development.

New challenges are emerging from the switch to a "market-pull" industry dynamic from the previous "technology-push" which is leading to changes in the demands placed on the industry and the relative power and influence of participation at different levels in the supply chain. In these circumstances, textiles are playing major role through its diversified applications and undoubtedly the future of this technical textiles appears to be bright in this, lot of uses are there. They are medical textiles, protective textiles, agricultural textiles, geo textiles, automotive textiles, smart textiles and industrial textiles. ♦