It is a well-accepted fact that textile innovation begins with the fibre. The performance of a fabric or garment for leisure wear, active sportswear, underwear or protective wear is based on the judicious choice of the right raw material. The various stages in the textile production chain contribute to enhancing the final result and the finishing process is particularly significant, but the choice of fibre is the fundamental factor in the design of high performance apparel. It is the essential ingredient that enables the wearer to feel difference.

Five years on and PTT starts to make a mark

The decisive factor determining the properties of a man-made fibre is clearly the polymer. Some of the most innovative textile applications in recent years have been achieved by enhancing the characteristics of polymers or by adding the right compound to a basic polymer, but ongoing intensive research and development by the multi-national chemical companies is destined to produce even more and better results.

There are a limited number of polymers from which man-made fibres are currently produced. Polyester, polypropylene and polyamide are the three most widely-used fibres in the world, with polyester representing more than two thirds of global consumption. The cellulose fibre family, acrylic fibre and a number of very special 'niche' fibres such as spandex, aramide and Nomex complete the picture. It would be easy to say that the future of high performance apparel depends on the chemical industry, but this is in fact only partly true. In recent years the major petrochemical companies have been disposing of their fibre business through mergers and spin-off operations, dramatically changing the structure of the fibre market. They tend to concentrate mainly on monomer and polymer production, which requires huge investments in R&D and often a long time to market, but have a wider field of application and many different end uses (not only for fibres but also for plastics and other hi-tech materials).

The world of man-made fibre production has changed tremendously since its beginnings, with a true textile culture growing up alongside the petrochemical companies that previously dominated fibre innovation. The man-made fibre business has, to a certain extent, become an integral part of a fully-integrated textile manufacturing chain, of which it represents the first and most fundamental stage.


Shell International Limited

A polymer for innovative fibres

While PTT (polytrimethylene terephthalate) is not new it is still sometimes referred to as the 'only new fibre introduced into the market in the last 40 years'. PTT is related to PET, as both contain terephtalic acid (PTA). It is an aromatic polyester made by the polycondensation of 1,3-propanediol (PDO) and terephthalic acid; it is the PDO which appears to give it some of its unique properties and PTT now appears to be demonstrating a real breakthrough in the world of man-made fibres. The polymer was first patented in 1941, but it was not until the 1990s, when Shell Chemicals developed a low-cost method of producing high-quality (PDO) 1,3-propanediol (the raw material from which PTT is made) that commercial production of the branded Corterra polymer was made possible. Working with the plant engineering contractor Zimmer AG, Shell developed efficient, reliable PTT manufacturing technology. Between the end of the '90s and the beginning of the new millennium, Shell Chemicals scaled up its PTT industrial process, starting up a new plant in Canada in 2004 with a production capacity of 95 Ktons/year.

In 2000, DuPont also entered the PTT market. The DuPont product is called Sorona and uses 1,3-propanediol produced from corn through bio-catalysed fermentation, a product it has called Bio-PDO. DuPont now has a range of commercial Bio-PDO based polymers which were launched in 2006.

The textile applications of PTT produced valuable results. Besides apparel, it has widespread applications in furnishing fabrics, carpeting, packaging, automotive and technical textiles. The polymer's other end uses include nonwovens, monofilaments, films and engineering thermoplastics. Shell estimates the future market development for PTT, combining all end uses, to be about one billion tons. In fact, it is the developing technology surrounding this polymer which has attracted much of the development as it allows utilisation in so many markets. PTT is easy to extrude, but must be dry in order to achieve a stable threadline.

Innovative textile properties

First of all, PTT has a much lower melting point than polyester (228°C instead of 265°C). Together with the so-called 'glass transition' (Tg = 45 – 65°C instead of 80°C), it allows low temperature dyeing with disperse dyestuffs while PET requires 130°C. The fact that it is easy to dye and holds the colour well has already been discussed in *WSA* in relation to colour fastness, and is clearly a major benefit. As well as simplifying the dyeing process, the low temperature implies valuable energy cost savings. Another important feature of the polymer is the Young Modulus (a constant representing the stress/deformation ratio): the value for PTT is 2.15 N/mm^2, compared with 9.58 for polyester. This is a measure of the fabric's softness, fluidity and handle.

The zigzag or semi-helical structure of the molecular chain provides the intrinsic stretch property of PTT filament yarns, giving it better elasticity than polyester. Water absorption in 24 hours is just 0.03%, compared with 0.09% for PET, 1.9% for PA6 and 2.8% for PA66. It is therefore a highly hydrophobic fibre, with the result that fabrics will not only dry quickly but will also be chlorine resistant—an ideal property for swimwear. Highly hydrophobic yarns also have

An Italian spin on PTT

One of the companies that has prominently promoted Corterra PTT is Filature Miroglio, a division of the Italian Miroglio Group, one of the major global operators in the textile and apparel sector. Founded at the end of the 19th century, the Miroglio Group gradually became a multi-national concern and now has a total annual turnover of about €1 billion, with 8,500 employees and 36 subsidiaries worldwide.

Miroglio Group is one of the few European examples of a fully integrated textile producer, with activities ranging from continuous filament and short staple spinning production to weaving; from finishing and printing to garment making.

Polyester filament production is fundamental within the Miroglio Group. Manufacturing started in 1981 to cover the group's captive consumption, and this activity quickly expanded in both the domestic and international markets. Originally based mainly within Europe, exports are now growing worldwide and today over 85% of its continuous filament and spun yarn sales are made outside the Miroglio Group. Its success over the last year is a measure of its carefully planned investment and high levels of research and development which has allowed it to continue to grow in contrast to the general trend in Europe

Together with filament yarn production—with a capacity of 25,000 tons/year—the company's production of spun yarns in man-made staple fibres is also growing, with current volume at around 10,000 ton/year.

Miroglio first launched Sens in 1999. This is the brand name given to its Corterra PTT yarn and is actually the acronym for Soft, Easy care, New and Strength. The name is considered to also evoke the yarn's particularly sensual touch. Over the years Miroglio has developed Sens in a wide variety of options including flat, twisted, crêpe, textured, textured and twisted yarns, plus tailor-made solutions for special applications. The very latest developments are air-textured yarns for automotive and furnishing fabrics, yarn on dyeing cones, hollow core filaments and ring spun yarns.

The Sens range is suitable for all weaving technology—warp and weft, circular knitting, warp knitting and even seamless—producing outstanding, versatile results with unique properties of softness, freshness and elasticity. These qualities are enhanced by its natural stretch properties thanks to the helical structure intrinsic to the polymer and by the excellent colour intensity in dyeing and printing. The list of Sens users is extensive and includes E. Boselli, Gruppocinque, Fieratex, Sampaio, Tess. Imperiali, and Calamai.

Miroglio notes that weavers at the forefront of innovation such as Borgini Jersey, Cloverbrook and Toray Europe are already using Sens for a new generation of fabrics that will soon be on the apparel market, allowing the most sophisticated and demanding consumer to 'sense' the difference.

Yarn properties

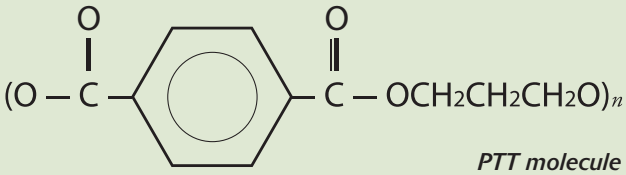
Features	PTT	PET
Softness	Very Good	Poor
Stretch recovery	Good	Poor
Abrasion	Excellent	Good
Transfer printing	Very Good	Good
Chlorine resistance	Very Good	Very Good
Dyeability	Very Good	Medium
Vibrancy of Colour	Very Good	Medium

Source: Miroglio

evident applications in active sportswear as they can be used in the creation of effective 'moisture management' systems and can be very effective when used in blends with natural hydrophilic fibres. It has been shown that even micro-denier artificial leather based on a PTT polymer is possible.

Moreover, PTT has outstanding abrasion resistance and excellent 'resilience', i.e. the ability to resume its original form even at molecular level, after undergoing repeated stress. This helps to avoid creasing. Stan Park, vice president of PTT for Shell Chemicals, summarises the benefits, "Corterra polymer combines some of the best qualities of nylon and polyester in one material. It really is a polymer of the future. Each day customers are finding new applications for it, like car seats, sportswear, toothbrushes and powder puffs. Fibre made from it is inherently stain resistant, anti-static, keeps its shape and has a luxurious feel: yet it is also durable and enhances natural fibres. Fabrics containing the fibre are more wrinkle resistant, dry faster and offer softness and stretch compared to the same fabrics without Corterra."

From polymer to filament yarns



PTT molecule

The marketing strategy adopted by Shell Chemicals to introduce the Corterra polymer into the global textile market was based on a number of partnerships with continuous filament yarn and staple fibre producers, selected from the world leaders for quality and state-of-the-art know how. Initially these included KoSa, Catalana de Polimers (CdP), Interface Flooring Systems, Inc. for carpets; Setila for the sportswear and casual wear markets (although it has since discontinued working with Corterra); Unifi Textured Yarns Europe Ltd. for base layers and the sports markets; Miroglio SpA which launched its yarn under the brand name Sens; SK Chemicals which introduced it under its own commercial brand of Espol, Hankook Synthetics Inc. which launched the yarns under the Zispan brand; and the Hyosung Corporation which introduced it under the brand Neopol to various downstream customers. In addition Asahi was involved in Corterra early on and has collected a large number of patents associated with it.