Pushing for progress in polypropylene

One word that is on many developers' lips these days is polypropylene. Because of its great resilience and low cost, this somewhat underrated and maligned fibre has for too long been the mainstay of inexpensive carpet, rope, vegetable sack and tarpaulin manufacturers, with the exception of one or two base layer manufacturers that have championed its use for many years (Helly Hansen being the best known for its Lifa products).Today companies such as Aquafil (Bonazzi Group), Dreamfel, Chemosvit, Fibrochem and Industrias Murtra are forging ahead with new and ever finer yarn and filament counts, new cross sections and ingredients to add special properties. Knitters including Cloverbrook, Maglificio Ripa, Calamai and LMA are generating ever more inventive 100% polypropylene and mixed fibre type hybrid fabrics (polypropylene/polyester-polyamide-cotton-elastomeric).

Polypropylene and polyethylene are the better known members of the polyolefin group of fibres all made from oil derivatives and both finding sound industrial uses, but never, until quite recently, acquiring the development effort or enthusiasm for technical investment in apparel that was lavished upon polyester. Polypropylene fibre is polymerised, dosed with colour and extruded in a coloured format (melt/spun dyed) as it cannot be dyed in fibre form. This gives the fibre very good wash fastness and light fastness although committing to colour at an early stage and ordering substantial minimum batch sizes per colour (500kgs) is something that both marketing and production planning have to get used to. This is, however, no different to yarn dyed polyester, polyamide or cotton.

Polypropylene has a wealth of technical characteristics that make it very suitable for use in apparel, especially where weight and warmth are critical. It is the lightest of all the fibres in common use in textiles and has the lowest coefficient of thermal conductivity. This means that it is not only very good in terms of heat retention—as substantial volume can be achieved for a minimum weight—but the insulating effect caused by the volume of trapped air is also helped by the low transference of heat through the fibre in the



Helly Hansen's Lifa products are popular with runners, sailors and climbers.

Helly Hansen



Modified Polypropylene cross sections as offered by Dreamfel.

Dreamfel

fabric. The low thermal conductivity also helps to protect against wind chill effects when garments are wet, hence the allegiance of generations of runners, sailors, climbers and rowers to Helly Hansen Lifa products which are continuing to achieve sales growth.

Equivalent fabric volume is achieved with some 30% weight saving against polyester and 20% against polyamide. This weight-to-volume ratio can also be increased by the use of modified fibre cross sections and hollow fibre versions. Dreamfel and American Fibres and Yarns (AF&Y) offer these. Also worth considering are air jet textured versions in Cotton Touch and Wool Touch which offer increased abrasion resistance and enhanced pilling and snagging performance.

Managing moisture

Polypropylene is naturally hydrophobic and has almost zero water absorption by the fibre, which forces moisture to pass through its structure in vapour form, speeding up the moisture transport process and maintaining the desired dry feeling. Most babies' nappies and other incontinence products are padded with it for this reason. What is very interesting is its use in combination with a fibre that is naturally hydrophilic. A pre-treated or naturally hydrophilic polyester (Sorbtec/Coolmax type) outer layer will pull moisture through the hydrophobic polypropylene inner layer to give extremely good comfort performance as in the Lowe Alpine's Dual Fiber Dryflo products.

Combinations with elastomerics are more complicated as it is impossible to reach a suitable setting temperature for the elastomeric component and low modulus elastomerics or low set temperature products are expensive. The use of Dow XLA's product is very interesting (Maglificio Ripa). As the elongation in XLA is inherent in the raw yarn, it can be fed into the fabric construction in a semi-relaxed state and will not give high shrinkage in wet finishing as is typical of segmented polyurethane elastomerics.

Some suppliers have made great efforts in the area of yarn development. One such company is Aquafil that has invested a great deal of work in product quality, especially with its microfibre products in 70f72 and 50f48. The company also has a deep knowledge of combination yarns made with polypropylene and cotton, wool or silk. Chemosvit Fibrochem has a very substantial range of counts from 50 decitex up to 600 decitex and a variety of products with different fibre characteristics including high and low stretch yarns, microfibres and specialities such as bacteriostatic fibres based on silver ions or halogenic aromatic compounds (Prolen Siltex and Prolen Bodyfresh), hollow fibres, fibres with modified cross sections and flame retardant yarns. It also produces airjet texture polypropylene to produce a cotton touch and melange type products. DreamFel has a wide range of products with 30/12; 50/24; 75/36, 75/48,100/ 48 and microfibre in 50/48 ; 50/72 70/72 100/96 plus hollow, antibacterial, far infrared, UV resistant, fire retardant, air textured and photocatalytic. It is currently promoting its Ever-dry, Ever-warm and Ever-bright products which have lustres and properties developed through modified cross sections. Industrias Murtra has carried out a great deal of research and development in the microfibre area and has had some success with one of the major players in base layers for outdoor wear. In the USA, AF&Y is worth looking at as it has a growing range of products for sportswear and very active product development and marketing departments.

Turning up the heat

The Achilles heel of polypropylene has always been its low melting point—you cannot iron it. Many other fibres have come onto the market recently with similar characteristics and with the increasing reluctance of people to iron anything these days this need not be a problem. The fabrics can be relaxed in manufacture and stabilised at low temperature, combinations

Women's Lifa base layer sleeveless tee from Helly Hansen.

Helly Hansen





From Lowe Alpine, men and women's Dual Fiber Dryflo tops with bi-component knit – polypropylene inside and polyester outside.

Lowe Alpine

of polyester and polypropylene can be dyed at the normal 125°C-130°C and relaxed and stabilised in a stenter at 115°C to ensure acceptable stabilities. Furthermore, it is not usually possible to dye or print polypropylene and thermal bonding is not generally available, although some companies claim to be able to both print and bond onto it. However, on the whole, logos, etc., have to be embroidered.

Polypropylene is very inert and resistant to attack by most chemicals—only mineral oils have to be avoided as these can cause degradation. However, in normal use low level contamination followed by washing should not be a problem and the danger only really applies to manufacturing processes. It is also resistant to attack by mildew and bacteria because of its almost zero moisture absorption. It is, however, oliophilic and will readily absorb oils and fats. Therefore the selection of softeners and lubricants is critical. Although polypropylene is fundamentally a desert to bacteria, if digestible oils and fats are applied, in the form of softeners, the effect is one of soaking the fibre in 'bug food' and, as with any other synthetic fibre, it will then begin to generate odour. The lubricants in some fabric softeners not only destroy hydrophilic finishes but are also digestible by bacteria. This is the reason for the odour problems that have held back the growth of polypropylene's usage in base layers for many years when alternative lubricants and softeners were not available or not used. In normal everyday use, with the correct finishing process and washing instructions, there is no odour problem with polypropylene garments.

Polypropylene is a great vehicle for additives and antimicrobial properties can be achieved by dosing the polymer with silver, carbon or photocatalytic positive ion emitters (Dreamfel) or chemical bacteriocides particularly for extended use garments. Interestingly, Lowe Alpine uses a Healthguard finish whereas Helly Hansen will continue to avoid additives completely "until more is known about the longer term effects of the body's absorption of nanoparticles and positive ions". It depends on which ideology you follow.

Weighing up the cost

Considering the comparative cost implications of polypropylene compared with other fibres is complicated. Yes, it is more expensive per kilogramme than polyester or nylon, even taking into consideration its pre-coloured format. However, as it will yield 30% to 40% more metres of cloth per kilogramme and it only needs low temperature finishing, the final cost per metre is not far off that of polyester fabrics of equal volume and thickness. In fabric form, for the same fabric volume 50 decitex polypropylene is roughly equivalent to 75 decitex polyester.

Polypropylene is also very easy to recycle back into most industrial extrusion end uses as long as colour is not critical as you cannot remove the colour in recycling. There are many end uses for polypropylene in industrial areas because of its 'living hinge' characteristics. It has very low flexing fatigue properties typically required for flip tops for bottles, cans, garment and bag fittings, clips and many other products.

It is also light, durable, strong, chemical resistant, warm to the touch and very colour fast. It makes great fabrics and garments for sport. Increased usage would stimulate greater diversity in yarn and fabric ranges and further investment in yarn and fibre development for apparel and would finally change people's perception of this wrongly maligned fibre.