Thermo-physiological comfort is the main focus of performance baselayers. Each new generation calls on increasingly sophisticated fibre and fabric constructions engineered to keep the skin dry and the body warm. In this mature and highly competitive product category, it is suggested that research should now focus on the sensorial properties of textiles as a possible innovation strategy.

Maximising next-to-skin comfort

By all accounts, comfort is a subjective matter. Despite progress made in the moisture management and thermo-regulation properties of performance materials, two functions that determine the thermo-physiological comfort of an item of clothing some consumers remain averse to synthetics or to wool worn next to the skin. Improving the sensorial properties of baselayer ranges could therefore be beneficial to brands. Furthermore, this could be a way to cater to the growing women's market and emerging 'athleisure' category.

"Comfort is a very subjective term," says Dr Katy Stevens, a textile researcher at the University of Innsbruck in Austria. "Some people will have low expectations of comfort, others will be very demanding, and still others won't know what to expect." She adds that it is difficult to say if one fibre is more comfortable than another as this depends on yarn count, cross-section, fabric construction, and garment design.

The next-to-skin clothing category is a diverse one in which three main fibre groups contend: polyester is said to account for roughly 50% of the market, followed by polyamide (30%) and polypropylene (20%). Polyamide plays a much more prominent role in intimate apparel, where its market-share is believed to be in the order of 70%. With the arrival of wool in the baselayer category, renewed attention has been brought to the issue of wearer comfort for a fibre that is often considered itchy or prickly.

The challenge of wool

Debunking myths regarding wool is precisely the goal of the Wool Comfort Meter, a machine developed by the Australian Wool Testing Authority (AWTA). Presented at ispo 2015, it uses a simple mechanism to measure the softness of wool knits by counting the number of fibres protruding from the fabric. When the ends of wool fibres push against the skin, they stimulate nerve endings and create a feeling of itchiness, the organisation claims. The device was carefully calibrated after a four-year long series of wearer trials. The conjunction of wearer data and the surface scanner is said to result in a realistic rendition of consumer responses to garments worn in different conditions and various activities. The size of the fibres, or their micron "makes up 70% of the hand feel, as a rule of thumb," says David Tester, a textile consultant who helped develop the machine. Designed to take the guesswork out of garment development processes, the Wool Comfort Meter is made for manufacturers and retailers and sells for $25,000. Four machines are now in operation, one of which has been acquired by worsted wool spinner Safil, based in Biella, Italy.

Looking to develop products for active wear, Safil applies its extensive wool know-how (the company processes some 7,000 tonnes a year) to performance yarns spun on X-compact spinning machines. Among the new developments in its Active Yarn category, Eiger is a 50% mercerised wool - 50% polypropylene yarn. Chamonix Core-spun sheathes high-tenacity polyamide inside an easy-care wool



outer surface. "Compact spinning results in smoother yarns," says Safil sales and product manager Filippo Dagostino, and covered yarns are "a way to improve the performance of wool without modifying its hand feel." Another new product in the pipeline is a merino-cotton blend, made on spinning machines from the 1960s that Safil acquired when it bought Grignasco in 2012.

The performance wool baselayer category continues to grow, as seen in the newly introduced Polartec PowerWool range. In this family of plated knits, the wool is positioned on the skin. For Polartec chief executive, Gary Smith, this is the ideal construction. He says: "The fabric doesn't rely on capillary action as the keratin protein fibre absorbs humidity and is naturally odour-resistant." The outer, polyester surface is said to offer better shape retention and resistance to wear and tear. "This combination turbo-charges merino wool," declared Mr Smith at the press launch of the range at ispo, "an instance in which 1+1 equals more than 2." Polartec has chosen ultra-fine merino, measuring 15.5 microns for the lighter-weight (147 g/m^2) and 18.5 for the mid- and heavier-weight PowerWool fabrics (210 and 230 g/m^2).

As is often the case in wool-based baselayer clothing, the placement of the wool yarns is far from standardised. Swiss bodywear brand Odlo's wool-polyester plated knit baselayers are



Active Comfort is Swedish functional sportswear brand Craft's newest range. The versatile line can be worn for many different activities including at home. Its soft knit fabric, seamless construction at the torso and loose fit are all designed to enhance wearer comfort.

Craft

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Polartec's new PowerWool range combines wool and polyester in a plated knit construction in which the wool is worn next to the skin and the polyester is placed on the outside. This double layer system is said to offer the best combination of moisture management, thermoregulation and durability.

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made to be worn with the polyester next to the skin and the wool on the outside. "By putting the polyester layer inside, you get a push-pull effect," says Eva Büsel, product manager at Odlo. "The high percentage of polyester will keep the skin dry." She points out that the wool surface will be coarser, while a flat polyester yarn will be smoother to the touch. Ms Büsel sees yet another advantage in placing the polyester yarns on the back as it enables brushing to increase thermal insulation.

Ever finer filaments

Polyester, the most prevalent fibre in performance baselayers, has come to dominate the category thanks to its many properties, which include a hydrophobic nature, dimensional stability, colour fastness and low cost compared with other fibres. The downside is that it is now beset by a price-driven market context. Innovation is, however, coming.

Turkish polyester fibre producer Korteks, marketed under the Dry Touch label, has focused on improving the hand feel of its yarns by giving them a cottony feel. The company achieves this by lowering yarn counts, down to 35/96 (0.36) denier per filament. "The main area of improvement for polyester would be to modify yarn count or develop special cross-sections; these are both more effective than applying a finish that will wash out with time," says Baris Mert, in charge of business development for Korteks, a Zorlu group company. A new generation of texturising machines will be in operation by mid-to-late 2015. Mr Mert says this is a multimillion euro investment that will improve hand feel and will enable new features to be applied to fine-denier yarns.

At Portuguese knitter LMA, a new multilobate polyester yarn has been developed for crossover performance and casual shirts. The fabric has a piqué face and a smooth back, and is part of the company's Alitecno range. "It is easy to care for, does not develop unpleasant odours and is comfortable to wear," says Manuel Barros. The chief executive of LMA, a long-time supplier of Lifa fabrics for Helly Hansen, believes nonetheless that polypropylene is the best fibre for performance wear because "it no longer retains odours" and is a good insulator. "The problem with polyolefin fabrics is processing. They can't be printed, and dope-dyed yarns are not suitable for just-in-time deliveries." He says these issues can be avoided with double-sided knits in which polypropylene is placed on the back and polyester on the face. The outer surface of the fabric can then be printed or dyed.

A classic in performance baselayers, polypropylene possesses a number of characteristics that make it a good choice for skin-friendly active wear. Dryarn, the polypropylene microfibre made by Italy-based Aquafil, has a higher rating than polyester on the IMT Comfort Index developed by the Hohenstein Institute. It scores 7.40 compared to 5.70 for polyester. Thanks to the low specific weight of polypropylene (0.92 g/cm^3), a garment made of Dryarn will weigh 32% less than an equivalent garment made of wool and 34% less than one in polyester, the company says. These, and its high thermal insulation properties, due to triboelectricity, are some of the reasons Mico Sport chose the fibre for its newly launched range of performance ski underwear with former ski champion Alberto Tomba. The M1 Alberto Tomba range features elaborate body-mapped knits. Seams are placed to avoid friction. The socks, made in a blend of Dryarn and Lycra Sport, have no seams at the toes, declared Luca Mastellini, one of the owners of Mico Sport, at the press launch at ispo 2015.

Made in Odlo's Greentec recycled polyester (38%), the Evolution Blackcomb Warm boasts a novel animal jacquard motif and body-mapped ribbed and mesh sections, as well as flat seams.

Odlo



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Austria-based Lenzing is rolling out a microfine (0.52 dpf) version of its non-fibrillating Tencel A100 fibre. Ideal for next-to-skin applications, the new microfibre will make fabrics soft, smooth and opaque despite their low weight.

E.Grebe / Lenzing

Dryarn is also the key ingredient fibre for another new underwear line developed for Italian sports brand Invicta by Italian knitwear specialist W-Z International. Made on Santoni knitting machines, the collection includes two other ranges, a merino wool-polyester blend and Resistex bioceramic fibre with Meryl Skinlife and Lycra.

Dryarn possesses specific dermatological properties, validated eight years ago by the Dermatological Clinic of the University of Modena and Reggio Emilia. The study was carried out on a sample of some 300 volunteers with sensitive skin, through three main phases during which men and women aged 18 and over underwent several skin tests to evaluate any possible allergies caused by contact with Dryarn. The positive results, including "considerable improvement found in some patients originally suffering from dermatitis or itchy skin" confirms its skin-friendliness the company says.

Lenzing's new microfine Tencel A100, the non-fibrillating version of lyocell that is specifically designed for knitwear, could also become a contender in high-comfort next-to-skin clothes. The Austrian cellulose fibre producer has progressively reduced the weight of this yarn, produced at the company's plant in Grimsby, UK. Initially weighing 1.4 dtex, the standard A100 now weighs 1.25 dtex and the microfine version 0.52 dtex, though this comes at a 10%-15% higher cost. "Ideal for next-to-skin fabrics, Tencel A100 microfibre will enable the production of softer, smoother and more homogenous fabric surfaces," says Dieter Eichinger Lenzing's vice-president of business development for apparel. Among the possible activewear end-uses, the company singles out its advantage "as a softener in wool and as a moisture manager with synthetic fibres".

Skin care baselayers

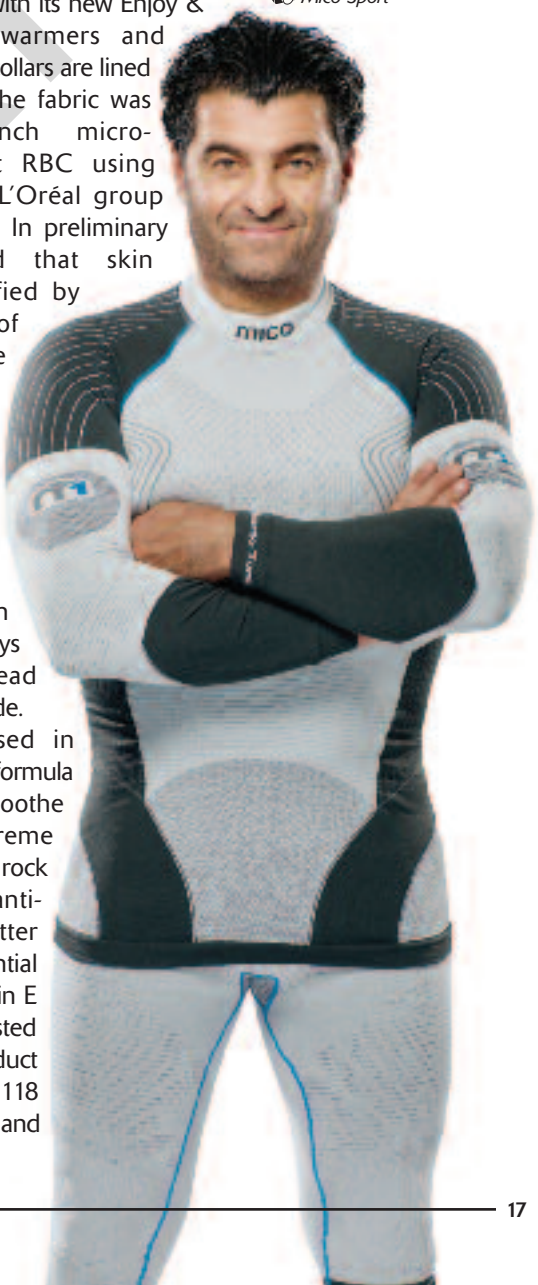
Uniqlo has recently introduced a new viscose microfibre to its HeatTech branded thermal underwear range. This has resulted in an "even smoother texture" the Japanese company says. For women, the fast-fashion retailer adds micro-encapsulated camellia essential oil for moisturising. The dose was increased by 30% in its Fall-Winter 2014 range compared to that of 2013, for "an even softer feel" and "to fight dry skin through the winter".

Introducing the concept of skincare into winter sports clothing is gaining new ground, as seen at action sports brand Roxy with its new Enjoy & Care range of neck warmers and snowboard jackets whose collars are lined with a cosmeto-textile. The fabric was developed with French micro-encapsulation specialist RBC using cosmetics provided by L'Oréal group skincare brand Biotherm. In preliminary research, Roxy found that skin dehydration was identified by women as a source of discomfort, whatever the material worn next to the skin. This is potentially a strong differentiating point for the brand as "performance is the dominant discourse in sportswear; few brands focus on comfort, and even fewer on skin comfort," says Roxy and Quiksilver head designer, François Latterrade.

The microcapsules used in Roxy's new line contain a formula designed specifically to soothe skin exposed to extreme conditions. These include rock samphire extract (anti-inflammatory), Shea butter (nourishing), apricot essential oil (moisturising) and vitamin E (anti-oxidant). Clinically tested for sensitive skin, the product was also field tested on 118 women aged between 18 and

Famed Italian ski champion Alberto Tomba is the face and mind behind a new performance underwear range by Mico Sport. The M1 Alberto Tomba four-piece kit is made in Dryarn, a micro polypropylene yarn by Aquafil, and features elaborate body-mapped knit structures to address the physiological needs of warmth, wicking and freedom of movement.

Mico Sport



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39 in New Zealand (blind test). "Women were polled at the end of the day and 24 hours later, and a majority said they felt a stronger effect after 24 hours," says Mr Latterrade.

Providing textiles with innovative skin-care properties is the key focus of France-based RBC. "Any form of physical activity leads to skin dehydration, due both to sweating and to mechanical friction, which lead to loss of comfort," says RBC chief executive, Yann Balguerie. "Boosting the stratum corneum, which is the outermost layer of the derma, can help maintain healthy skin." He also points out that "marathon runners in antiquity would coat their bodies in olive oil, a lipid." The company is looking to develop products that care for the skin of athletes. In addition to improving skin texture, Mr Balguerie recommends adding a scent, "such as peppery wintergreen for warm up sessions, or fresh-effect menthol for after sports."

Because of their high cost and low durability, microcapsule-based cosmeto-textiles have yet to win over the performance-minded sports apparel industry. Furthermore, it has been pointed out that an additive that crosses the skin barrier raises issues with regards to consumer safety, water pollution, and the European Union's REACH directive. Accused of making unsubstantiated slimming claims, Japanese intimate apparel brand Wacoal lost a class-action suit brought against its Nurel yarn coffee-infused textiles in the US last September.

Spanish polyamide producer Nylstar has taken a different approach to developing a range of skincare fibres under its Meryl umbrella brand. The company's Meryl Hyaluronan is "our silver bullet" says Mark Hartnell, sport category manager, because it offers "the highest level of anti-oxidant properties". Its active ingredient, known as golden hyaluronan, is also present in Meryl Derm, but at lower concentrations (and costing half the price). A third skincare yarn, Meryl Hydrogen is said to prevent dry skin.

Beyond these high-tech skincare yarns, Nylstar sees its Meryl Sport category as being superior to other synthetic and natural fibres with regards to wearer comfort. "Natural fibres are good at absorbing humidity but not at getting rid of it, and synthetic fibres are relatively hydrophobic, absorbing very little moisture," says Mr Hartnell. When compared to cotton's 8% moisture uptake and the very low absorption levels of polyester and polypropylene (less than 1%), the 4.5% absorption rate of Meryl polyamide 6.6 would then be "smack in the middle," offering a perfect balance that helps avoid "stickiness".

With the 'athleisure' trend, Mr Hartnell says people will be "wearing sports clothing for more than 30 minutes". This means they will want to look better, which would help make a case for choosing polyamide over other fibres.



A new range of neck warmers and snowboard jackets whose collars are lined with a moisturising and soothing cosmeto-textile from action sports brand Roxy aims to alleviate skin irritations in cold weather. The Care & Enjoy concept was codeveloped with L'Oréal skincare brand Biotherm and by French microencapsulation specialist RBC.

Roxy

Italian polyamide producer Fulgar also believes polyamide can bring novelty to performance baselayers. "Brands are always looking for new products," says the company's marketing manager Alan Garosi. The company intends to develop products tailored to each brand's specific needs. "Fulgar produces more than 2,000 types of yarns," he adds. Its popular mélange space-dye yarns have recently been improved upon with a new process offering a scrambled effect without the usual striations. The fibre producer is currently working on an even finer nanofibre nylon yarn, available in 50/96 or 20/40 (0.52 or 0.50 denier per filament).

Performance polyamide

Comfort is a key issue for Matteo Cecchi, Eurojersey sales manager for sportswear. He explains: "All Sensitive fabrics offer great fit and freedom of movement thanks to their three dimensional elasticity and superior fabric memory. The unique patented construction and the superior quantity of Lycra fibre ensure highest elongation and isotropic properties." Two fabric groups specifically address sensorial and thermo-physiological comfort. In the cosmeto-textile category, Sensitive A-More is made in a polyamide yarn produced by Nurel that is said to offer "permanent firming and moisturising" properties. The second category calls on two finishes (developed by Swiss company HeiQ), antibacterial Pure and Adaptive. The latter "increases the thermoregulating and hydrophilic properties of the Sensitive Fabrics Bodyware range", according to Giuseppe Crivelli in charge of the intimate apparel market.

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WL Gore has recently adopted polyamide for its C-knit backer fabric. The fine gauge (60 gauge) circular knit made in polyamide 6.6 weighs 19 g/m^2 and was developed to provide consumers with a "perceivable and measurable" innovation, says Christian Mayer, WL Gore product manager. "A hosiery fine fabric," he says its mass is half that of the former backing fabrics. The resulting laminates are 10% lighter and breathability is said to be lower by 0.5 Ret. The face fabrics of this new category are also exclusively made in nylon 6.6. "Softness is hard to prove in a lab," says Mr Mayer. So WL Gore enlisted 200+ Japanese field testers to wear the product: 84% of these perceived the C-Knit backer as being softer in feel. "It slides and glides," adds Mr Mayer, which is seen as an added perk for hiking, trekking and free-riding clothing.

The subject of wearer comfort is a complex one, confirms Carvico SpA general manager Stefano Eretti: "The chemical and physical properties of fibres translate into different perceptions for the final user. These are necessarily subjective and cannot really be quantified." The performance knits manufacturer is currently working on a new product whose main feature will be a "capacity to enhance the body thermoregulation system both in hot and cold weather," providing an extra-cool feeling in high temperatures and keeping the body warm in cold weather conditions. The research is based on three main knitting constructions: tricot, charmeuse and atlas. "This is an ambitious project which also implies the need to modify some of our knitting machines accordingly and is therefore a 'work-in-progress' which has already led to the birth of some interesting prototypes anticipating what is going to be the fabric of the future," says Mr Eretti.

The ongoing quest to improve the comfort of performance baselayers is dependent on many parameters. With progress made in finer yarn counts, fancy cross-sections and advanced texturising, as well as sophisticated fabric constructions, brands will have new solutions to test and trial in the next-to-skin category. The innovation pipeline promises to provide more ways to maximise wearer comfort and win over new consumers.



1. Outer material
2. Gore-Tex membrane
3. Gore C-Knit Backer Technology

The C-knit backer fabric developed by WL Gore is made on a fine gauge circular knitting machine, in polyamide 6.6, resulting in a "perceivably" softer fabric that also "slides and glides" better.

WL Gore



The spring-summer 2015 Porsche Design by adidas women's gym collection relies on a soft and stretchy polyamide for tops and a fast-drying four-way stretch knit for leggings.

adidas

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