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From the high-loft puff jacket, with or without genuine down, to the slim, never-need-to-take-it-off thermal layer, the insulation category is breaking new ground with solutions that are as varied as they are versatile.

Thermal solutions explore new territories

It's a busy period for insulation manufacturers. The new products being developed are redefining a category that now encompasses not only traditional puff jacket styles but also the emerging family of lightweight padded jackets for summer. This trend can be traced back to the many variations on the down sweater, to name Patagonia's popular item, and to the impact of Moncler's coveted products and success. Despite its luxurious properties and desirability, down has a number of shortcomings, notably a poor performance when wet. Growing concerns regarding ethical sourcing and availability of raw material also weigh in on the natural insulator's popularity and drive demand for synthetic or hybrid alternatives.

A hybrid world

"Down has wonderful thermal properties and it is very popular. But it loses its warmth when wet and it doesn't dry fast. PrimaLoft on the other hand has the ability to stay warm when wet. By combining these two in a very homogenous mix, we believe we can enhance the properties of both categories," says Michael Joyce, PrimaLoft CEO and president. This is the thinking behind the company's new hybrid PrimaLoft Gold, Silver and Black Down Blend insulations. The Gold category is made of 70% goose down and 30% PrimaLoft microfibre, Silver combines 60% duck down with 40% PrimaLoft microfibre and Black is made of 50% duck down with 50% PrimaLoft microfibre.

Mr Joyce sees synthetics "slowly eating away" at natural down uses in favour of what he calls "engineered content". "With the supply chain issues in natural down, prices will continue to be high. When you overlay traceability and diminishing supply, it doesn't make sense for compliance and economical reasons to use down," he says, adding that the consumer market is not elastic with regards to price.

PrimaLoft Down Blends target current natural down uses, and are said to display high compressibility thanks to a high proportion of down clusters (90% in the PrimaLoft Gold and Silver references). "This doesn't rule out the use of hybrid blends in lightweight summer styles," says Vanessa Mason, product developer and supply chain manager for PrimaLoft.

The company plans to offer two levels of traceability. The higher will follow the guidelines laid down by the SAC Traceability programme that include monitoring of hatchlings farms by third-party auditors, leading to higher costs and implying limited supply. The basic level of traceability encompasses a pledge to train and teach suppliers, backed by random checks and audits.

Italian company Molina has been mixing natural down with synthetic or natural fibres for over 30 years, developing a process that creates a highly homogenous blend. A newly developed product pairs natural down with silk. The company says its process endows the silk component with a fill power of approximately 420 cubic inches (see panel for more information on fill power). Additionally, the lightness and "fresh sensation" of silk make it a good choice for summer-weight jackets, says company president, Agostino Molina.

Columbia Sportswear has introduced its own hybrid down blend insulation for the F/W 14-15 seasons. An extension of the Portland-based brand's Omni-Heat Reflective technology, Turbodown combines a layer of down and a layer of synthetic insulation with a silver dot finish applied to the liner fabric. A second layer of the reflective material can be placed on the inside of the face fabric, which the company says "doubles the reflective insulation" of the composite, which "performs in all conditions, wet and dry".

Down alternatives in rolls or balls

With EVOdown, Italian insulation specialist Thermore has developed a new product with a high loft. Neither padding nor loose fibre, EVOdown is what the company calls a "rolled free fibre composite". Two external higher density layers encapsulate the loose fibres in the

US sportswear brand Salence uses Climashield's ultra-slim Contur thermal insulations.
Salence

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(Left) The Hot Forge Hybrid Hoody by Black Diamond is made with PrimaLoft Gold Insulation Down Blend, an intimate blend of 70% goose down (90% cluster/10% feather) with 30% PrimaLoft microfibre.

PrimaLoft / Black Diamond

(Right) For Summer 2015, The North Face, an exclusive user of PrimaLoft's ThermoBall, combines the loose fibre insulation with soft shell side panels and sleeves to create a hybrid jacket.

The North Face

middle section to achieve a down-like aspect and hand feel in a traditional rolled format. Blown-in fibre balls also deliver a high-loft down-like appearance, but the Italian company says they often come with stability limitations, clumping issues, fibre migration and the development of cold spots that EVOdown helps avoid. The new range comes in three weights (80, 115 and 170g/m^2) for ultra-light or puffy styles. Fabrics must be down-proof and ideally weigh less than 30g/m^2. Thermore Aria, launched last year, is an ultra-light thermal insulation consisting of 98% air by volume and now made with 50% GRS-certified recycled polyester. It is available in three weights as well: 60, 115 and 170g/m^2.

Like down, loose fibre insulations are blown into clothing during manufacturing. The process is not new but is enjoying renewed appeal with growing demand for alternatives to down. The North Face's ThermoBall jackets are made with a loose fibre ball filler jointly developed with PrimaLoft. "The polyester balls mimic goose down, and allow for tighter quilting line grids," says Mark McCarthy, Summit Series senior product manager. He sees "huge growth in the micro-warmth category and a shift away from down", adding that these products are "quite versatile and can be worn all year round".

3M's Thinsulate range – arguably the industry's first slim insulation solution, introduced 30 years ago – has recently been expanded to include Thinsulate Featherless, a 100% polyester fibre ball insulation that undergoes a partial silicone treatment. The loose fill insulation is said to achieve the performance of 600 fill power down, and to be twice as warm when wet. "It is a good option for brands looking for down-like products without the sourcing issues associated with down and its poor performance when wet," says Andy Pendegrass, key account manager for performance solutions at 3M UK. "With the cost of down continuing to increase, our 100% synthetic product portfolio will help consumers get the style they want at the price they want," says 3M home care marketing manager Leslie Kramer.

A new range developed by Japanese manufacturer Amaterrace combines polyester fibre balls with acrylic in a 90% polyester/10% acrylic blend. Additionally, the acrylic fibre possesses a special function that generates heat when absorbing moisture from the body. "This is an ideal product for slim summer-weight insulations," says sales manager Akihiro Nishino.

The fibre ball format is the shape of Outlast's most recent development, Spherix. The company that introduced phase-change material (PCM) technology to performance outerwear describes its product as an "active temperature regulator". "We don't consider Outlast to be in the business of insulating or cooling," says Martin Bentz, managing director for Outlast Europe. He points out that "PCM-based products are pro-active. They kick in before the body over-heats so that it doesn't need to produce as much sweat."

Outlast's new fibre ball product fits the bill for ultra-light down-like fillers. Spherix is a combination of PCM-laden viscose yarns, measuring 7 to 9 dtex, which means "we can put many capsules inside" says Mr Bentz, with polyester fibre balls – which provide the loft – in a homogenous blend that the company says won't separate with wearing and washing. The

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new filler can be used for puffy or slim clothing with the advantage of adapting to varying climate conditions. "The user won't need to put on or remove the jacket when the weather changes," says Mr Bentz. As a design perk, Spherix doesn't require a downproof fabric and can be used with what Mr Bentz calls "fibreproof" fabrics.

Introducing elasticity

Also touted as a product that can be kept on in changing temperature conditions, Polartec Alpha is a loosely knitted insulator developed by the inventor of polar fleece. "This product is opening up new ground as there was no item that offered both a puffy hand feel and high breathability," says Eric Yung, Polartec's European marketing director. A category in its own, Polartec Alpha is said to present higher stability, compared to down, while stretching and packing into a small volume thanks to its open-knit construction. The company also claims that it dries 40% to 60% faster than non-woven insulations. Alpha was originally developed for the US army, which was "looking for an insulating material offering high breathability, but that could also be dyed, for safety reasons when soldiers are in the field," says Mr Yung. He sees Alpha as a next-generation soft shell, mentioning that trail runner champion Kilian Jornet has adopted the Polartec Alpha concept.

For summer products, Polartec Alpha is available in three weights - 80, 60 and 40g/m^2 (along with 100 and 120g winter weights) - the heavier addressing static conditions and the two lighter references designed for high aerobic activities. Fabric specifications are different from those of traditional non-woven insulations as the lining fabric must be breathable (with a 25 cfm rating). "It is possible even to line the product with a mesh fabric, which is not the case for other insulations," says Mr Yung. There is also no need for a downproof fabric on the outside or quilting, reducing manufacturing costs. Mr Yung notes that Polartec Alpha allows all types of hybrid constructions with other Polartec fabrics, such as PowerStretch.

Climashield, based in Tennessee and owned by HarVest Consumer Insulation, is the company that formerly marketed its products as Polarguard and is now expanding into Europe. A big supplier to the US military, which accounts for nearly 60% of its business, the manufacturer specialises in continuous hollow-core filament insulations that are resin-bonded. "Weight for weight, continuous filaments loft more than cut staple yarn insulations," says Climashield COO Matt Schrantz. Tested and adopted by the military, it offers, he says, "the highest warmth for weight." The continuous filament construction stretches without breaking, avoiding the development of cold spots. Aquaban, a fluorine-free water repellent finish, is applied to the batting that surrounds the filler to speed up moisture transfer.

Climashield's summer-weight solution is called Contur. Featuring four-way stretch, it has been "engineered to have a lower loft" and since it "traps less air, its thermal efficiency is lower," says Mr Schrantz. The lightest reference weighs 60g/m^2 and is needle punched.

Developed in close partnership with active-wear brands, Toray's new 3DeFX+ insulation is designed as a "complete clothing concept that includes all layers" based on the company's fabric technologies and non-woven materials developed in collaboration with the Japanese company Vilene, of which Toray is a large shareholder. The new insulation is made with four different types of yarns and offers what the company calls "three-dimensional stretch". Company tests have shown that the 60g/m^2 3DeFX+ insulation has a 60% higher clo value than other insulators of the same weight. Upmarket brand Kjus introduced the material in its A/W 14/15 season skiwear collection.

And then there's wool

Like fibre balls, an old technology that has captured new interest, non-woven wool insulations are also making a comeback by targeting brands looking for natural fibre thermal solutions. German wool felt specialist



A prototype jacket made with 3M Thinsulate Featherless fibres, a fibre ball insulation.

3M Thinsulate

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The Equilibrium Jacket by Kjus is the recipient of a Polartec Apex Award; the slim silhouette is made with Polartec Alpha, a knitted thermal insulation.

Polartec / Kjus

Lavalan is reintroducing a range first developed in the 1960s. Inspired by the popularity of merino wool, the company offers a wide array of compositions, including cashmere, vicuña and camel hair (yak is in development). "We apply the modern non-woven technologies of synthetics to natural fibres," says sales director, Matthias Böhme. At times, the natural fibres are blended with Ingeo (a PLA fibre) or a synthetic fibre to enhance dimensional stability, improve washability, and lower the weight of the finished product. The company says that wool not only insulates against the cold but also breathes. "EMPA tested our camel hair insulation against PrimaLoft with results showing that camel hair was 20% warmer, weight for weight," says Mr Böhme. Lavalan's insulations can also be tinted using natural dyes by Dutch company Rubia in a wide palette of shades. The company's customers include Mover and Ortovox (that use the Swiss wool quality), as well as fashion brands Zegna and Hugo Boss.

In the US, Hobbs Bonded Fibers has also introduced wool padding. The RamTect branded insulation was developed in collaboration with Doug Hoschek, co-inventor and marketer of Polarfleece, and Carey Hobbs, owner of Hobbs Bonded Fibers. The wool insulation fabric is made using the company's patent pending, no yarn compression technology. The resulting insulation requires neither quilting nor baffling, two processes that compromise a garment's warmth by punching holes through the liner and outer fabric. "Clothing designers have been trying to find the perfect balance between garment weight, warmth and moisture wicking for a long time," says Mr Hoschek. "RamTect offers options for lightweight technical clothing designers, as well as creating a 'Made in USA' marketing message for brands."

There seems to be something for everyone in the wealth of thermal solutions coming to market. In addition to the varied blends, formats and materials, they also feature a larger roster of functions, spanning enhanced performance in wet conditions, breathability, ease of movement and washability. What remains to be achieved is explaining to consumers how these novel insulations function and how they compare to traditional down and padding.

Fill Power: evolution of a standard

With the introduction of new insulation concepts, the traditional methods of evaluating thermal performance are also evolving. The two main units of measurement are the clo and the fill power. A common gauge of synthetic insulation, clo is a unit of measurement pertaining to thermal retention. One clo is enough to keep a resting person comfortable at room temperature. Fill power is the standard used to qualify down. It expresses the amount of space one ounce of down will occupy in cubic inches when allowed to reach its maximum loft. A lofting power of 400–450 is considered medium quality, 500-550 is considered good, 550–750 is considered very good, and 750+ is considered excellent. The higher the fill power, the larger the down cluster size and percentage of clusters to feathers. Patagonia claims to have achieved a fill power of 1,000 with its plasma-treated Encapsil down.

With the new hybrid blends that combine natural down and synthetic fibres, the traditional methodology may no longer apply. "Fill power is a measure of volume, while clo is a measure of thermal properties," points out PrimaLoft product developer Vanessa Mason, who believes clo is a better standard to go by. "Synthetics today have higher molecular weights than down. Our hybrid blends may not display the same volume properties of down alone but when tested for thermal performance in construction, they will have the same clo values," she says. PrimaLoft Gold Blend, a microfibre insulation in a layered structure, possesses the equivalent warmth of a 450 FP down. "If I were to test the fill power of PrimaLoft Gold Insulation, it would be around 75-100 FP. This is an example of how fill power does not capture or characterise the warmth performance of synthetics."

For Turbodown, a layered construction of natural down and synthetic insulation, Columbia Sportswear is also introducing a new scale for assessing warmth. With regards to product classification, the company believes that consumers are accustomed to existing down fill measurements, so it has applied that system in a new fashion. The down's fill power is simply added to the synthetic filler's weight. With this method, Turbodown Gold (100g synthetic + 550 FP down) has a rating of 650 TD, for Turbodown, Platinum (60g synthetic + 800 FP down) is 860 TD and Diamond (40g synthetic + 850 FP down) is 890 TD.

"We're used to the challenge of educating users to clo versus fill power," says Ms Mason, who may be faced, like her colleagues, with another set of challenges in the years to come.

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