



getting the balance right

Performance fabrics for sportswear need to be able to keep the wearer comfortable, dry and in the 'thermo-neutral zone'. Kathlyn Swantko explains.

The sports products industry is hugely important category within the U.S. consumer market.

According to the Sporting Goods Manufacturers Association (SGMA), sports products industry represented nearly \$70 billion at wholesale in the U.S. in 2003. Of that figure, sports apparel represents the largest segment with sales of \$22.8 billion.

With this growth, there has been the continued development of new and innovative technical fabrics to keep up with the demands of the sports apparel market. Consumers are interested in staying dry and comfortable during a sports workout. They also want their clothes to be soft and easy-care. As a consequence, many of the innovative textile developments of the mid to late '90s, such as the application of moisture management and anti-microbial treatments are now commonplace in today's performance fabrics.

"Today's consumer expects more from their every day apparel – more comfort, easier care, easy to wear – that's the main trend manufacturers are responding to," said Outlast Technologies VP for global sales and marketing, Brad Poorman.

Because of the interest generated in this technology, KnitAmericas decided to look

into one of the not so well understood performance quality of temperature-regulation, also referred to as thermo-regulation or phase change technology.

The first question many people ask is what exactly is temperature regulation? A more technical term that is commonly used interchangeably with temperature-regulation is thermo-regulation. However, most people in the performance sportswear industry think of thermo-regulation as staying warm, which is incorrect, or at least only half correct. The term is broader than that. According to Mark Lazararus, president of Laztech Consultants, Inc., who works with many

companies in developing new products for the performance fabric market, "People tend to associate the word 'thermo' only with heat. But, it is actually maintaining the body temperature to the level that will maximize performance and comfort, while protecting the user."

Joel Furey, executive vice president of Noble Fiber Technologies, the producer of X-Static, added, "Temperature regulation or thermo-regulation is best defined by its goal, which is to maintain both the core body temperature and the wearer comfort in diverse environments."

Art Blue, president of Comfort Technologies, producer of Akwatek and Aquadyne, performance modifications for polyester and nylon fibers, frames the word in more scientific terms. He said, "Thermo-regulation describes the group of biological processes by which the body regulates its temperature. Even at rest the human body is a mass of ongoing chemical reactions that generate heat. Thermo-regulation is designed to keep body heat within an optimum temperature range called the 'thermo-neutral zone' (usually set at 37 degrees C +/- 1 degree). When the body temperature extends beyond the limits of the thermo-neutral zone, bodily systems



X-Static powerstretch zip T-neck

begin to operate less efficiently, and at extremes even can result in death. Therefore, thermo-regulation is critical both from a safety and performance standpoint.”

Typically, fabrics do not inherently provide thermo-regulation. In order to thermo-regulate effectively, fabrics must not inhibit the thermo-regulation efforts of the body itself. Blue continued, “When a fabric thermo-regulates, it will allow air to circulate around the body, and at the same time provide a cushion of insulation (either hot or cold) when the body needs it. The fabric must be able to adjust to the needs of the body over a wide range of external temperatures and activities.”

Thermo-regulating fabrics

Mark Lazarus pointed out that while certain combinations of fabric construction, chemical finishes, and garment construction can also keep the body warmer or cooler, depending on the environmental conditions, for the most part, fabrics are geared for one or the other.

Furey of Noble Fiber Technologies, agrees. He said, “Cold-weather garments must address both radiant heat loss (through the use of infrared reflective materials and insulative materials) and convective heat loss (through a wind barrier). On the other hand, warm-weather garments must aid evaporative heat loss by increasing moisture movement, and increasing the velocity of heat conduction through thermally conductive materials.”

According to Lazarus, the business of providing thermo-regulation in a textile product will vary for different brands and for different climatic conditions. He stated, “You could develop quite a broad matrix of brands and technologies. We tried to do this back in the 90s when I



X-Static Xcursion Crew



Arctic shield Jacket

was chairman of the Fiber & Fabric Committee at SGMA. However, the general rule of thumb is to create some airspace in the ‘micro-climate’ between the skin and the garment, or between layers – hence the popularity of fleece constructions like Malden’s Polartec. For cooling, air flow is a big factor, so mesh constructions are quite popular – again creating space between the main body of the fabric and the skin will allow air to flow through the mesh construction.”

Mike Apperson, CEO of American Fibers and Yarns Company, makers of Innova and Innova AMP polypropylene yarns, explained, “There are three main characteristics that provide thermo-regulation in fabrics. Firstly, water retention and absorption must be as close to zero as possible, which assures that the porosity of the knit or weave acts as capillaries to move moisture away from the skin; secondly, a fabric must have a good insulation value to supplement the boundary layer air gap on the surface of the skin; and last of all the fabric must be lightweight with good bulk to achieve maximum comfort.”

Microencapsulation

Originally developed for NASA, Outlast Technologies’ fibers, fabrics, and foams contain patented micro-encapsulated phase materials called Thermocules, which store and release heat, providing comfort

in any outdoor temperature level of activity. “In phase change products, we can engineer fibers and fabrics to different specifications. Meeting different performance expectations beyond temperature control, utilizing Outlast’s new Smart Fabric Technology umbrella brand,” said Poorman. “Smart Fabric Technology is an ingredient technology that helps make other products perform better—providing climate control or temperature regulation for greater comfort.”

Comfort Technologies’ Aquatek and Aquadyne fiber modifications are most widely used in base layer clothing. Blue explained, “The closer to the skin, the more critical the design and function of the fabric from a thermo-regulation perspective. A fabric in an outer-layer garment will likely need to be designed primarily to provide protection from the weather, and its assistance with thermo-regulation would allow for body heat to escape, or to be retained as the body needs.”

Another base layer technology is one from American Fibers and Yarns. Apperson noted, “Innova yarns are widely recognized as exhibiting the best performance in base layers where moisture movement is most critical. The U.S. military uses Innova yarns in their next to skin, because of its high insulation values and its very low weight.”

X-Static provides still another thermo-regulating technology. X-Static has a pure silver surface coating and reflects all radiative thermal energy, which is produced by the body in cold weather. Silver is also the most conductive element. So, in hot weather, the body produces conductive energy, which is quickly distributed by X-Static to the environment, keeping the wearer cooler in hot environments.

These are just a few insights into the various technologies and constructions available to provide effective thermo-regulation. However, to further complicate the matter, there are different levels of thermo-regulation for different end-uses. Lazarus noted, “The matrix of branded possibilities explodes when you bring in all of the factors, whether the development is for base-layer or outerwear. Oh, and don’t forget the sock industry!”