

PERFORMANCE TEXTILES

Performance textiles are a new paradigm for the textile industry and represent one of the fastest growing sectors of the industry. Performance textiles are textiles that provide additional functions such as repellency, resistance, or protection from a specified element including fabrics that resist wrinkles, soils, or odors, and/or protect from an environmental condition. They were first introduced in the active wear and outdoor markets, for a wide range of athletics such as aerobics, running, cycling, hiking, swimming, and skiing. Today performance textiles are not limited to sports and outdoor enthusiasts; they are crossing over the boundary into everyday fashion and home furnishings.

What Makes a Textile a Performance Product? Technologies

Microfibers: The technology behind microfibers is the size of the fiber. Microfibers are fibers that are less than one denier per filament or 100 times finer than a human hair. Textiles produced with microfiber yarns are softer and possess better drape and they provide lighter weight, dimensional stability and easy to care textiles for the consumer (Goldstein, 1993). The fiber content of these textiles can be polyester, polyamide, nylon, rayon, or acrylic with polyester being the majority. Examples of products utilizing microfibers include lingerie, activewear, towels, and upholstery fabrics.

Nanotechnology: One of the hottest trends in the fashion industry today is ‘nanotechnology,’ which is invisible to the naked eye but is utilized to increase the performance and the functionality of textiles. The “nano” in nanotechnology refers to the material or chemical with a particle size of one-billionth of a meter. In textiles and apparel products, nanotechnology can be used to provide performance characteristics such as antimicrobial properties, UV-resistance, stain-resistance, anti-static qualities, and wrinkle resistance.

Microencapsulation: The textile industry utilizes microencapsulation, a technology that uses microcapsules, which serve as tiny containers of substances. The substance, liquid or solid, is released to fulfill a specific purpose. It is similar to a capsule in the fact that a coating, referred to as the wall, shell, or membrane, surrounds the material inside. “The content of the microcapsules can be released in a variety of ways, depending on the characteristics of the capsule wall, including physical pressure, friction, diffusion, wall dissolution, and biodegradation” (Nelson 1991). In today’s performance market, microencapsulation in textiles includes the application of fragrances, skin softeners, insect repellent, and antimicrobial agents. Examples of microencapsulation include mosquito-repellent finishes applied to outdoor clothing or dust mite protection applied to mattresses and mattress pads. The insect-repellent finishing agent is encapsulated as a surface finish on the textile and released over time during product use.

What 'Functions' do Performance Textiles Provide for the Consumer?

Antimicrobial: Clothing and textile materials are carriers of microorganisms such as bacteria and fungi. The inherent properties of a textile product can provide the ideal opportunity for these organisms to grow, which explains why odors develop on damp textiles or body odor is retained by clothing until it is washed and cleaned. Any chemical or substance that inhibits the activity of microorganisms is generally referred to as an antimicrobial.

Today antimicrobial textiles serve a multitude of functions; for example, anti-odor technologies utilize chemical treatments such as a silver-based nanotechnology and/or microencapsulation to control the bacteria that contributes to the odor. Textile products that benefit from the use of antimicrobial treatments include, but are not limited to, apparel, footwear, home furnishing, automotive and healthcare.

Antimicrobial finishes not only provide protection against odor but also prevent stains and health concerns that include allergies and infectious diseases. Examples of consumer products that utilize antimicrobial finishes include Odor-Eaters® insoles for shoes, and socks such as SoleFresh™ or FootSmart® diabetic socks with Aegis Microbe Shield®; both utilize silver nanoparticles. Silver's natural antibacterial and antifungal properties mean that the socks combat infection, sores, and, yes, stinky feet.

Stain Repellent and Stain Release: 'Stain-repellent' finishes enable spills to bead up and roll off or allow them to be gently blotted off. The stain repel function is often associated with liquid or water-based stains, such as coffee or juice but can also prevent dry soils and dirt from sticking to the surface of the fabric. On the other hand, 'stain/soil release' finishes work with ground-in and oily stains, those stains that tend to penetrate the fabric more intensely. The release function allows the soil to wash out easily during clothes washing or carpet cleaning. Today the repel and release functions are often combined to provide dual-action protection. This dual-action technology serves both purposes. It repels liquid-based stains on the surface, while releasing the oil-based, ground-in stains during cleaning. Repel finishes, such as 'Teflon®' can prevent the penetration of water through the fabric's surface, thus making it difficult for ground-in stains to be removed during washing. The dual-action, however, allows detergents to travel through the fabric to aid in stain removal.

Stain repel/stain release chemistries that make this performance possible include fluorocarbons, silicones, and urethanes applied as nano-sized particles that will provide the performance without altering the texture and appearance of the fabric. Home furnishings as well as the fashion market have benefited from these new technologies, for example Eddie Bauer's Nano-Care® chinos and Levi's Dockers® Go Khaki™ with Stain Defender® that offer wrinkle and stain-resistance, and Teflon® Advanced Carpet Protector that protects carpet and upholstery from dirt and stains and facilitates easy maintenance.

Moisture Management: "The ability of a garment to transport moisture away from the skin to the garment's outer surface." Moisture management is one of the key performance criteria in today's apparel industry. The garment's ability to transfer moisture greatly affects the comfort of the wearer. The human body loses moisture through the process of sweating, a natural cooling system. However, with added moisture management, a garment is able to wick moisture away from the skin enabling it to move to the outside of the garment where evaporation occurs. This keeps the user cool and dry (Thiry, 2005). Moisture management can include the use of microfiber technology or the application of silicones at the molecular level to enhance both hydrophobic and hydrophilic properties of a fabric. Examples of moisture

management products include Under Armour Tech Tee® fabric that claims it feels like cotton, but provides the ultimate in moisture management, and Thinskin® moisture management apparel that keeps the body drier in any weather condition. The introduction of moisture management technology goes beyond these sportswear examples to casual clothing, such as Coolmax® and Coolplus® found in socks, underwear and outerwear or Dri-Power® fleece with fibers that wick away moisture to keep one cool in summer and warm in winter.

Ultraviolet Protection: Because skin cancer is on the rise, the risks associated with sun exposure and the ways individuals can protect themselves are attracting a great deal of attention. According to experts, including the U.S. Environmental Protection Agency, the technique that best protects the skin against UV radiation is clothing ("U.S. Environmental Protection Agency," 2006). As a result, researchers are developing anti-UV radiation agents to further enhance a textile's ability to protect the wearer from harmful rays.

A UV-protective textile is a textile that provides protection from UV light in addition to reducing the risk of skin injury related to exposure. Although the term *ultraviolet protection factor* (UPF) has been used interchangeably with the term *sun protection factor* (SPF), the term UPF describes the sun protection offered by fabrics, specifying the level that the fabric is able to block UV rays from reaching the skin, whereas SPF is the sun protection factor offered by liquid lotion sunscreens and sunblocks. The protection factor is linked to the length of time it takes for reddening of the skin (erythema) to occur with protection compared to no protection. A UPF value of 15-24 is categorized as "Good UV Protection," 25-39 as "Very Good UV Protection," greater than 39 as "Excellent UV Protection" (ASTM, 2006, pp. 813-814).

The use of UPF garments started with children's wear but can be purchased in a host of products today. Examples include Sportif UPF shirts with sun protection technology rated at UPF 50+ for protection from the sun.

Bundling Functionality: Much of the functionality added to textiles today is a combination of technologies. Nanotechnology may be coupled with silver-based technology to create superior functionality. An example of "bundling" technology includes an odor control product called Visa Endurance® Scent Control System, which also possesses moisture management and stain releasing capabilities or, Buzz Off® UV 30+ that offer Buzz Off Insect Shield and UV sun protection with a claim of durability of up to 70 washings.

Care and Maintenance

The care and maintenance of performance textiles is important. It not only can affect the life of the garment, but it can alter the intended use or the function. Many manufacturers report that dry cleaning is not recommended or warn against the use of fabric softener because it can often build up over time and mask the finish or clog the fabric's pores; in particular, "microfibers" may experience a reduction in the fabric's functionality. (Joyce, 2005)

Recommendations for dryer settings include using lower heat settings. Damage occurs from high temperatures or from garments left in the dryer over an extended time. Many performance textiles dry quickly and need to be removed from the dryer before over drying occurs.

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