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Performance Textiles: Institutional Products

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Performance textiles (also referred to as 'functional', 'technical', 'smart textiles' or 'hi-tech' textiles or fabrics) are making strong inroads across the institutional textile market as linens, apparel, interior furnishings and medical textiles. Performance textiles are materials developed for a special need or application, such as protection, comfort and care. The technology of performance ranges from chemical treatments to new fibers and weaving techniques.

It wasn't so long ago that a fluid-proof apron or gown was a non-breathable vinyl or rubber coated fabric that left its wearer literally steaming on the inside. Today, performance fabrics and innovative technologies make possible the incorporation of hi-tech properties into fabrics that make textiles odor-resistant, UV-resistant, heat-resistant, cold-resistant, water-resistant, wrinkle-resistant, stain-resistant, wicking, fast-drying, and …bug repellant! Technology is changing interior textiles as well, as new technologies produce elegant, soft designs that wear like iron and can take the abuse of patients, visitors and guests, while still looking great. If you are responsible for the purchase or care and maintenance of these new technologies, it is beneficial to learn more about these performance products.

PERFORMANCE FABRICS BASED ON NANOTECHNOLOGY

What is nanotechnology? Scientifically speaking, one 'nanometer' is one-billionth meter or 10^{-9}, which is about 100,000 times smaller than the diameter of a single human hair. Nanotechnology is the manipulation of a substance's structure at the molecular level. The fundamental principle of nanotechnology is the fact that properties of substances dramatically change when their size is reduced to the nanometer range. The textile industry has utilized nanotechnology to improve performance or increase the functionality of textiles. The results of such developments include smart or intelligent textiles and improved performance of functional textiles by upgrading existing finishes of products.

Textile applications of nanotechnology have primarily focused on generating nanostructures and/or using nanosized chemicals. An example of a nanostructure is a composite fiber of polyester, nylon and/or polyethylene, which utilize nanoparticle sized fillers of clay, metal oxides or carbon to increase the strength and improve physical properties such as conductivity. The resulting product can provide enhanced performance characteristics, which may include barrier performance to water and chemicals, electrical conductivity or reduce static electricity, UV absorption, antimicrobial and self-decontamination.

A second application of nanotechnology is the use of nanosize chemicals to provide functionality to a textile. Textiles have used nanotechnology to upgrade chemical finishes by applying the chemical at the nanoparticle size, which results in a more thorough application to the textile material and therefore, results in better functionality and increased durability. To illustrate, fluorocarbon and silicone chemistries applied as nanoparticle sized polymers are attached to the fibers of fabric during the manufacturing process. Rather than coating the fabric with a protective treatment as in the past, this level of technology actually alters the molecular structure of the fibers. Nanosized molecules are bonded to fiber molecules so the treatment becomes an integral component of the finished product. Nanosize particles have a larger surface area and, hence, higher efficiency than larger size particles. An added advantage is that nanosize particles are transparent and do not alter the color and brightness of the textile substrate.

PERFORMANCE DUE TO MICROFIBERS AND ULTRAFINE FIBERS

What is a microfiber? The secret behind microfiber technology is the size of the fiber. A microfiber is 100 times finer than a human hair and half the thickness of a silk fiber. A synthetic fiber with a denier of less than 10 is identified as a microfiber. An ultrafine fiber has a denier of less than 1.0 or a diameter less than 10 microns, which is equivalent to 10,000 nanometers. The fiber content of microfibers can be polyester, polyamide, nylon, rayon or acrylic.

When micro and ultrafine fibers are woven or knitted into fabrics, the end products are very compact structures. The resulting compactness of the weave can create water repellant or water proof fabrics, or microfiber technology can be used to produce fabrics that are more absorbent than conventional fabrics depending on the desired performance of the product. Microfiber textiles may also provide stain and soil repellency, which will enable spills to bead up and roll off before they penetrate the fabric. Other fabric characteristics, such as the surface or hand of the fabrics, can be enhanced as most microfiber fabrics have a luxurious feel or soft touch. Microfiber fabrics are also typically wrinkle resistant and easy to care for.

Microfiber technology has influenced the institutional environment by making routine tasks easier and more efficient. For example, the introduction of microfiber mop pads, microfiber towels and microfiber mitts revolutionized the care of floors and other surfaces. A microfiber cleaning product is a blend of synthetic fibers, such as polyester and nylon as a fiber bundle that splits into ultrafine single fibers that appear as a microfiber segmented structure. The microfibers act as a collection device that absorbs oil, grease, dirt and dust, and retain the soil in the structure of the product until it can be washed away during laundering. The second function of the microfiber collection system is based an electrostatic effect. Most particles (dust, dirt, lint) in nature possess a naturally occurring charge, and microfiber cleaning products contain charged fibers. The electrical charges on the dirt particle and fibers attract each other to enhance the capture efficiency of a microfiber product. Retained dust, dirt and lint are retained by the microfiber cleaning structure until they are released during the laundry cycle.

Microfiber technology has gone far beyond mops and cleaning cloths to furniture fabrics for institutional use, including such product brands as Sunbrella, Crypton and Microban. The resulting fabric is impervious to food, wine, magic markers and even bleach making them very appealing for the institutional markets of restaurants, hotels and nursing homes.

PERFORMANCE TEXTILES - STAIN-RESISTANT TO SOIL RELEASE

Uniforms, scrubs and lab coats with stain-free or stain-resistant fabrics are the beneficiary of these new technologies. The process behind the technology is the use of nanotechnology in a stain-resistant fluorocarbon finish. Fluorochemicals create a barrier to water and soils due to the hydrophobic character that it imparts to individual fibers. When a drop of water contacts a textile surface, wetting typically occurs. But, if the surface tension of the fabric has been altered by a fluorochemical, the fabric will allow a droplet of water to bead up and roll off without penetrating the fabric structure.

The application of fluorocarbons, as soil repellent finishes, has expanded from their introduction on men's pants to institutional apparel and linens. The advantage of advancements in fluorocarbon stain repellent finishing is that it is an applied finish that does not affect other properties of the fabric. For example, the technology adds stain repellency functionality, but permits cotton and cotton/blended fabrics to maintain their wrinkle-resistant and easy care properties.

Stain protection technologies may also provide dual-action stain protection as they impart soil repellency combined with stain release technologies. A dual-action stain repellant/stain release technology functions by repelling water-based stains, while at the same time allowing soils that become stains when they penetrate the finish to be released. These stain protection products include StainSmart® by Milliken, Advanced Care Teflon® by DuPont®, and Scotchgard Protector™ by 3M®. The new dual-action technologies provide the 'best of both worlds' in stain protection. The 'repel' function allows most liquid-based spills, such as coffee, juice or cola, to bead up and roll off, or they can be easily wiped off, thereby preventing soils from staining the fabric. The 'release' function works on soils that penetrate fabrics or by enabling those tough ground-in stains to wash out easily. The technology works by allowing surfactants and detergents to move through the fabric to assist in the removal of the stain.

Nurses' scrubs, uniforms and work wear with dual-action protective finishes are now available to the institutional markets. Hospitality and healthcare fabrics have also been enhanced by the introduction of stain/soil-repel and stain-release technology as both interior textiles and linens offer these new finishes in innovative products. For example, Standard Textile's new Impact™ Technology provides splash, stain and bacterial resistance. Impact™ Technology is an innovative technology, not a coating that embeds its protection within the fibers of the fabric. Impact™ is splash resistant, which causes fluids to simply roll off the fabric. In cases where a stain is detected, Impact's™ stain resistance allows for products to be spot cleaned for items such as blood, urine, betadine and coffee. Signature Plus™ table linens with performance features that won't shrink, fade or lint has the added benefit of soil release chemistry, adding yet another performance advantage. StainSmart® is also available for wall coverings for hospitality and commercial interior design fabrics that offer stain-release/repel properties as well as flame-retardant performance.

PERFORMANCE TEXTILES - MOISTURE MANAGEMENT
FLUID RESISTANCE, BARRIER FABRICS & WATER PROOF

The ability of a fabric to transport liquids is called moisture management and the transfer of moisture in clothing significantly influences the wearer's perception of comfort. The human body has a built in cooling mechanism when it looses moisture through the process of sweating in the form of water vapor. Water vapor carries heat away from the body as it evaporates from the skin and/or fabric surface. In the garment-skin interaction, the absorption of sweat by the garment and/or its' transportation through the fabric in the process of evaporation both relate to clothing comfort.

One of the earliest introductions of 'moisture management' to the institutional textiles market was Gore-Tex®. Gore-Tex® is a thin, microporous membrane that is bonded to fabrics of nylon and polyester to make them both waterproof and breathable. The technology behind this product is also related to size, i.e. pore size. The pores (nine billion pores per square inch) in the membrane are too small (20,000 times smaller) for water droplets to pass through, so liquids are repelled. But those same pores are large enough to allow molecules of water vapor (sweat) to pass through—making it "breathable" from the inside.

Milliken's StainSmart® Comfort Zone™ fabrics feature the repel and release functions of StainSmart® combined with the performance benefit of moisture management as the back side of the fabric wicks perspiration away from the body. The triple-action technology is available to both the hospitality and healthcare industries. Standard Textile's hospitality products include the performance line blanket Acrymax®, which is a blend of acrylic and polyester microfibers. The blanket provides warmth with breathability with its built in performance of Moisture Vapor Transmission (MVTR). Visa® Prestige™, a Milliken innovation to the healthcare market, offers moisture movement through Visa™ as it wicks moisture away from the skin to offer the comfort of cotton, with the easy-care wash and wear performance of polyester. Visa® is hydrophilic; it wicks perspiration away from the skin moving moisture to the outer surface of the garment, where it evaporates. The Visa® treatment also has stain resistant performance that prevents dirt and oil transfer, thereby reducing soil redeposition.

PERFORMANCE FABRICS – ANTIBACTERIAL, ANTIMICROBIAL & ODOR CONTROL

Antibacterials are agents that interfere with the growth of bacteria. Technically antibiotics may be viewed as antibacterials, but the term 'antibacterials' is most often used to describe agents in healthcare and cleaning products rather than medicines. Antibacterials are found in cleaning products, soaps, and today are incorporated into fabrics for use in apparel and interiors. The function of antibacterial textiles is to control and reduce bacteria, infection and/or odors. The products work by inhibiting and preventing the growth of micro-organisms such as bacteria. Impregnating fibers with polymers or silver technologies are key developments used for antibacterial applications.

Antimicrobials can be divided into two types based on the mode of attack on microbes. The first type of antimicrobial (controlled release mechanism) is slowly released from a reservoir either on the fabric surface or in the interior of the fiber. This

may be accomplished by utilizing micro-encapsulation of the active ingredient to permit its controlled release. 'Odor-eaters' for socks and athletic wear operates on this theory. This leaching type of antimicrobial can be very effective against microbes on the fiber surface or in the surrounding environment. One approach to the controlled release of antimicrobials is micro-encapsulation. The second type of antimicrobial finish consists of nanosized molecules that are chemically bound to the fiber surfaces. These products control those micro-organisms that are present on the fiber surface. In the institutional textile market, antimicrobial finishes function by preventing or destroying the microorganisms. The application of this technology appears in apparel as well as linens.

An example of the antimicrobial technology is AgION™, a silver-based inorganic zeolite which has been embedded in polyester Fossfibre® bicomponent fibers. Unifi, Milliken and Noble Fiber Technologies have also developed silver ion-based antimicrobial treatments. The systems work by killing the bacteria (microscopic chemical warfare), an infection or odor prevention technique.

Antimicrobial finishes have also been combined with other functional performance characteristics, including water and stain resistance. Fabrics that were traditionally targeted for outdoor use are making their way into institutional applications such as hospitals or restaurants. An example is Crypton In & Out – the very first guaranteed fade resistant, bleach-cleanable, indoor/outdoor Crypton super fabric. Crypton In & Out offers a clean and sanitized fabric for healthcare facilities.

CARE & MAINTENANCE OF HIGH PERFORMANCE PRODUCTS

During the past few years linen managers can't ignore the integration of high-performance textile technologies into the institutional market. The earliest introductions of high performance fabrics were designed to meet specific requirements or mandates such as protection from blood-borne pathogens for the surgical team. Today the application goes far beyond specialized groups to offer apparel, uniforms and bedding products with high tech and high performance functions. As the new technologies meet the needs of clients in both the healthcare and hospitality industries, the institutional linen managers will be held accountable or responsible for the care and maintenance of performance textiles.

Washing high-performance textiles using a standard sheet or towel cycle may affect the function or performance of the product. Most high-performance products can be cleaned in a washer and dried in a dryer, but special attention must be made to the manufacturer's recommended method of cleaning. For example, many products have warnings, such as DO NOT USE BLEACH, DO NOT USE FABRIC SOFTENERS of any kind, DO NOT WASH WITH LINT GENERATING ITEMS, DO NOT USE HIGH HEAT or DO NOT IRON. Special attention should be paid to the warnings on high-performance products, for example, product manufacturers may warn against the use of fabric softeners and claim that they may clog the microfibers, or coat the nanosize particles on the surface making the fabric less effective. A general rule of thumb is that a linen manager should evaluate the care and maintenance recommendations of the manufacturer for each high-performance product.

Summary

Performance fabrics are a new paradigm for the textile industry but represent one of the fastest growing sectors of the industry. Smart/interactive textiles are being developed to offer structures that will sense and react to environmental conditions. For example, products with nanotechnology, which will store energy for the slow release of heat or cold or temperature adaptive textiles, which incorporate a micro-thermal material that can be used as phase change product to provide 'adaptive comfort'. It sounds complicated, but what it really means is that the fabric actually responds to small changes in the wearer's body temperature and microclimate (the space between the skin and the fabric) by absorbing excess body heat and releasing stored heat when necessary. The product provides a 'smart' textile that may be used by the medical field. Other products may include health-care and wound-healing functions and far-reaching technology may include self-cleaning and repairing functions. Smart and interactive textile technology is being developed to receive and respond to stimuli from the body. The sensors may monitor heart rate, respiration, temperature, etc. and if vital signs drop below critical values, the system would send a distress signal. Such products may include a sensory baby-vest for monitoring new-born babies.

The possibilities for performance textiles are endless. In the future, the textile industry has the capability to develop performance textiles to meet the needs of the healthcare and hospitality markets.

Elizabeth Easter holds a PhD in Textile Science from the University of Tennessee. Currently a professor in the Department of Interior Design, Merchandising and Textiles at the University of Kentucky, Dr. Easter also conducts research and directs graduate student projects in the area of textiles. She supervises the Textile Testing laboratory at UK which conducts the evaluations for textile and apparel companies and provides the Testpiece Service and Special Testing to ALM. She has authored a number of articles and text for ALM over the years and is an instructor at the American Laundry & Linen College held on the campus of Eastern Kentucky University twice yearly.