

New Technology Helps Medical Textiles Fight Hospital Germs

BY MATTHEW HENRY, APPLICATIONS ENGINEER MANAGER, NANO HORIZONS INC.

Ask any hospital or other health care facility administrator what is the most vexing problem faced by their organizations and the answer will likely be HAIs—hospital acquired infections. According to a recent study conducted by the Washington, D.C., think tank Resources for the Future, 48,000 Americans die of infections caught while in the hospital each year and that is probably a conservative figure. In its 2009 quality report to Congress, The U.S. Health and Human Services Department found “very little progress” in eliminating HAIs and called for “urgent attention” to the problem. In addition to the negative impact on patient outcomes, HAIs also hit the hospital’s bottom line. Medicare has reduced or eliminated reimbursements to hospitals for HAI treatments and the mean cost of treating HAIs is estimated to be \$13,973 per incidence. With a hospital-acquired infection rate of approximately 5% of admissions, reducing this rate to even 4% could translate into millions of dollars in savings per hospital.

Fortunately, advances in antimicrobial technology are providing hospital administrators, doctors, and health care sector suppliers with new opportunities to reduce the seemingly intractable HAI rate. While standard infection prevention practices such as hand washing and disinfection are of paramount importance, an additional approach gaining attention and support is to expand the role of antimicrobial agents in hospital settings from the traditional therapeutic one to a preventative one; in short, to provide built-in antimicrobial protection for the entire patient environment – from the scrubs of the healthcare givers to the wall paint, curtains, and patient bed in the hospital room. The success



Greenology USA uses SmartSilver™ antimicrobial additives in its Do No Harm™ medical scrubs. Photo courtesy of ©Greenology USA LLC

of this preventative approach depends primarily on using an antimicrobial agent that is effective, safe, durable, affordable, and adaptable to a variety

of materials. Silver, revered for thousands of years as a natural healing metal and preservative, uniquely fits this set of requirements.



NanoHorizons offers a diversified line of SmartSilver™ additives. Photo courtesy of ©NanoHorizons Inc.

SILVER - AN ANTIMICROBIAL

The inherent antimicrobial properties of silver have a long historical track record. As early as 1200 BC, the ancient Phoenicians stored water in silver bottles to prevent spoilage from microbes. By 500 BC, Greeks and Romans routinely used silver vessels for water purification. In the fourth century BC, Hippocrates, the father of modern medicine, noted the healing benefits and anti-disease properties of silver. As they trekked westward, 19th century American pioneers used silver to keep their water safe and prevent common ailments such as dysentery, colds and flu. They also used silver dollars in their milk containers to slow bacterial growth. The 1800s also saw silver used directly for medicinal purposes—as silver sutures for surgical wounds, as a silver nitrate solution to eliminate blindness in newborns, and to treat typhoid and anthrax. Before the onset of antibiotics, silver compounds were used to prevent infection during World War I. During the 1920s, over 3 million prescriptions were written annually for medicinal silver.

Silver’s impressive history continues today. Because it is recognized as one of the most non-toxic and safest of nature’s metals, silver is routinely used in neonatal eye drops to prevent eye infection. It is the preferred antimicrobial in wound care because of its ability to reduce infections without pro-

moting antibiotic resistance. Silver sulfadiazine is the most popular treatment for burns in U.S. burn centers. Outside the health care sector, you will find silver in surfaces such as cutting boards and table tops to help protect against food contamination, in sport and military clothing to reduce bacteria-causing odors, and in water purification filters used by international airlines and NASA.

The challenge for hospital and health care facility administrators, therefore, is not in finding the right antimicrobial agent to protect the patient environment. Silver has a long history of use with an excellent safety record and proven efficacy. Instead, the challenge is in developing a cost-effective means to integrate silver into price-sensi-

tive health care facility products that are made of a variety of materials (including natural and synthetic fibers as well as plastics, coatings and foams), and to do so without requiring product manufacturers to redesign their current processes. The solution lies in leverag-

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NanoHorizons' state-of-the-art laboratories conduct industry-standard efficacy testing and R&D. Photo courtesy of ©NanoHorizons Inc.

ing the natural antimicrobial capabilities of silver with nanotechnology.

LESS IS MORE

Nanotechnology combines engineering and science to make materials that are smaller than 100 nanometers and, in doing so, impart to these materials unique properties not present in their bulk form. NanoHorizons Inc.

specializes in the field of practical nanotechnology for a broad range of textile, health care and industrial applications. The company's nanoscale silver antimicrobial additives are entirely developed and manufactured in the United States, are EPA-registered and Oeko-Tex® approved, and are marketed globally under the SmartSilver™ brand.

NanoHorizons' proprietary application of nanotechnology produces silver particles that are nanoscale (<100 nm) in size. To put things into perspective, the width of a human hair is about 100,000 nanometers while the average size of bacteria and viruses is generally 2,000 and 100 nanometers, respectively. Reducing silver to these extremely small sizes provides several important benefits not found in silver's bulk form. The first is related to antimicrobial performance. Ionic silver, the active form of silver that inhibits the growth of microbes, is released from the surface of the silver when exposed to moisture. The key to optimizing the use of silver as an antimicrobial, therefore, is to maximize the production of silver ions that target and eliminate microbes. The smaller the silver particle is, the larger the surface area producing silver ions. Hence, unlike bulk silver-based antimicrobial solutions that depend on adding increasingly more silver to be effective, nanoscale silver can achieve the same or better levels of efficacy using considerably less silver, thereby reducing costs and environmental impacts.

Nanotechnology brings other advantages to silver. NanoHorizons' silver particles are covalently bonded to molecules in the products in which they are integrated. In this way, the silver particles are less susceptible to being washed out or worn off over time. Under the proper application techniques, their antimicrobial capabilities are effective for the expected life of the host materi-

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al. In addition, silver nanoparticles are so small that they don't impact mechanical properties such as hand feel or tensile strength, and unlike organic antimicrobials, silver won't negatively impact other textile effects such as flame retardation or moisture control. Finally, NanoHorizons' proprietary production methods result in a nanoparticle silver additive that is integration-ready and compatible with virtually any manufacturing process across a wide variety of host materials. SmartSilver additives are easily mixed or metered into finished and in-process formulations. The additives are also stable against UV light and high temperatures and resist oxidation.

FIGHTING BACTERIA WITH TEXTILE


Medical textiles have numerous applications in the health care field including clothing, bedding, curtains, and medical devices, to name a few. NanoHorizons works with a number of OEMs and end-customers that manufacture medical textiles. Greenology USA LLC's Do No Harm™ brand, for example, has launched a line of eco-friendly medical scrubs and apparel enhanced with SmartSilver that helps protect the scrubs from bacterial contaminants found in the workplace and transported from room to room. NanoHorizons' silver nanoparticles have also been integrated into materials used in the construction of wound care dressings to help prevent wound site infections as well as in breast forms used by women following mastectomy surgery.

NanoHorizons offers several formulas of its SmartSilver additives, facilitating integration into customer-specific manufacturing processes. For textile applications, the most frequently used formulas are the SmartSilver™ Masterbatch and the SmartSilver™ Pro Series. The Masterbatch antimicrobial additives consist of silver nanoparticles pre-dispersed in a specific resin for use by yarn and film extruders as well as by companies involved with molding and foaming thermoplastics. Manufacturers use these resins like

any other standard additive-based masterbatch to add antimicrobial performance to the desired polymer.

For dye-based processes, the Pro Series offers manufacturers the option to exhaust an antimicrobial directly onto fibers or fabrics made of natural fibers, such as cotton and wool, or onto synthetic fibers, such as polyester and nylon. These additives are applied like an exhaust acid dye and can be treated either before or after the dye step. NanoHorizons also offers a line of powder-based dispersible additives that can be applied to textiles using standard finishing or coating equipment. The resulting treated textiles have proven to be both safe to wear and effective at killing bacteria even after 50-75 launderings.

PATIENT ROOM OF THE FUTURE

Left unchecked, HAIs threaten significant economic consequences to the health care system as well as an unacceptable human toll. In this fight against microbe-causing infections, there is no substitute in the healthcare setting for personal hygiene and frequent facility cleaning. That said, however, research has shown that health care workers clean their hands effectively only about half the time. A comprehensive approach that integrates durable antimicrobial protection into multiple patient touch points can provide a second line of defense to the current labor-intensive cleaning procedure. Nanoscale silver additives, such as SmartSilver, offer a cost-effective and flexible solution to integrate safe and proven antimicrobial protection into virtually all hospital surfaces that harbor germs. With their ubiquitous presence in the patient room, medical textiles enhanced with these additives can play a key role in reducing the HAI threat. 

For more information contact:
NanoHorizons Inc.
Tel: 1-814-355-4700
Fax: 1-814-355-4722
Email: Info@nanohorizons.com
Website: www.smartsilver.com

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719-375-1564
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