INTRODUCTION
The hospital and healthcare system is challenged by the presence of microorganisms and the negative
effects they cause. Deterioration, defacement and odors are all dramatic effects which occur from the
microbial contamination of surfaces as varied as uniforms and medical non-woven fabrics to medical
devices and hard surfaces i.e., walls, tables, ceilings, and air duct systems. Most significantly, these
surfaces can act as microbial “harbors and transfer site (vectors),” offering ideal environments for the
proliferation and spread of microorganisms that are harmful to buildings, textiles, and humans. The
ability to make microbial resistant surfaces in a healthcare environment has advantages in many
applications. This is especially true in healthcare and hospital environments where the emergence of
hospital acquired infections caused by MRSA, *Aspergillus sp.*, *Clostridium difficile*, *Mycobacterium spp.* (TB),
and other drug resistant species have threatened the health of its patients, staff, and visitors. According
to a February 2007 National Statistics (UK) report, “The rates for deaths involving MRSA doubled for both
males and females between 2001 and 2005.”

In spite of the many precautions taken to prevent or reduce the transmission of harmful organisms in
hospitals such as hand-cleaning, housekeeping and laundry protocols, the risk of cross contamination of
surfaces and textiles to patients and staff is considerable. Any textile material and hard surface in a
hospital environment is a potential carrier of infectious agents including bacteria, fungi, and yeast. The
only effective strategy for reducing such infections and the conditions where organisms can build
resistance is to reduce the dose of microorganisms throughout the healthcare complex, using safe
persistent antimicrobial technologies to treat such surfaces and to maintain the highest standards of
hygiene and use protocols for antibiotics.

This document discusses how a bound organofunctional silane antimicrobial has been and can be
successfully used to reduce microbial dose on multiple substrates in a healthcare setting, i.e., medical
nonwovens, blankets and linens, wound care materials, uniforms, and the hard surfaces that enclose and
protect the healthcare environment. Laboratory and field test data will be discussed.

SURFACEAIDE ANTIMICROBIAL
Microorganisms, their body parts, metabolic products, and reproductive parts cause multiple problems to
surfaces. They are human irritants, sensitizers, toxic -response agents, causers of disease, and simple
discomforting agents. Clearly, microorganisms are the most potent pollutants in the indoor environment.
Human reactions of building-sourced microbial exposure involve an array of physical and systemic
reactions affecting the skin, mucous membranes, and eyes, upper and lower respiratory tracts and
muscles. Some reactions are short-term (acute) and others are long-term (chronic). All affect productivity,
health costs, and well-being.
The antimicrobial SurfaceAide 1000 is based on the organofunctional silane antimicrobial technology. This unique antimicrobial technology has been effectively used for over thirty years without any human health or environmental problems inside manufacturing facilities or in actual end use situations.

When applied, SurfaceAide 1000 actually polymerizes with the substrate making the surface antimicrobial. It does not migrate or create a zone of inhibition so it does not set up conditions that allow for adapted organisms. Because this technology stays on the substrate, it does not cross the skin barrier, does not affect normal skin bacteria, nor causes rashes or skin irritations. It does not poison the microorganism. When a microbe contacts the SurfaceAide 1000 treated surface, the cell is physically ruptured by a sword-like action and then electrocuted by a positively charged nitrogen molecule. This bound technology has a mode of action that relies on the technology remaining affixed to the substrate - killing microorganisms as they contact the surface to which it is applied. Durability to wear with broad-spectrum antimicrobial activity has also been demonstrated.

HealthNovation - CS Lab LLC has evolved from a specialty waterbased coatings manufacturer in the commercial and sports industries to a global player in sustainable, environmentally-beneficial surface treatments. Since the days where standard practices involved the use of solvents and other hazardous types of materials, HealthNovation always strived to use the most environmentally friendly technologies available to provide safe, sound, and effective solutions to our customers. The chemistry and application knowledge gained in the development and successful commercialization of these coatings on various surfaces, including natural and synthetic surfaces, facilitated the development of a complete family of waterbased ready-to-use antimicrobial products using the ÆGIS Microbe Shield technology as active antimicrobial ingredient in the formulations.

Throughout years of close collaboration, HealthNovation SAS Environments and HealthNovation-CS Lab LLC have developed a close working relation and forged a working partnership in various areas. The proven results and unsurpassed safety record of the ÆGIS Microbe Shield technology, its unique proprietary manufacturing process, and HealthNovation-CS Lab LLC’s formulation knowledge of waterbased coatings behind the antimicrobial products have proven an exceptional combination. To date, HealthNovation-CS Lab LLC’s unique and products have been applied to over 50 million square feet of surface area, including areas considered high frequency touch or contact areas in places ranging from schools, sports facilities, professional sports venues, hospitality buildings to nursing homes and hospitals.

LABORATORY & FIELD EXPERIENCES

The enabling technology of the SurfaceAide Antimicrobial is based on a silane backbone that readily reacts with and onto numerous substrates yielding a colorless, odorless, extremely durable, micro-polymer network on the treated surface. Numerous patents and hundreds of peer reviewed and trade industry publications support the efficacy and utility of this IR-100 award winning antimicrobial technology. Numerous studies have been done for EPA registration, quality control, field efficacy and customer run validations. These tests universally show equivalency of the SurfaceAide Antimicrobial to the HealthNovation SAS Antimicrobial data base.
Since 2006, over 20,000,000 sq ft of surface having been treated, including areas considered high frequency touch or contact areas. Antimicrobial applications with SurfaceAide 1000 and SportsAide 1000 have included post surface analysis taken randomly from treated surfaces to evaluate the bioburden on the surface. In each case, swab samples are sent to an independent NVLAP and AIHA accredited Analysis Laboratory for analysis and reporting. The generated data from these results form a real life compilation that demonstrate the efficacy and the longevity of the SurfaceAide 1000 antimicrobial treatment, and show clearly the utility and appropriateness of the technology as part of system of microbial control in a healthcare setting.

LABORATORY & FIELD EXPERIENCES

1. CASE STUDY - THE ARTHUR G. JAMES CANCER CENTER HOSPITAL AND RESEARCH INSTITUTE:
The study building is a 12-story comprehensive cancer center and research institute located in Columbus, Ohio. Just prior to its opening in January 1990, a ruptured water pipe on the 12th floor flooded the building with an estimated 500,000 gallons of water. Ceilings, walls, carpeted floors and upholstered furnishings were either wet or exposed to high humidity.

After assuring that the building’s structural integrity had not been compromised, attention focused on restoring the microbiological quality of the building to levels consistent with its intended use, particularly in the Bone Marrow Transplant area and other areas where immunosuppressed patients would be housed or transported.

Despite high efficiency air filtration, and widespread use of a chlorine-based disinfectant fog throughout the building and its ventilation system, large numbers of fungi and bacteria were retrieved from the air in all areas of the hospital. Large numbers of water-associated bacteria, such as Acinetobacter sp, as well as fungi were retrieved from carpeting.

Prior to the flood, hospital and university researchers had designed a study protocol to investigate the effect of surface modification with silane antimicrobials on infection rates within the Bone Marrow Transplant, Hematology and Oncology areas in the hospital. The flood and subsequent microbial contamination preempted the study. But, investigation of various antimicrobial systems to achieve sustained microbial control during the study provided an important tool for use in remediation and beyond.

All accessible interior surfaces (including carpeting, ceilings, walls, above ceiling space, furnishings, elevator shafts, mechanical and electrical chases) were treated with the silane quaternary amine antimicrobial 3-trimethoxysilylpropylmethyloctadecyl ammonium chloride (HealthNovation SAS Antimicrobial) in water in accordance with the manufacturer’s application specifications. The applications were randomly tested for uniformity and penetration throughout the treatment process.
Results (See Table 1)

- Pre-treatment retrievals were in a range of 721 – 2,800 CFU’s/m³. Of the 209 sample sites, 122 (58%) sites produced 2,800 CFU’s/m³, the upper detection limit of the sampler.

- Post-treatment sampling during the seven months following restoration of the building produced an average of 4.1 CFU’s/m³ at 643 sites. Retrievals were in a range of 0-25 CFU’s/m³. Of the sample sites, 289 sites (45%) produced 0 CFU’s/m³; an additional 231 sites (36%) produced retrievals in a range of 1-5 CFU’s/m³.

- The second post-treatment samplings were performed in 1991 at 82 sites randomly selected by floor. The samplings produced retrievals in a range of 0-9 CFU’s/m³, with an average retrieval of 0.8 CFU’s/m³. 40 sites (48%) produced 0 CFU’s.

- The final post-treatment samplings were performed in 1992 at 86 sites randomly selected by floor. The samplings produced retrievals in a range of 0-4.7 CFU’s/m³, with an average retrieval of 0.4 CFU’s/m³. 56 sites (65%) produced 0 CFU’s.

- Each of the 24 Bone Marrow Transplant patient rooms was negative for microorganisms during all of the post-treatment samplings.

- The facility is presently free of odor and has a new appearance unaffected by the extensive application of a surface antimicrobial. No fungal nosocomial infections were recorded in this facility during the 30-month study and a post study check after five years. All renovations or reconstruction in the facility were strictly controlled and all newly added or modified surfaces were treated with bound silane quaternary amine antimicrobial for five years after the initial treatment.
Table 1. Summary Sample Retrievals

2. BUILDING EVALUATION – RESIDENTIAL STUDY:

Methodology: A total of 19 homes in the metropolitan area of Cincinnati, Ohio were selected for the study, at least 10 of which housed adolescent mold allergy sufferers. The homes were selected in conformance with the following criteria: (1) at least one family member had to be under the care of an allergist for at least one year and diagnosed as mold sensitive, (2) the attending allergist was asked to document clinical observations for at least six months, and (3) carpet and air conditioning were required in the main living areas of the home.
Prior to initiating the study, the following characteristics of each home were noted: (1) type, size and age of home, (2) type of air conditioning, (3) presence and type of air filtration devices, (4) presence and type of other allergy control actions used in the home, and (5) characteristics of carpeting in the home as to (a) age, (b) amount, and (c) wall-to-wall or area. The following parameters were recorded about the mold sensitive occupants in each home: (1) age, (2) sex, (3) relative degree of severity in allergic responses, (4) other allergies, (5) current allergy therapy, and (6) name and length of time under the care of an allergist.

Testing: Two weeks prior to treatment standard plastic Petri dishes (BBL) containing Sabauroud’s Dextrose Agar were placed at floor level in random arrays (20 plates per home) throughout test zones. Plate locations, time, activity and ambient conditions within zones were recorded.

The entire carpeted area of 18 homes selected for the study was treated with the silane quaternary amine antimicrobial agent per the manufacturer’s specifications by an authorized applicator. One home (#19) was not treated and served as a control.

Two weeks following treatment, Petri dishes were placed at floor level in the pre-treatment locations. Post-treatment samplings were designed to replicate pre-treatment conditions as closely as possible. All plates were exposed for one hour, sealed and sent to the laboratory for incubation and enumeration using standard microbiological methods.

Participants were aware that they were part of a study but not informed regarding control or treated homes.

Results:

Comparisons of total Aeromicrobial gravity plate retrievals and percent changes before and after silane modified quaternary amines treatment can be seen in Figure 1.

Average total microbial retrieval in the homes prior to antimicrobial treatment of the carpet ranged from 6 Colony Forming Units (CFU’s) per plate to 42 CFU’s per plate (Figure 1). After antimicrobial treatment, the average total microbial retrievals ranged from 1 CFU per plate to 20 CFU’s per plate.

Thirteen of the 19 homes (68%) showed greater than 50% reduction in total aeromicrobiological populations following antimicrobial treatment of the carpeting.

Analysis of the symptomatic responses from the mold-sensitive occupants in the homes revealed that 19 of 24 (79%) people recorded intermediate to significant improvement in their conditions. The improvements noted were fewer headaches, decreased congestion, better balance, decreased sinus problems, required medicine reduced or stopped, and an overall better feeling. The remaining five allergy sufferers recorded essentially no changes in their allergic symptoms. Three of the original study participants reported being ill with colds or other infections during the evaluation period, and the allergy-sufferer in the control house (#19) reported no change of condition. These four original participants are not included in the calculation above.
Figure 1. Comparison of total Aeromicrobial retrievals and percent changes before and after antimicrobial treatment in residential homes.
3. BUILDING EVALUATION – COMMERCIAL STUDY

Methodology: Studies on ten buildings from various geographical locations (See Table 2) are reported in this paper. These buildings represent a wide array of structures and geographies. The common thread is the widespread reporting of SBS (Sick Building Syndrome) symptoms from the building occupants. Suspecting microbial involvement sourced from the environmental surfaces, microbial retrievals and mediation was undertaken. This study was designed to determine gross variances of bioaerosol presence within large test areas.

Gravitational sampling was utilized to provide broad aeromicrobiological profiles of test zones, thereby enabling a quantification of retrievals prior to the following treatment. Although the recovery of airborne agents, often in patterns that roughly parallel clinical events, has fostered widespread confidence in the validity of fallout techniques (11), this retrieval method cannot be used to quantify changes in aerobiological densities. However, the repeated demonstration of statistically significant variances form a sufficiently high number of sampling locations provides confidence in identifying an event as causal and allows for gross comparisons at specific sample sites.

**Commercial Building Studies**

<table>
<thead>
<tr>
<th>Number</th>
<th>Type</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>School</td>
<td>Alexandria, KY</td>
</tr>
<tr>
<td>2</td>
<td>Print Shop</td>
<td>St. Petersburg, FL</td>
</tr>
<tr>
<td>3</td>
<td>Office Building</td>
<td>Rochester, NY</td>
</tr>
<tr>
<td>4</td>
<td>Condominiums</td>
<td>Keystone, CO</td>
</tr>
<tr>
<td>5</td>
<td>Office Building</td>
<td>Clearwater, FL</td>
</tr>
<tr>
<td>6</td>
<td>Office Complex</td>
<td>Clearwater, FL</td>
</tr>
<tr>
<td>7</td>
<td>Office Building</td>
<td>Clearwater, FL</td>
</tr>
<tr>
<td>8</td>
<td>Office Building</td>
<td>Miami, FL</td>
</tr>
<tr>
<td>9</td>
<td>Office Building</td>
<td>Tampa, FL</td>
</tr>
<tr>
<td>10</td>
<td>Office Building</td>
<td>Cincinnati, OH</td>
</tr>
</tbody>
</table>

Table 2. Building Location List

Treatment: An aqueous solution of 3-trimethoxysilylpropyldimethyloctadecyl ammonium chloride was applied to dry carpeting in accordance with the manufacturer’s specifications. Carpeting was not cleaned prior to antimicrobial applications. Building occupants in six of the buildings were not aware of any remediation activities. Although samplings were performed during normal work hours, application of the treatment was performed at night on or weekends without their knowledge.

Testing: Two week prior to treatment, standard plastic Petridishes (BBL) containing Sabauroud’s Dextrose Agar were placed at floor level in random arrays (14-50 sites per building) throughout test zones. Plate locations, time, activity and ambient conditions within zones were recorded.

Two week following treatment, Petridishes were placed at floor level in the pre-treatment locations. Post-treatment Samplings were designed to replicate pre-treatment conditions as closely as possible. All plates were exposed for one hour, sealed and sent to the laboratory for incubation and enumeration using standard microbiological methods.
**Results:**

Data and observations of ten buildings are reported in this paper. These are representative of all buildings we have investigated, both in quantification of variances and clinical observations of occupant response. Figure 2 shows the percent variance of each building following treatment of carpeting. These averages are derived by dividing the total number of colonies retrieved by the number of plate sites.

The variances between pre-treatment and post-treatment retrieval averages range between 71-98%. Within this group of buildings, 2 (20%) showed greater than 90% change, 9 (90%) greater than 80% change, and 10 (100%) greater than 70% change.

In Figure 3 we can see the actual retrieval counts at 33 sites within the test building Number 3. These data are representative of patterns observed in the ten buildings in this study. Note the pre-treatment variances representing a range from 2 CFU/Plate - 4156 CFU/Plate whereas the post-treatment retrieval counts range only form 0 CFU/Plate - 4 CFU/Plate.

**Follow-Up Sampling in 5 Buildings During 2nd Year After Treatment**

<table>
<thead>
<tr>
<th>Building</th>
<th>Pre-Treatment</th>
<th>Post-Treatment</th>
<th>2nd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>13.4</td>
<td>1.7</td>
<td>3.6</td>
</tr>
<tr>
<td>No. 3</td>
<td>54.0</td>
<td>1.0</td>
<td>1.1</td>
</tr>
<tr>
<td>No. 6</td>
<td>20.3</td>
<td>3.5</td>
<td>4.1</td>
</tr>
<tr>
<td>No. 9</td>
<td>27.4</td>
<td>3.3</td>
<td>3.5</td>
</tr>
<tr>
<td>No. 10</td>
<td>17.0</td>
<td>2.9</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Table 3. Average CFUs 2 years after treatment

This stabilization of the aeromicrobiological retrievals is noteworthy along with the consistently effective reduction in numbers retrieved.

The clinical profiles of building occupants within the commercial buildings were evaluated during the twelve months following treatment. No changes were reported or observed in any of the buildings. During the second year following treatment, aerobiological samplings were performed at 5 of the buildings in conformance with the initial and post-treatment sampling criteria. The retrieval averages are presented in Table 3 and reveal aeromicrobiological profiles in ranges with post-treatment averages.

In the ten investigations in this report of BRI/SBS within a large diversity of building designs and geographies, symptomatic improvement was uniformly reported room workers and reduction of microbioaerosol levels were observed after treatment of the carpeting with the silane quaternary amine antimicrobial.
Figure 2. Fungal Retrieval on ten buildings. Pre- and Post- antimicrobial treatment
4. HOSPITAL BLANKET STUDYs

HealthNovation Environments participated with Spartan Mills and the Virkler Company in studying blankets that were treated with the silane quaternary amine antimicrobial and blankets that were untreated. In any environment, blankets can become a haven for bacteria. These bacteria usually represent a spectrum of Gram positive and Gram negative organisms capable of producing infections, staining, deterioration and odors. In a hospital environment, fever and sweat are common and an excellent source of bacterial contamination.

In an effort to evaluate the effects a hospital environment has on treated and untreated blankets two separate studies were undertaken. The first simulation study was initiated to simulate the types of exposures blankets receive when in use on a feverish patient. The second in-use study was initiated to determine the effectiveness of the antimicrobial on blankets when stored and used within a care facility.
**Results:**
The in-use study on Spartan Mills blankets correlates well with the simulated study undertaken earlier in the year. Both studies clearly show that blankets treated with the silane quaternary amine antimicrobial have a significantly lower bioburden and will present less of a risk in the patient environment. Historical data generated by American Hospital Supply and Dow Corning Corporation supports these findings.

These data generated by university, medical and industrial laboratories represent some of the most extensive microbiological work ever performed on antimicrobial treated substrates for use in the healthcare community. The control of the microorganisms is impressive and provides numerous benefits:

- Prevents blanket staining due to mold and mildew growth that occurs on damp blankets prior to laundering.
- Controls blanket deterioration due to microbial growth that occurs on blankets during storage.
- Controls odors caused by bacteria and fungus normally found in blankets.
- Provides 3 times more protection from bacteria and fungus than an untreated blanket.

**5. NONWOVEN SURGICAL DRAPES**

A considerable body of microbiological efficacy data was generated to support the effectiveness of the nonwoven surgical drape through a variety of microbiological tools. These included: in-vitro tests, Scanning Electron Microscopy (SEM) work and clinical evaluations. The purpose of these tests was to support claims relating to the reduction of microbial dose on the drape in the vicinity of the wound. The surgical drape fabric was found to kill the bacteria commonly associated with surgical wound infections and takes an active role in maintaining an aseptic field at the wound site.

The antimicrobial surface serves to isolate the wound from bacterial transfer from the drape surface. The antimicrobial component of this fabric was chemically bonded, safe for use in surgery, and did not lose its effectiveness when sterilized, stored, or handled during the manufacturing procedure or in surgery. Representative data are presented in Tables 4, 5, and 6.
Results:
Table 4 shows results of laboratory testing on the silane quaternary amine antimicrobial treated nonwoven (Kaycel, Kimberly-Clark) fabrics against a broad spectrum of bacteria and yeast using a padding contact test protocol (AATCC-100).

![RESULTS AATCC METHOD 100, ANTIMICROBIALS ON FABRICS\(^1\) ANTIMICROBIAL AGENT TREATED NONWOVENS](image)

<table>
<thead>
<tr>
<th>Microorganisms</th>
<th>Sample</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>Control</td>
<td>16</td>
</tr>
<tr>
<td>Gram (+) Bacteria</td>
<td>Treated(^2)</td>
<td>100</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>Control</td>
<td>0</td>
</tr>
<tr>
<td>Gram (-) Bacteria</td>
<td>Treated</td>
<td>99.6</td>
</tr>
<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>Control</td>
<td>0</td>
</tr>
<tr>
<td>Gram (-) Bacteria</td>
<td>Treated</td>
<td>100</td>
</tr>
<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>Control</td>
<td>0</td>
</tr>
<tr>
<td>Gram (-) Bacteria</td>
<td>Treated</td>
<td>100</td>
</tr>
<tr>
<td><em>Saccharomyces cerevisiae</em></td>
<td>Control</td>
<td>0</td>
</tr>
<tr>
<td>Yeast</td>
<td>Treated</td>
<td>99.9</td>
</tr>
</tbody>
</table>

\(^1\) DuPont FC-170 surfactant used, substituted for Rohm and Haas Triton X-100

\(^2\) Fabric was Kaycel
Table 5 shows results against a battery of clinical isolates on the silane quaternary amine antimicrobial treated Sontara,® Dupont.

<table>
<thead>
<tr>
<th>Microorganisms</th>
<th>Sample</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Citrobacter diversus</em> Wound Isolate</td>
<td>Untreated¹</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>Treated¹</td>
<td>93.6</td>
</tr>
<tr>
<td></td>
<td>Inoculum</td>
<td>0</td>
</tr>
<tr>
<td><em>Pseudomonas seruginosa</em> Urine Isolate</td>
<td>Untreated</td>
<td>28.3</td>
</tr>
<tr>
<td></td>
<td>Treated</td>
<td>99.9</td>
</tr>
<tr>
<td></td>
<td>Inoculum</td>
<td>0</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em> Wound Isolate</td>
<td>Untreated</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Treated</td>
<td>99.7</td>
</tr>
<tr>
<td></td>
<td>Inoculum</td>
<td>0</td>
</tr>
<tr>
<td><em>Escherichia coli</em> Urine Isolate</td>
<td>Untreated</td>
<td>11.6</td>
</tr>
<tr>
<td></td>
<td>Treated</td>
<td>98.6</td>
</tr>
<tr>
<td></td>
<td>Inoculum</td>
<td>0</td>
</tr>
<tr>
<td><em>Proteus mirabilis</em> Wound Isolate</td>
<td>Untreated</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Treated</td>
<td>99.5</td>
</tr>
<tr>
<td></td>
<td>Inoculum</td>
<td>0</td>
</tr>
</tbody>
</table>

¹ DuPont FC-170 surfactant used, substituted for Rohm and Haas Triton X-100
² Fabric was Kaycel
Table 6 shows results comparing untreated linen, untreated Sontara, and the silane quaternary amine antimicrobial treated Sontara with a 15 minute contact time of the bacterial insult in the presence of various buffer and irrigation fluids.

Table 6

<table>
<thead>
<tr>
<th>Sample</th>
<th>Buffered Phosphate</th>
<th>Saline</th>
<th>Serum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated Linen</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Untreated Sontara Nonwoven</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Untreated Sontara Nonwoven</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Treated Sontara Nonwoven</td>
<td>99+</td>
<td>90+</td>
<td>90+</td>
</tr>
</tbody>
</table>

1 Modified AATCC method 100 using test fluids Klebsiella pneumoniae statistically significant at the 95% confidence level.

Under all of these stress conditions against the variety of test organisms, the silane quaternary amine antimicrobial showed from one to three log reductions of the test organisms.
6. WOUND CARE SILK DRESSINGS

Giuseppe Stinco at The Institute of Hygiene and Epidemiology evaluated the effectiveness of a special silk fabric (MICROAIR DermaSilk treated with the silane quaternary amine antimicrobial) in the treatment of patients (ages 3-31 years) affected by Atopic Dermatitis (AD) with acute lesions at the time of examination. SCORAD measurements were taken each at baseline, 7, 14, 21, and 28 days. Using the SCORAD index, a significant decrease in AD severity was noted with the treated dressings in comparison to the non-treated dressings (Fig. 5). Investigators concluded the special silk fabric treated with the non-leaching silane quaternary amine antimicrobial was “more effective in the treatment of AD than cotton and unmodified silk,” and “appears to be able to reduce pruritus in AD more effectively than unmodified silk.”

Koller, et al. at Medical University, Vienna (Department of Pediatrics) studied the clinical effectiveness of Dermasilk in children with atopic dermatitis. Twenty-two children with mild-to-moderate atopic dermatitis were recruited for a three-month study. All received three different tube fabrics – Dermasilk treated with HealthNovation SAS Microbe Shield, A non-treated sericin-free silk fabric and cotton. SCORAD scores were recorded at the beginning of the study and after 2, 4, 8 and 12 weeks. “Significant reduction” of SCORAD index for the participants receiving the Dermasilk tube was observed after 4, 8 and 12 weeks in comparison to patients wearing the cotton tubes. (Fig. 6) The study team concluded that “Dermasilk is useful in the treatment of mild-to-moderate atopic dermatitis.”

He added the effectiveness was due to the characteristics of the fabric including smoothness without skin irritation; no sensitizing due to the silk being sericin-free; maintenance of water balance of the skin and absorption of sweat; and antifungal and antibacterial properties due to antimicrobial treatment with HealthNovation SAS.
Dermasilk fabric underwear: fast antimicrobial properties, no leaching into skin

Vittoria Sambri from the University of Bologna (Microbiology and Oncology) studied, \textit{in vitro}, the “microbe-cidal capacity of 10 different fabrics” that are used in contact with skin, against \textit{Lactobacillus acidophilus}, \textit{Staphylococcus epidermidis}, \textit{Staphylococcus aureus} (methicillin resistant) and \textit{Candida albicans}.

The textiles studied, along with the HealthNovation SAS Microbe Shield treated Dermasilk fabric, were fabrics treated with silver, polyamide, chitosan and triclosan. Although most fabrics studied showed a marked increase in antimicrobial activity within the 24-hour incubation time, only Dermasilk “showed to exert its maximum antimicrobial activity in a short time (within the first 60 minutes).” The differences in antimicrobial activity over the time period is likely due to the mode of actions of the different materials.

“These materials that required a longer period of incubation are likely to release the antimicrobial in the medium,” said Sambri. This fact, he added “is likely to provoke a marked modification in the microbial ecology of the body district (e.g. the genital area).”

Wound care garments as a therapeutic aid against Lichen sclerosus in women

Lichen sclerosus is a skin disorder that can affect men, women or children, but is most common in women. It usually occurs on the vulva (the outer genitalia or sex organ) in women, but is seen on other parts of the body, especially the upper body, breasts, and upper arms.

Researchers at the University of Bologna (Department of Internal Medicine, Geriatry and Nephrology – Division of Dermatology) recruited 42 women, ages 22 to 79 years (mean 51.1) affected by vulvar lichen sclerosus. After examination and assessment, each women was give three pairs of underwear made of either cotton or HealthNovation SAS Microbe Shield treated Dermasilk. At the end of six months, data indicates, although all saw an improvement of symptoms, those wearing the HealthNovation SAS Microbe Shield treated Dermasilk underwear showed “more marked, rapid and long-lasting” relief, namely in regards to burning, pain, dryness and dyspareunia.
SURFACEAIDE CASE STUDIES

CASE 1: PROFESSIONAL SPORTS TRAINING CENTER

In July 2006, approximately 29,000 sq ft were treated at a professional athletic installation. Areas treated included Locker Rooms, Showers, Restrooms, Steam Room, Weight Rooms, Training Area, Meeting Rooms, Conference Rooms, Offices and Spa. On July 2009 sixteen (16) random surface sample analyses were taken of different treated areas including high touch/ high traffic area, including exercise equipment, door knobs, handles. Results of samples revealed that after three (3) years of the antimicrobial application, none or little bioburden on the surface tested.

CASE 2: HIGH SCHOOL

In October 2008, approximately 8,000 sq ft were treated at a high school. Areas treated included the Weight and the Wrestling Room. On October 2009, five (5) random surface sample analysis were taken of different areas, including the high touch/frequently touched areas, such as exercise equipment, and wrestling mats. Results of the samples revealed that after one year of the antimicrobial application, the treated areas show no bioburden on the surfaces tested.

CASE 3: PROFESSIONAL SPORTS ARENA

In March 2006, approximately 12,000 sq ft were treated at a professional athletic installation. Areas treated included Locker Rooms, Showers, Restrooms, Steam Room, Weight Rooms, Training Area, Meeting Rooms, Conference Rooms, Offices and Spa. On March 2009 eight (8) random surface sample analysis were taken of different treated areas including high touch/ high traffic area, including exercise equipment, floors, lockers. Results of samples revealed that after three (3) years of the antimicrobial application, none or little bioburden on the surface tested.
SUMMARY

Reducing dose of microorganisms in the healthcare environment by eliminating reservoirs and transfer surfaces using safe and effective antimicrobial treatments is critical to reducing microbial dose and has been clearly demonstrated with the use of the bound silane quaternary amine antimicrobial technology on a wide range of substrates and clinical settings.

In choosing an antimicrobial treatment, careful consideration should be taken to guarantee the following key aspects:

1. Adopting a non-leaching antimicrobial that doesn’t pose the risk of crossing the skin barrier or negatively affecting the normal microbial flora of the skin. If it creates a “zone of inhibition” or must integrate into the all to have function, it leaches or moves and has the potential to cause problems to people and the environment.

2. Adopting an antimicrobial technology that is adaptable across many utilities and applications areas, and stand up to use and abuse conditions through the life of the substrate treated or good.

3. Adopting a non-leaching antimicrobial that doesn’t pose the risk of creating adaptative resistant microorganisms.

4. Adopting an antimicrobial technology that is registered with the EPA, the EU BPD and other regulatory agencies for the specific product it is applied to.

5. Adopting an antimicrobial technology with a proven history of use.

6. Adopting an antimicrobial technology that has technical and marketing support.

The published papers in the addendum of this document are but a small part of the literature and patents generated by big corporations, universities, and private laboratories that support the claims of durability and effectiveness of the silane quaternary amine antimicrobial technology. These papers are available upon request.
CITATIONS


ADDENDUM

HEALTHCARE USES OF THE HealthNovation SAS MICROBE SHIELD TREATMENT INDEX

FOUNDATION PAPER - HealthNovation SAS /ÆGIS TECHNOLOGY


MEDICAL APPLICATION PAPERS ON THE SAS TECHNOLOGY Hospital Treatments


Implantables


Medical Garment and Goods


Carpeting Studies

- Microbiological Problems Associated with Carpeting, WC White, Robert Monticello, Hugo Soens (Devan) - Presented at Unitex First World Congress-Carpets, May 2002 Belgium


Air Filter Studies

- Enhanced Filtration Performance with AEM 5700 Antimicrobial Treatments: Laboratory and Field Studies W. Curtis White, CEO and Director of Research and Development, ÆGIS Environments, Midland, MI USA
Hospital Blankets
Reducing Microbial Contamination in Hospital Blankets Krueger, James, ÆGIS Environments, Midland, MI USA

Wound Care
