The ÆGIS Microbe Shield Treatment for Carpets: Effectiveness and Durability In Field & Laboratory Testing

Introduction

Laboratory tests, field tests, and field experience with carpet installed in challenging environments have shown that the SYLGARD Antimicrobial Treatment (now known as the ÆGIS Microbe Shield™) is remarkably effective and durable in controlling microorganisms. These organisms cause odors, defacement, and deterioration of carpet. Many of these microorganisms are associated with allergic reactions and potentially infectious diseases.

The ÆGIS Microbe Shield is the only carpet treatment available today that protects floor coverings against mildew and odors caused by microorganisms, while retaining its effectiveness after stain removal and cleaning. The ÆGIS Microbe Shield lasts for the lifetime of the carpet.

Many hospitals, schools, and other institutions favor carpeting over vinyl flooring. Carpeting improves aesthetics, reduces noise, and helps prevent slips and falls. But hospitals are also concerned about the possible spread of infectious diseases and odors caused by microorganisms, and the threat of allergies resulting from uninhibited growth of microorganisms.[1,2,3,4,5]

In the home, odors caused by microorganisms may be troublesome in bathroom and kitchen carpets, and in child and pet areas. Restaurants, hotels, and motels face similar odor problems in bathrooms, guest rooms, and public areas.

Antimicrobial Additives in Cleaning Products

To combat these problems, both institutions and homemakers have established housekeeping practices which include the use of cleaning products containing antimicrobial additives. These additives are based on halogenated salicylic acid anilides, organotin compounds, quaternary ammonium compounds, and quaternary ammonium sulfonamide derivatives. These treatments base their activity on leaching or diffusion into the surrounding environment. Since most of them are water-soluble, they lack cleaning durability and have to be constantly reapplied. Many have limited biological activity against specific microorganisms and have to be applied in combination with other products. And laboratory tests have shown that, although these products are effective against some bacteria, both gram-negative and gram-positive bacteria readily adapt to many of them, lessening their effectiveness over time. This has led to a general disenchantment with these products and a search for an antimicrobial which can combine effectiveness with durability.

A New Approach

The ÆGIS Microbe Shield is a silicone quaternary amine with broad-spectrum antimicrobial activity. The active ingredient (3-trimethixysilylpropyldimethyloctadecyl ammonium chloride) controls a broad range of bacteria and fungi resposible for odors, rot, and mildew. This compound destroys microorganisms by disrupting the delicate cell membranes, and therefore, does not need to be absorbed in solution to be effective. In addition, the ÆGIS Microbe Shield is unique because it combines this property with an important new technology developed by Dow Corning Corporation scientists. They have learned how to bond biologically active molecules to inert surfaces[6]. This means that

the ÆGIS Microbe Shield not onlt destroys microorganisms but remains effective through cleaning and stain removal. The combination of these two technologies - antimicrobial treatment bonded to carpet fibers - has given the ÆGIS Microbe Shield a durability unmatched by other antimicrobials on the market today. Other mill-applied treatments such as organotin compounds, *bis*-chlorinated phenols, and arsenicals are not durable to repeated washings. They leach or migrate from the carpet when the carpet is washed or when is is wet in service. In addition, these treatments generally are effective against a narrower spectrum of microorganisms than is the ÆGIS Microbe Shield.

Laboratory Testing

Extensive laboratory testing has confirmed the effectiveness and durability of the ÆGIS Microbe Shield. One test involved conditions simulating a tropical environment, ideal for the growth of fungi. **Table I** illustrates the effects of cleaning on the antifungal power of the ÆGIS Microbe Shield.

The true test of a product, however, is how it performs in the real world. In a study jointly designed by a major carpet retailer, Certified Testing Labs, and Dow Corning, the durability of the ÆGIS Microbe Shield was evaluated on nylon carpet samples installed in the Atlanta International Airport. The ÆGIS Microbe Shield was applied to the residential-style carpet at Burlington Industries and Aladdin Mills using three variations of recommended spray treatments. Burlington also supplied tufted and dyed carpet made from a treated fiber. Regardless of the method of application, the treated carpet pieces were still biologically active after 35,000 foot traffics and two cleanings. Conditions of this walk-on test were much more severe than those encountered in a typical residential installation.

Hospital Tests

In other testing, the antimicrobial activity of the ÆGIS Microbe Shield was evaluated under conditions that more closely simulated actual use. Here, untreated contol samples and treated samples were installed at a major Southeastern hospital for a 36-month study. **Table II** shows that the effectiveness of the treatment was not diminished through normal wear and cleaning.

Another example of the effectveness and durability of the ÆGIS Microbe Shield was demonstrated at Barnes Hospital at the Washington University Medical Center. Barnes Hospital was one of the first hospitals in the U.S. to install carpeting of any type. Problems developed because of the tendency for carpet to harbor food for bacteria and fungi, leading to odors and staining. In addition, matting, dirt retention, and pattern loss adversely affected appearance. To avoid these problems in a replacement carpet, architects began searching for the appropriate type of carpet and antimicrobial treatment for this application. Not satisfied with product claims, the hospital was determined to do its own testing before choosing the replacement carpet.

Eleven different nylon carpet samples of various constructions were installed in 11 patient rooms in October 1983. The samples included five different antimicrobial treatments and several without treatment. Small samples of each were also glued to the concrete floor of a hospital supply room to evaluate the effectiveness and durability of the antimicrobial treatments.

The 11 small samples were washed every weekday for 6 weeks to simulate 10 to 15 years of in-service cleaning. Each of the samples was then injected with different odor- and stain-causing live-organism solutions. Table III lists these microorganisms.

After the inoculation, the organisms were incubated at room temperature for ten days. The samples were then subjected to standard removal procedures for each type of stain, followed by two rotary scrubbings and two hot-water extractions. Finally, they were allowed to dry for two days before being taken up for evaluation. Included in this final evaluation was a visual test for staining and color retention, and a "sniff" test for odors.

When the results were in, the samples with the ÆGIS Microbe Shield were judged to have the least odor retention, the best color retention, and minimum staining. Antimicrobial effectiveness was retained throughout the cleaning cycles. Particularly important was the effectiveness against a wide variety of organisms capable of spreading infection. Because of these results, the carpeting eventually chosen by the hospital used the ÆGIS Microbe Shield.

The microorganisms used in the Barnes Hospital study indicate the broad spectrum of activity exhibited by the ÆGIS Microbe Shield. **Table IV** illustrates further the effectiveness of the ÆGIS Microbe Shield.

Do microorganisms adapt to it?

Another concern of institutions requiring antimicrobial protection in their floor coverings is the adaptation of microorganisms to the antimicrobial treatment. In the case of standard water-soluble antimicrobials, the microorganisms can become immune to the treatment, and the effectiveness of the treatment may be gradually reduced. **Table V** shows the results of adaptation studies on treated and untreated carpeting.

Through these laboratory and field tests, the ÆGIS Microbe Shield has been shown to be effective in protecting carpet from the adverse effects of microorganisms, and to be durable through numerous cleanings. In addition, the ÆGIS Microbe Shield is safe and essentially nontoxic with minimal potential for adverse impact on the environment.

References

1).Snyder, J. *Canadian Hospital*, Vol. 13, 1966, p.56. 2).Walter, W.G., *Health Lab Sci.,*, Vol. 3, 1969, p.140. 3).Baker, P.G.H.,*New Zealand Medical*, 1977, p.88. 4).Schaffer, J.G., *Health Lab Sci.*, Vol. 3, 1965, p.80. 5).Lanese, R.R., *Amer. J. Pub. Health,*, Vol. 63, 1978, p.171. 6).Plueddemann, E.P., *Journal of Adhesion* Vol. 2, 1970, p.184.

Tables:

Table 1:
Antifungal Activity of Nylon Carpet With The ÆGIS Microbe Shield - - Twelve-Week Tropical Chamber Exposure

High-Density Nylon Control Sample	*% covered by fungi in 1 week*	*% covered by fungi in 6 weeks*	*% covered by fungi in 12 weeks*
No Shampooing	100	100	100
7 Shampoo Cycles	100	100	100
14 Shampoo Cycles	100	100	100
21 Shampoo Cycles	100	100	100
High-Density Nylon Sample with the ÆGIS Microbe Shield	***% covered by fungi in 1 week***	***% covered by fungi in 6 weeks***	***% covered by fungi in 12 weeks***
No Shampooing	0	0	0
7 Shampoo Cycles	0	0	0
14 Shampoo Cycles	0	0	0
21 Shampoo Cycles	0	0	0

Table 2:
Antimicrobial Activity of Nylon Carpet With The ÆGIS Microbe Shield in a 36-Month Use Study at a Major Hospital

Sample Nylon Carpet	*% Bacterial Insult Reduction Before Installation*	*% Bacterial Insult Reduction After 12 Month Wear, 1.5 Million Traffics*	*% Bacterial Insult Reduction After 22 Month Wear, 3 Million Traffics*	*% Bacterial Insult Reduction After 36 Month Wear, 4.5 Million Traffics*
Untreated Control	0	0	2.3	3.8
Treated With The ÆGIS Microbe Shield	85	91	78	87

Table 3: **Microorganisms Used in Barnes Hospital Study**
Pseudomonas aeruginosa in tryptic soy broth.
Enterobacter aerogenes in tryptic soy broth.
Klebsiella pneumoniae in tryptic soy broth.
Serratia marcescens in tryptic soy broth.
Proteus Mirabilis in tryptic soy broth.
Staphylococcus aureus in tryptic soy broth.
Aspergillus niger in Sabouraud's broth.
Penicillium sp. in Sabouraud's broth.
Streptomyces sp. in Sabouraud's broth.
Streptomyces sp. in Sabouraud's broth.
Pseudomonas aeruginosa in urine.
Human blood mixed with tryptic soy broth.

Table 4: **Efficacy of the Active Ingredient of the ÆGIS Microbe Shield Against Gram-Positive and Gram-Negative Bacteria, Yeasts, and Fungi**
Bacteria:
Staphylococcus aureus
Streptococcus faecalis
Escherichia coli
Salmonella typhosa
Salmonella choleraesuis
Psuedomonas aeruginose
Mycobacterium smegmatis
Mycobacterium tuberculosis
Streptococcus mutans
Klebsiella pneumoniae
Enterobacter agglomerans
Staphylococcus epidermis
Acinetobacter calcoaceticus
Yeasts:
Saccharomyces cerevisae
Candida albicans
Fungi:
Aspergillus Niger
Aspergillus Flavus
Aspergillus terreus
Chaeromium globosum
Penicillium funiculosum
Trichophyton interdigitale

This table represents only a small number of the total microorganisms which are controlled.

Table 5: **Bacterial Adaptation Studies on Nylon Carpet Processed With the ÆGIS Microbe Shield**		
Using the CTM 0923 shake flask test	***% Reduction Klebsiella pneumoniae***	***% Reduction Staphylococcus aureus***
Exposure	1 , 2 , 3 , 4	1 , 2 , 3 , 4 , 5
Untreated Nylon Control	0 , 0 , 0 , 0	0 , 0 , 0 , 0 , 0
Treated With The ÆGIS Microbe Shield	99.8-99.6-98.8-97.5	98.6-97.5-96.3-99.4-98.8