

Assessment of Accelerated Hydrogen Peroxide for Sanitizing Carpet

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Abstract

Carpet is a three dimensional porous flooring surface that accumulates both settled and tracked in soil and biocontaminants. Biocontaminants that accumulate on and in the pile of carpet typically consist of soil-borne bacteria or mold spores. When carpet becomes damp following a moisture event such as a spill, these accumulated spores may germinate and grow producing offensive odors and stains. An accelerated hydrogen peroxide (AHP) technology was assessed for the ability to sanitize soiled carpeting. Sections of soiled carpet were sprayed with the peroxide based cleaner-sanitizer followed by brush agitation. Following fifteen minutes of dwell time the carpet was vacuum extracted using hot water only. Enrichment cultures prior to cleaning-sanitizing and following cleaning-sanitizing demonstrated effective kill and physical removal of the viable biocontaminants. The value of sanitizing cleaning of carpet has received little focus. Most carpet cleaning product claims today center around appearance and allergen removal. Identification of chemistries that effectively sanitize carpet would improve its aesthetic and hygienic status.

Introduction

Carpet has long been specified in commercial interior environments for its acoustical, ergonomic and design attributes. Carpet products, especially 50 cm vinyl backed carpet tile, has gained acceptance in many of these commercial interiors including healthcare and education facilities. Concerns have been expressed by infection control personnel in hospitals regarding carpets in patient care areas or those areas where spills may occur. The perception is that carpet harbors infectious microorganisms and that it cannot be thoroughly cleaned when soiled. The Centers for Disease Control has reviewed carpet and in the 2003 Guidelines for Environmental Infection control states "Despite the evidence of bacterial growth and persistence in carpeting, only limited epidemiologic evidence demonstrates that carpets influence health-care-associated infection rates in areas housing immunocompetent patients. This guideline, therefore, includes no recommendations against the use of carpeting in these areas. Nonetheless, avoiding the use of carpeting is prudent in areas where spills are likely to occur (e.g., laboratories, areas around sinks, and janitor closets) and where patients may be at greater risk of infection from airborne environmental pathogens (e.g., HSCT units, burn units, ICUs, and ORs)". The purpose of this research was to evaluate the efficacy of an accelerated hydrogen peroxide (AHP) sanitizer for reducing the viable biocontaminants on commercial carpet tile. Sattar reported on the antibacterial efficacy of accelerated hydrogen peroxide (AHP) against Methicillin resistant *Staphylococcus aureus* MRSA and Vancomycin resistant *Enterococcus faecalis* VRE in a carrier test and, in this report, AHP was examined against similar microorganisms on carpet.

Materials and Methods

The product used to treat the carpet was Johnson Diversey Alpha HP with Accelerated Hydrogen Peroxide (AHP). AHP is described by the manufacturer as a synergistic blend of commonly used, safe ingredients that when combined with low levels of hydrogen peroxide produce exceptional potency as a germicide and performance as a cleaner. Ingredients listed on the product label included phosphoric acid, hydrogen peroxide, ethoxylated alcohol, alkylbenzenesulphonic acid, propylene glycol propyl ether, and water.

Sanitizing of used carpet

A mechanical die was used to cut 48 mm diameter disc-shaped samples from pieces of used carpet tiles from both commercial and health care environments. The discs were placed into sterile 150 by 15 mm Petri dishes and overlain with sterile Tryptic Soy and Potato Dextrose agar. The dishes were incubated at 30°C for 72 hours, and inspected for the presence of microbial growth.

The used carpet tiles were then sanitized cleaned by using an accelerated hydrogen peroxide based sanitizer, Alpha HP. The cleaner was sprayed on to the carpet tile using an aerosol sprayer for 5 seconds or until complete coverage was obtained, and was agitated by using a scrub brush. The cleaner was allowed a 15 minute contact time with the carpet, and then it was extracted with a Tennant carpet extractor (hot tap water only). After the samples were dried under a biosafety hood, the die cutting procedure and the enrichment culture procedure were repeated on the sanitized samples.

Laboratory controlled studies

A mechanical die was used to cut 48 mm diameter, disc-shaped samples from pieces of unused carpet tiles. The samples were sterilized in an autoclave at 121°C with 15 psi. The discs of carpet were pre-wet using sterile, deionized water, and were placed in a 150 by 15 mm Petri dish. Overnight cultures of Methicillin-Resistant *Staphylococcus aureus* ATCC 33541 and vancomycin resistant *Enterococcus faecalis* ATCC 51575 were standardized to 10⁶ cells using a spectrophotometer, and the samples were inoculated with 0.5 ml of MRSA in Nutrient broth. A "0" hour serial dilution and pour plates were conducted as a viability control. After 15 minutes, the cells were recovered from the control samples via serial dilutions in Lethen broth with 0.3% sodium thiosulfate. After the initial 15 minutes, the experimental samples (Run 1) were sprayed with Alpha HP using an aerosol sprayer for 3 seconds each (approximately 1.5 ml per disc). The treatment sanitized for 15 minutes, and then the cells were recovered from the treated samples via serial dilutions. Plates were placed in a 37°C incubator for 48 hours. After the incubation period, the plates were counted. Samples for Run 2 were sprayed for 6 seconds (approximately 3 mls of the Alpha HP per disc). Cells were recovered in the same manner as described for Run 1.

Formula for Log Reduction

Determine Log (x*10a) of control samples

Determine Log (x*10a) of treated samples

Determine geometric mean of control samples:

Log values of control samples: b1, b2, b3, ...bn

Mean= (b1*b2*b3*...bn)^{1/n}

Determine geometric mean of treated samples:

Log values of treated samples: c1, c2, c3, ...cn

Mean= (c1*c2*c3*...cn)^{1/n}

Log reduction= geometric mean of the control samples – geometric mean of the treated samples

Percent kill= (1-10-log reduction)*100

Where:

x=value of samples

a=exponent value

b=log value of control samples

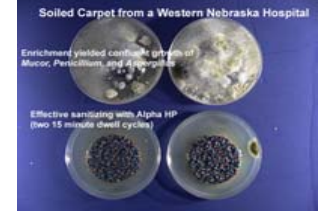
c=log value of treated samples

n=number of log values in set

Results and Discussion:

Used carpet samples

The used carpet was visibly soiled and compacted. A noticeable loss of color vibrance and fiber tuft definition was evident (Fig 1). Water recovered from the carpet following the sanitizing procedure was extremely turbid and had a putrid odor. Enrichment culture prior to extraction yielded almost confluent growth of *Bacillus* species bacteria, *Mucor*, *Penicillium*, and *Aspergillus* species mold. Post-sanitizing enrichment culture yielded only a single colony of *Aspergillus niger* (Fig 3).



Lab controlled studies

Staphylococcus aureus ATCC 33541 Run 1 and Run 2

| Sample | Avg. CFU treated with Sterile H2O | Avg. CFU AHP treated | Geometric mean control | Geometric mean AHP treatment | Log Reduction |
|--------|-----------------------------------|----------------------|------------------------|------------------------------|---------------|
| Run 1 | 7.6x10 ⁵ | 5.7x10 ³ | 5.86 | 3.64 | 2.22 |
| Run 2 | 1.22x10 ⁵ | <1x10 ² | 5.08 | 1.99 | 3.09 |

Enterococcus faecalis ATCC 51575 Run 1 and Run 2

| Sample | Avg. CFU treated with Sterile H2O | Avg. CFU AHP treated | Geometric mean control | Geometric mean AHP treatment | Log Reduction |
|--------|-----------------------------------|----------------------|------------------------|------------------------------|---------------|
| Run 1 | 4.99x10 ⁶ | 7.8x10 ³ | 5.97 | 3.69 | 2.28 |
| Run 2 | 2.15x10 ⁵ | <1x10 ² | 5.33 | 1.99 | 3.34 |

The Johnson Diversey Alpha HP product demonstrated good cleaning and sanitizing activity on soiled carpet from a western Nebraska hospital. It cleaned the soiled fibers and brightened the appearance of the carpet. The accelerated hydrogen peroxide product along with vacuum extraction effectively removed or inactivated the accumulated biocontaminants. In the laboratory controlled studies against known antibiotic strains the Johnson Diversey Alpha HP product produced 2 to 3 log reductions of the initial bacterial inoculum following a 15 minute dwell time. Doubling the spray time to six seconds did enhance the log reduction of both challenge organisms by one log. Healthcare facilities electing to use carpet should implement, where appropriate, the use of carpet sanitizers. These products not only clean the surface for aesthetics but also can make the carpet more hygienic by effectively killing or removing biocontaminants.

References:

Alpha HP Multi-Surface Cleaner, Johnson Diversey Inc. Sturtevant, WI , www.johnsondiversey.com

Sattar, S.A., 2004. Final Report. Assessment of the microbiocidal activity of an accelerated hydrogen peroxide based formulation (AHP-5) against VRE and MRSA. Centre for Research on Environmental Microbiology (CREM) Faculty of Medicine, University of Ottawa Ottawa, Ontario, Canada