



Clostridium Difficile Endospores and PAA Germicides

Introduction

Actril and Minncare Cold Sterilants are Peracetic Acid (PAA) based sterilants that have specific claims against even the hardest class of organisms – spores. While Actril and Minncare Cold Sterilants have been shown effective against the AOAC spore test organism – *Bacillus subtilis* – this white paper examines the effectiveness of current germicides, as well as, Actril and Minncare Cold Sterilants against *Clostridium difficile*.

History of *C. difficile*

While identified in the literature for over 70 years, *C. difficile* began to be increasingly recognized in the 1970s as an organism that had adapted and was becoming progressively more antibiotic resistant. *C. difficile* is a spore forming, gram positive bacteria that is highly resistant to acidic environments such as seen in the gastrointestinal (GI) system. Because they can thrive in the intestinal tract, *C. difficile* releases toxins directly into the GI system, destroying the intestinal lining resulting in diarrhea and extreme dehydration.¹

From 1999 to 2004, *C. difficile* related deaths almost quintupled with the death rate increasing by 35% per year in the United States.² In other nations, *C. difficile* has surpassed MRSA as the “superbug” of greatest concern in terms of numbers of deaths and continued growth rates.³

Germicides and *C. difficile*

C. difficile has two states: vegetative and endospore. In the vegetative state, *C. difficile* is readily destroyed by a large number of germicides such as quaternary ammoniums, dilute hypochlorite (bleach) solutions (1%), phenols, and alcohols.⁴ In contrast, *C. difficile* in the endospore state is characterized by a thickened cell wall, which provides protection against drying-out and acidic environments.

This cellular structure enables the *C. difficile* endospore to be resistant to the previously-mentioned germicides. In a study reported by Dr. William Rutala in 2006, the following disinfectants demonstrated no measurable activity at 20 minutes against *C. difficile* spores:

- (1) Chlorhexadine,
- (2) Vesphene (phenol),
- (3) 70% isopropyl alcohol,
- (4) 95% ethanol,
- (5) 3% hydrogen peroxide,
- (6) Clorox disinfecting spray (65% ethanol, 0.6% quaternary ammonium),
- (7) Novaplus (10% povidone iodine) and
- (8) Virox’s Accel (0.5% hydrogen peroxide).⁵

In fact, in one study performed in England, two disinfectant compounds – quaternary ammonium and hydrogen peroxide – appeared to even encourage the growth of *C. difficile* spores.⁶

Minncare and Actril vs. Spores

Both Minncare and Actril Cold Sterilants are broad spectrum germicides with sporicidal claims. In testing conducted under AOAC Sporicidal Test Protocols, Minncare and Actril Cold Sterilants were successful with complete kill against *Bacillus subtilis* and *Clostridium sporogenes*.^{7,8} In another test conducted, a 1% Minncare solution demonstrated a 106 reduction of *Bacillus subtilis* (ATCC 9382) spores.⁹

While both Actril Cold Sterilant and 1% Minncare Solution have been shown effective against spores in general, a more specific test was conducted to look at its effectiveness in a short time period against *C. difficile* spores.¹⁰ This test is summarized below:

Test Methodology: ASTM E 2197-02 – Conducted with ATCC 700792 (*C. difficile* spore)

Test Results: The inoculated carriers had a starting population of 4x10⁵ cfu. 10 carriers were exposed for 10 minutes to each Actril and 1% Minncare solution. The results at the end of the ten minute period were:

Germicide	Carriers	% Reduction
Actril Cold Sterilant	10	99.999
1% Minncare Solution	10	99.9

Discussion

While a few antibiotic regimes such as vancomycin continue to be effective for the most part against *C. difficile* spores, good infection control practices dictate environmental reduction of the organism before infection. As previously indicated, not all germicides are effective against *C. difficile* spores and some may even promote growth.

In testing by Minntech Corporation, both Actril Cold Sterilant and 1% Minncare Solution significantly reduced the populations of *C. difficile* spores 99.999% and 99.9%, respectively.

References

- 1 McMaster-Baxter Nicole Pharm.D., Musher Daniel M. MD. *Clostridium difficile*: Recent Epidemiologic Findings and Advances in Therapy. *Pharmacotherapy*. 2007;27(7):1029-1039.
- 2 Redeling Matthew D., Sorvillo Frank, Mascola Laurene. Increase in *Clostridium difficile*-related Mortality Rates, United States, 1999-2004. *Emerging Infectious Disease*. 2007; 13(9):1417-1419.

³ www.statistics.gov.uk/pdfdir/deaths0207.pdf

⁴ From EPA labels.

⁵ Rutula William, et. al. Surface Disinfection: New Processes and Products. Presentation at 2006 APIC National Meeting. 2006.

⁶ Fawley Warren N., et.al. Efficacy of Hospital Cleaning Agents and Germicides Against Epidemic *Clostridium difficile* Strains. *Infect Control Hosp Epidemiol*. 2007 Aug ;28 (8):920-5.

⁷ Minncare Cold Sterilant: Research Data Report. 2003.

⁸ Actril Cold Sterilant: Research Data Report. 2003.

⁹ Maltais Jo-Ann, Stern Thomas. Technical Report: A Superior Biocide for Disinfecting Reverse Osmosis Systems. 2003.

¹⁰ Minntech Study. *C. difficile* and Actril Cold Sterilant and 1% Minncare Solution. May 2008.

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