The Material Compatibility of Aerosolyzed & Vaporized Hydrogen Peroxide

A Quip Laboratories White Paper

Introduction

The use of Fogged Hydrogen Peroxide (H2O2) has grown steadily in industries that require disinfection and the elimination of micro –organisms, as its ability to kill spores and sterilize materials, has been demonstrated in many studies with a variety of practical applications (Agalloco & Akers, 2013). Questions have arisen though, about compatibility with different materials used in the healthcare and biomedical industries.

Material compatibility is essential in these industries because of the cost and importance of the equipment used. The consequences of malfunctioning healthcare equipment can range from expensive mishaps to deadly disasters. Biomedical equipment must be maintained in excellent condition in order to assure accuracy in a facility's findings.

There have been a number of studies into the material compatibility of fogged hydrogen peroxide, and the purpose of this paper is to compile those findings and show the efficacy and material compatibility of H2O2 systems when used within healthcare, pharma, biomedical facilities, or any facility that utilizes exposed electronic instruments.

Efficacy and Increased Popularity of H2O2 Systems

Before understanding just how H2O2 reacts with the materials present in healthcare, pharma or biomedical facilities, it's important to note the efficacy of such a system as a bactericide, virucide and sporicide. The H2O2 process was developed in the mid-1980s, utilizing a patented closed-loop, low concentration, "dry" process. Over the last decade, a number of tests have proven the efficacy of these systems, and have overwhelmingly found that hydrogen peroxide is exceptionally effective when used as a dry fog because of its ability to fill hard to reach crevices and disinfect often missed corners of a facility.

H2O2 has shown to have reliable biocidal activity against a wide range of healthcare and biomedical associated pathogens. In fact, according to a Journal of Hospital Infection published study (Volume 80, Issue 2, February 2012, Pages 110–115), fogged hydrogen peroxide "resulted in complete inactivation of all viruses tested including poliovirus, rotavirus, adenovirus, murine norovirus (Tuladhara, Terpstrac, Koopmansa, & Duizer, 2012). Sanosil's own studies have found that the H2O2 solution used in the HaloFogger® system is an extremely effective biocidal agent, capable of killing methicillin resistant Staphylococcus aureus and Pseudomonas aeruginosa after only 20 minutes (Sanosil, 2010). A full list of the biocidal efficacy of the HaloFogger® system can be furnished upon request.

Additionally, according to the CDC, "properly used, H2O2 is an effective sterilant capable of efficient and rapid elimination of contaminating microbes. Vapor phase hydrogen peroxide

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has been shown to be an effective sporicide at concentrations ranging from 0.5 mg/L to <10 mg/L." (Arlene & Vesley, 1990)

In summation, the efficacy of H2O2 is widely agreed upon. It has been accepted by both the

FDA and the US Environmental Protection Agency (EPA) as a sterilizing agent, and has been used successfully in a number of different industries including healthcare, pharma, biodmedical and even food, where H2O2 is widely used to "sterilize containers, closures and aseptic chambers (i.e., isolators) used for manufacturing low-acid and dairy-based beverages as well as other applications." (Center for Disease Control, 2009)

Testing History of H2O2 Systems

Since the early 2000s, studies have been conducted to find just what effect, if any, H2O2 systems have on the materials often present in industries that use them. This paper provides a quick guide to the history of these studies and their findings, and those seeking more comprehensive information should refer to the works cited at the end of this guide.

In a 2003 study by B&V Testing, materials underwent H2O2 injection at 108 g/min, fogged from nine H2O2 generators for five hours, with an average H2O2 concentration of 327 ppm. Materials tested included a laptop computer, an LCD monitor, a telephone, electronic scales, various electronic sensors, stainless steel clamps and connectors, rubber grommets and washers, rubber hoses and various plastic containers. B&V found that the materials tested showed no significant changes in physical or chemical properties, even following 500% typical use H2O2 exposure (Flynn & Harris, 2003).

Seven years following the B&V findings, a 2010 study was conducted and funded by the EPA, through its Office of Research and Development's National Homeland Security Research Center. In this study, materials were classified into four sections and tested at 250 ppm H_2O_2 concentration for 4 hours with initial RH of 35% (total CT of 1000 ppm-hr). Class 3 materials (cell phone, PDA, fax machine, dvds and cds) were completely unaffected by the H_2O_2 fogging (with the exception of a single PDA which appeared to have suffered unrelated battery failure.)

The cell phones from each condition were able to send and receive calls, provide clear audio on both ends of the call, and maintain the same clear ringtone for incoming calls as they had done prior to exposure. The keypads for each phone remained fully operational. The batteries maintained their capability to charge fully and showed no physical signs of damage… The same computer was used to test the CDs and DVDs before and during the 12-month observation period following exposure. No problems were encountered reading the disks at any time.

(EPA, 2010)

Class 4 materials were made up of high-end electronic devices, and included desktop computers and monitors. According to the study, "No visual or functional changes were noted for any Category 4 equipment that had been exposed to H_2O_2, regardless of concentration and run conditions." (U.S. EPA., 2010)

In addition to the B&V and EPA tests, there have also been a number of studies showing the material compatibility of H_2O_2 systems in other industries. One such test by the Federal Aviation Administration on the material compatibility of H_2O_2 on a number of different commercial grade structural materials including 2024-T351, 2024-T6 and 7075-T6 aluminum, 304 stainless steel, carbon fiber/epoxy composites and glass fiber/epoxy composites, including FR4 laminate materials widely used for printed circuit boards, found that H2O2 systems were compatible across the board (Chou, S. F et al., 2009).

> **"No visual or functional changes were noted… regardless of concentration and run conditions."**

Material Compatibility of the HaloFogger® Unit with HaloSpray®

In 2012, Sanosil tested the compatibility of a wide range of materials with HaloFogger's ready-to-use (RTU) H2O2 solution over a run cycle of 20 minutes and a setting time of 90 minutes. The materials included:

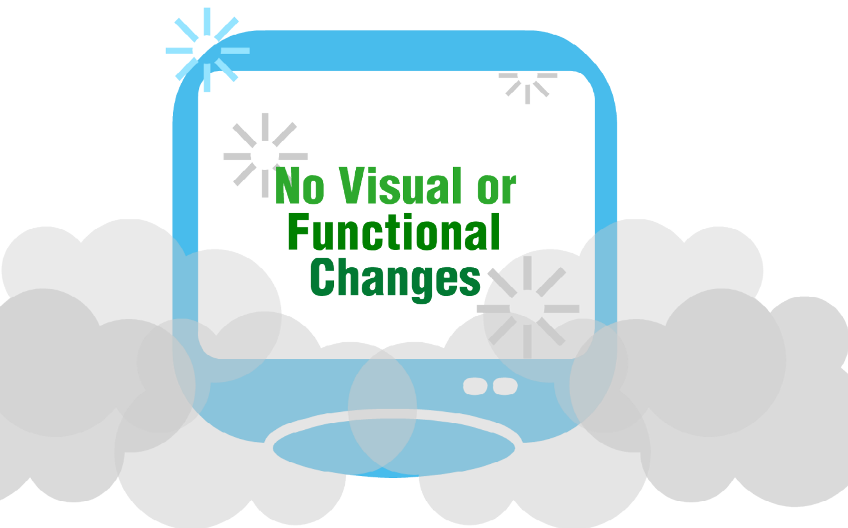
Aluminum 5251/ H22 Sheet
Aluminum Alloy Niploy Coated
Aluminum Bronze
Anodized aluminum 30 microns
Brass sheet
Copper sheet
Mild steel
Stainless steel
Brushed painted mild steel
Epoxy painted mild steel
Galvanized steel
Polyester powder coated aluminum
Stove enamel painted mild steel
ABS Plastic
Acrovyn
Glass reinforced plastic (GRP)
Machinable Nylube PBC
Neoprene
Perspex
Polypropylene
Polythene
PTFE
PVC
PVC foam
Silicon rubber seal
Torlon
Viton
Desmopan timing drive belt
Door-closer
Ceramic tiles
Computer system with monitor
Linear bearing
Rubber floor tiles

Window frame (double glazed)

Over the course of the tests, Sanosil found good compatibility with all materials with the exception of copper and mild steel. These materials saw noticeable changes and are not recommeneded for use with H2O2.

Conclusion

The use of fogged hydrogen peroxide has grown steadily in industries that require disinfection and the elimination of micro-organisms. Its ability



to kill spores relatively quickly and sterilize materials, has been demonstrated in a variety of practical applications. Perhaps just as important as biocidal efficacy however, is the material compatibility that fogged hydrogen peroxide systems have shown, particularly against materials commonly found within the healthcare, pharma and biomedical industries. Studies have consistently demonstrated the exceptional efficacy and material compatibility of H2O2 systems when used within those facilities that utilize exposed electronic instruments by showing that, throughout multiple tests run by a variety of different entities, H2O2 has excellent material compatibility within the healthcare industry.

The HaloFogger® is an innovative, hands free, dry-mist dispensing device designed to deliver an aerosolized drymist of concentrated Halo(tm) Disinfectant to thoroughly treat every expose surface within a room.

To find out more about this unique H2O2 system, contact Quip today or visit [www.QuipLabs.com.](http://www.QuipLabs.com)

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About Quip Laboratories, Inc.

Based in Wilmington, DE and founded in 1981, Quip Laboratories focuses on providing sanitation solutions to Life Science, Food Processing and Healthcare sectors. Their state-of-the-art manufacturing facility produces proprietary chemicals that have enabled the company to achieve a leadership position in the markets served.

Featuring in-house research and development, production, quality control and sales and marketing, Quip provides a "total-systems" approach to providing efficient and eco-gentle environment hygiene. Find out more about us at Quip at www.quiplabs.com.