



Odorox[®] System Effect on Microorganisms

General

Atmospheric hydroxyl radicals are continuously produced by the action of the sun's radiated energy on water vapor in our atmosphere. There are, on average, 2 million hydroxyls in each cubic centimeter of ambient outdoor air during normal daylight hours. They are the main driving force behind the daytime reactions with hydrocarbons in the troposphere and neutralize most natural and man-made pollutants including greenhouse gases like methane, hydrogen sulfide and ozone.

Atmospheric hydroxyls are also proven to kill bacteria, virus, and mold because they are able to penetrate their permeable cell membranes. Conversely, humans, animals and plants have developed symbiotically with atmospheric hydroxyl radicals and thrive in their presence. Atmospheric hydroxyls are a critical component of nature's dynamic ability to provide environments that are free of harmful chemicals and pathogens. (D. E. Heard, "Analytical Techniques for Atmospheric Measurement", Blackwell Publishing, 2006 – professor at the University of Leeds, UK).

The HGI Odorox[®] irradiation process is fundamentally very simple. High energy spectrum UV irradiation of various wavelengths interacts with the water vapor in ambient air. Since water vapor is present in sufficient concentrations in ambient air, atmospheric hydroxyl radicals are the major by-product, as they are produced by the removal of a hydrogen atom from water vapor. HGI's Odorox[®] optics reaction chamber and active process controls result in an effective commercially viable production of atmospheric hydroxyls within the same range as those found in nature.

Effect on Microorganisms and Germination

HGI Industries has done a number of microbiological studies to evaluate the speed and effectiveness of their systems to eliminate a broad range of pathogens on non-porous and porous surfaces and on plant material. Results from a licensed testing laboratory using pathogens commonly tracked by the EPA as representative of their type, indicated that substantially all of the following microorganisms were killed on stainless steel, glass and cotton fabric respectively, within the specified times summarized below.

- C. difficile – 99.8% and 98.6% within 48 hours
- Listeria – 94.7% and 98.6% within 48 hours
- Aspergillus niger – 99.9% and 97% within 48 hours
- Porcine Reproductive Respiratory Syndrome (PRRS) virus – 97.9% within 6 hours
- Pseudomonas aeruginosa – 91.9% within 4 hours
- Influenza A virus – 99.98% and 99.9% within 6 hours
- Methicillin Resistant Staph. Aureus (MRSA) – 65.1% and - 94.4% within 48 hours

Recent studies on the reduction of bacterial and fungal pathogens on plant material from raw and sprouted barley processing were also conducted. Random samples of raw barley and fresh barley sprouts (removed in the processing of sprouted barley) were exposed to atmospheric hydroxyls from an MVP14[™] Odorox[®] unit over a period of 2 to 96 hours. Kills rates in excess of 99.9% were measured by a licensed testing laboratory for the following pathogens. No fungal growth was

isolated on any samples after 6 hours of treatment with respect to the raw and sprouted barley product.

Sprouted Barley Product:

- *Aspergillus niger*
- *Candida krusei*
- *Trichosporum beigeli*
- *Rhodotorula glutinous*
- *Acinetobacter baumannii*
- *Enterobacter agglomerans*
- *Enterobacter clocae*
- *Bacillus sp.*

During this time, the plant material was stirred every two hours and appeared unchanged.

Raw Barley product:

- *Pantoea Agglomerans*
- *Acinetobacter Baumannii*
- *Bacillus SP*
- *Psuedomonas Fluorescens*
- *Penicullium Citrinum, Mucor SP*
- *Fusarium SP*
- *Afusarium SP*
- *Aspergillus Flavus Group (GRP)*
- *Aspergillus Niger GRP*
- *Syncephalastrum SP (Zygomycete)*
- *Pithomyces SP*

During this time, the plant material was not stirred.

Persistence

The HGI Odorox[®] system is designed to produce optimal-energy atmospheric hydroxyls which are excellent radical transfer agents. They rapidly react with nearly every organic chemical available to remove a hydrogen atom, and form an organic radical that is subsequently decomposed by continued oxidation. Hydroxyl radicals also abstract hydrogen from ambient water vapor, thereby producing yet a new atmospheric hydroxyl. Under the influence of high velocity fans, the hydroxyl radicals can effectively treat large volumes of air and completely sanitize air, surfaces and porous fabrics in even exceptionally large spaces.

Atmospheric hydroxyl radicals are an unstable species, they do not linger in the air environment or on surfaces. As long as the Odorox[®] system is running, the chain reactions persist. When the system is shut off, the hydroxyl radicals dissipate within a couple of seconds.

Safety

As a category, the FDA does not regulate or require premarket 510(k) approval for UV irradiation air cleaning devices since they irradiate ambient air and sanitize in a manner similar to that found in nature.

The safety standard of systems that preferentially produce atmospheric hydroxyls was established in 2005 when NASA developed a hydroxyl generating system using a titanium dioxide catalyst for use on the space shuttle that was subsequently commercialized as the Abracair system. They obtained approval to use the system for the reduction of aerosolized mold and bacteria in hospitals, nursing homes and medical facilities – including neonatal nurseries, hospitals and operating rooms – without formal 510(k) premarket approval (510k #K052732, Abracair Models QTZ300-60 and -24, notification in compliance with the Safe Medical Device Act of 1990, CFR, Part 807.92 , Feb. 7, 2006, www.fda.gov/cdrh/industry/support/index.html). These same criteria have been applied by the FDA to the HGI Odorox® systems.

The National Institute of Environmental Health Sciences searched the NIH files, PubMed and the National Library of Medicine and “cannot find any hard science or research indicating that hydroxyl radical generation is harmful to human health. That applies to both atmospheric and man-made generation” (Colleen Chandler, NIEHS Office of Communications and Public Liaison, 8-5-10). Further, at HGI’s request, the CDC, FDA, OSHA and NIH researched their databases and did not find any data indicating that atmospheric hydroxyls were unsafe. None of these agencies indicated that their approval was required for commercial use. Hydroxyl systems have been in use for over ten years and no adverse effects have been reported.

Green Technology at Work®

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