

Advanced Oxidation Effects on Infectious Diseases and Indoor Air Quality

By Dr. James Marsden,

Indoor air quality (IAQ) is rapidly becoming a buzz word for the HVAC contractor. Most people associate indoor air quality with air filtration, which is designed to remove airborne particles. The problem is that standard air filters have little or no effect on microbials such as viruses and bacterial, or molds, VOC, odors and other health-related air contaminants. IAQ got its start with the media rash of mold stories of the 1980s. Odor control was the buzz word of the 1990s, and with the fears of SARS, Bird Flu, Norwalk, MRSA and H1N1 (Swine Flu), the 2000s will be the decades of infectious diseases and control of bacteria and viruses. Major hotel chains, hospitals, cruise lines, schools/colleges, restaurant chains, property managers and major corporations are developing infectious diseases contingency plans. It began with the Norwalk Virus on cruise ships and MRSA in hospitals. The SARS Virus in China, and now the widely feared H1N1 (Swine Flu). The concern is negative publicity, employee safety and, of course, legal liability. Most infectious diseases contingency plans consist of the multiple interventions concept, which consists of the utilization of multiple disinfection technologies and procedures. The cruise line industry had a serious problem with the Norwalk Virus a few years ago. Thousands of people were getting infected. Their plan included:

- Rapid identification and isolation of the sick.
- Continuous disinfecting of handrails, door knobs and banisters.
- Continuous UV disinfection of indoor air via the HVAC ducts.

It was later discovered that standard HVAC UV systems were not working as the dwell or contact time was not nearly long enough. These were replaced with an Advanced Oxidation technology. The problem with any HVAC UV air disinfection system is the contaminated air has to travel a long distance before the bacteria or viruses may or may not be killed in the UV kill zone of the HVAC unit. Let's say you have a virus and you sneeze, anyone within six feet of you will have been potentially exposed. The fact that the airborne virus might or might not be killed in the UV air disinfection system later is of no consequence. You have already been exposed. This concept was discovered by Sandia National Labs while working on a homeland security project for a potential terrorist bio attack on an airliner. In theory, a terrorist could aspirate a virus easily. No one would know until the next day after they have traveled and spread the virus. This is how worldwide pandemics can get started. The solution was to kill the virus at the source before it reaches another person. The problem was how do you do that? Hydroxyl

Oxidation technology called photo catalytic oxidation, looked promising as having the ability to kill an airborne virus within three feet. The next problem was how do you validate the results? The validation had to be a double-blind in a bio test chamber and had to be repeatable. Now, how do you duplicate a sneeze? No two people sneeze alike or not even the same person could duplicate his or her own sneeze. A high-tech sneeze machine was needed. Of course, there was no such thing, so they developed one. When you sneeze, you evacuate one lung of air volume. You expel about one gram of fluid at about 100 miles per hour. The world's first sneeze machine was built with controls for volume, fluid and speed. Now it was possible to duplicate a sneeze allowing a repeatable method of testing the effectiveness of photocatalytic oxidation technologies. Photo-catalytic oxidation creates an airborne plasma basically consisting of friendly oxidizers. Friendly being those found in nature that return to oxygen and water after they oxidize, such as hydroperoxides. The process is like misting the air with an atomized or very fine mist of hydrogen peroxide. A series of tests were conducted by Kansas State University, who also works closely with Sandia National Labs. The first results were outstanding with a kill rate of 78% of a sneeze at three feet. A more advanced cell, was developed that ionized the photo catalytic oxidation plasma making it far more effective on a broader scope of contaminants. Photo catalytic oxidation sneeze results showed 88% reductions. During the SARS scare a few years ago, the Chinese Government installed photo catalytic oxidation cells in city buses and subways after determining it killed the deadly SARS virus. A Chinese manufacturer has implemented this technology on China buses and subways. It is a normal reaction to question the long-term safety of any product that is effective and uses new or "breakthrough" technology. This type of question has become common as our litigious society has taught us to question things that significantly outperform existing methods or products. The breakthrough modality in the photo catalytic technologies is a group of oxidants known as Hydroperoxides, and hydroxyl radicals. Hydroperoxides have been a common part of our environment for over 3.5 billion years. Hydroperoxides are created in our atmosphere whenever three components are present: oxygen molecules, water vapor and electromagnetic energy. The Hydroxymax also has the ability to super charge these hydroperoxides or ionize them into ionized hydro peroxides. Ionized hydro peroxides and hydroxyls are very effective at destroying harmful microbials in the air and on surfaces. As oxidants, they do this by either destroying the microbe through a process known as cell lysing or by changing its molecular structure and rendering it harmless (which is typically the case in VOC's and odors). The amount of hydroperoxides and hydroxyl radicals required to accomplish this task in a conditioned space is below the level that is constantly in our outside air. The photo catalytic oxidation technology has brought the oxidants found in the outside air into the indoor conditioned air. One of the best features of hydroxyl radicals and ionized hydro peroxides is as they settle out of the air they disinfect surfaces. This was validated in a Kansas State University Bio Chamber on stainless steel surfaces, resulting in a 99+% kill on numerous viruses and bacteria. There is no known case of hydroxyl radicals or hydroperoxides ever creating a health risk. Considering we have been exposed to

hydroperoxides in nature since the day man stepped on the planet, it is a reasonable assumption that hydroperoxides do not constitute a health risk.

Over the past 25 years, more than one million photo catalytic oxidation products have been successfully used worldwide without a safety problem.

Partial List of University Test Results

- Avian Influenza (Bird Flu)*
- Norwalk Virus* • Pseudomonas Sp.*
- MRSA Bacteria*
- Listeria*
- E.coli*
- Staph*
- Strep*
- Stachybotrys chartarum*
- Candida*
- 99+% reduction on stainless steel surface in a Kansas State University Class II Bio Chamber In addition:
- Formaldehyde 99+%
- Mold 97% to 98%
- Hydrogen Sulfide 80%
- Odors – pet, chemicals and human biological odors 55% to 98%
- Smoke 70%
- Particulate – ISO-Class 3

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