

AIRPHX Technology Overview¹ Summer 2024

AIRPHX uses a proprietary non-thermal plasma technology that is (i) excellent at reducing air and surface micro-organisms and (ii) highly effective at reducing volatile organic compounds (VOCs) and other harmful gases. AIRPHX technology uses electricity to create a plasma field that converts a small percentage of the oxygen present in ambient air into oxidizing molecules without using chemicals.² The oxidizing molecules created by AIRPHX include oxygen ions, free radicals and peroxides that are highly reactive due to the presence of an unpaired valence shell electron. The high vibrational energy in the AIRPHX plasma field creates free electrons within the plasma core that are highly effective at reducing levels of VOCs and other harmful gases that pass through the AIRPHX device. AIRPHX technology is unique – no other technology is as effective at reducing micro-organisms, VOC's and harmful gases in real world installations.

Impact on Micro-organisms and Pathogens

When the units are deployed consistent with the user guide,³ gas-phase hydrogen peroxide (or H₂O₂) and other types of oxidizing molecules are produced within AIRPHX's proprietary and patented plasma chamber. The only type of oxidizing molecule generated by AIRPHX technology that is regulated by government entities and enters the treatment space at detectable levels is gas-phase hydrogen peroxide. The other oxidizing molecules generated by AIRPHX include atomic oxygen (O), singlet oxygen (O₂ with displaced electron), hydroxyl radicals and superoxide (O²⁻), which are also highly-effective oxidizing agents for any micro-organisms that pass through the units. AIRPHX technology destroys pathogens by introducing oxidative stress, rupturing the cell wall and destroying the pathogen on a cellular level.

Impact on VOCs and Other Harmful Gases

Common examples of VOCs that may be present in our daily lives are benzene, ethylene glycol, formaldehyde, methylene chloride, tetrachloroethylene, toluene, xylene and 1,3-butadiene. These VOCs are broken down into harmless compounds by free electrons within the plasma core produced by

¹ This summary relates to the current version of the AIRPHX CID 75k (a wall-mounted unit) and AIRPHX IDU 250k (an in-duct unit), which deploy an advanced generation of AIRPHX technology. AIRPHX's PA2400 and PA3100 wall-mounted units, which used nearly identical but slightly more powerful technology, are being or have been phased out of production.

² AIRPHX understands that it holds the only patents issued in the U.S. and internationally related to the generation and use of non-thermal plasma to create disinfecting molecules.

³ The user guide contains guidance on appropriate use of the units, including the proper size of the treatment space and, with respect to AIRPHX wall-mounted units, instructions on mounting the units (e.g. elevated) and the requirement that the units are installed in an area with good airflow to ensure adequate dispersal of the oxidizing molecules. Note that each installation location is different in size, layout, type of HVAC system, frequency of air exchanges, and composition of ambient air due to, among other things, other cleaning protocols, humidity level, etc.

AIRPHX technology. These electrons create a vibration that breaks the bonds of the VOCs without increasing temperature in the AIRPHX unit.

Common gases in our environment, such as carbon dioxide (CO₂) and carbon monoxide (CO), are sometimes considered to be VOCs. Although they are not technically VOCs, these gases – in high concentration – can be as significant a concern as VOCs themselves. By using high vibrational energy produced by the free electrons within the AIRPHX plasma field, AIRPHX technology breaks the bonds within these gases, reducing them to safer levels. One such independent test involving CO₂ levels confirmed the AIRPHX IDU 250k's unique ability to convert carbon dioxide to oxygen and no other gases.

There are no detectable levels of secondary VOCs or other harmful gases when harmful gases pass through the AIRPHX plasma field.

Regulated Molecules/Safety

The hydrogen peroxide produced by AIRPHX technology is different than vaporized or aerosolized hydrogen peroxide. Gas-phase hydrogen peroxide has a more acute bond angle and a variable half-life measured in hours. Gas-phase hydrogen peroxide is an excellent disinfecting agent and occurs naturally in the air. The National Institute of Health confirms the efficacy of hydrogen peroxide: “[n]onflammable, hydrogen peroxide is a powerful oxidizing agent” <https://pubchem.ncbi.nlm.nih.gov/compound/Hydrogen-peroxide>. Hydrogen peroxide is seen as an environmentally safe alternative to chlorine-based bleaches, as it degrades to form oxygen and water. Hydrogen peroxide has no known carcinogenic potential.

Hydrogen peroxide is regulated by the Occupational Safety and Health Administration (OSHA) and the Center for Disease Control (CDC) through The National Institute for Occupational Safety and Health (NIOSH), both of which have established limits of 1.0 part per million (ppm). AIRPHX technology has been tested for hydrogen peroxide levels using the Interscan Hydrogen Peroxide Analyzer, and generally hydrogen peroxide levels are undetectable (much less than 0.01 ppm of hydrogen peroxide) when AIRPHX units are operated in accordance with the user guide.⁴ AIRPHX is aware of no CDC, FDA or Environmental Protection Agency guidelines or any studies suggesting that gas-phase hydrogen peroxide at these low levels raises any health concerns.

International product testing company Intertek has confirmed that the de minimus levels of ozone generated by AIRPHX's CID 75k and IDU 250k pass California's stringent ozone emission standards (UL 867), as well as the UL 2998 standard – certifying these AIRPHX units as “ozone free”.

Certified Organic

AIRPHX units have been verified by the Washington State Department of Agriculture to comply with National Organic Standards (7 CFR Part 205).

⁴ Notwithstanding the low levels of gas phase hydrogen peroxide produced, AIRPHX units create sufficient levels of gas phase hydrogen peroxide to be extremely effective at reducing airborne and surface micro-organisms in properly sized treatment spaces. The reason gas phase hydrogen peroxide is generally undetectable is two-fold: 1) hydrogen peroxide molecules are oxidized as part of the disinfection process (when they interact with a micro-organism); and 2) there is continuous introduction of new micro-organisms into treatment spaces for a variety of reasons, including introduction of outside air with high levels of mold spores and fungi. It is the continuous introduction of new micro-organisms into human occupied spaces that undermines claims by other disinfection technologies that they are 99.9% effective.

Real World Applications

AIRPHX customers appreciate that the technology has been found to be safe and effective in occupied, real world installations, not just laboratories. AIRPHX technology has been creating safer and healthier environments for years in thousands of installations such as commercial gyms, college athletic programs, hospitals (including wards of hospitals with immune-challenged patient populations), senior living facilities, casinos, military bases, police and fire stations, food processing facilities, commercial buildings, residences, dental offices and country clubs. Independent testing of these AIRPHX installations demonstrate industry leading reductions of surface and airborne micro-organisms, typically greater than 95% reduction on surfaces and greater than 90% reduction in the air. Reductions of VOCs and other harmful gases has been documented in laboratory testing intended to replicate real world settings. See <https://airphx.com/research/>.