

# Puraclenz

Active PCO (Photocatalytic Oxidation) Technology  
Summary of Efficacy Testing From Independent Labs

# ACTIVE PCO (PHOTOCATALYTIC OXIDATION) TECHNOLOGY SUMMARY OF EFFICACY TESTING FROM INDEPENDENT LABS

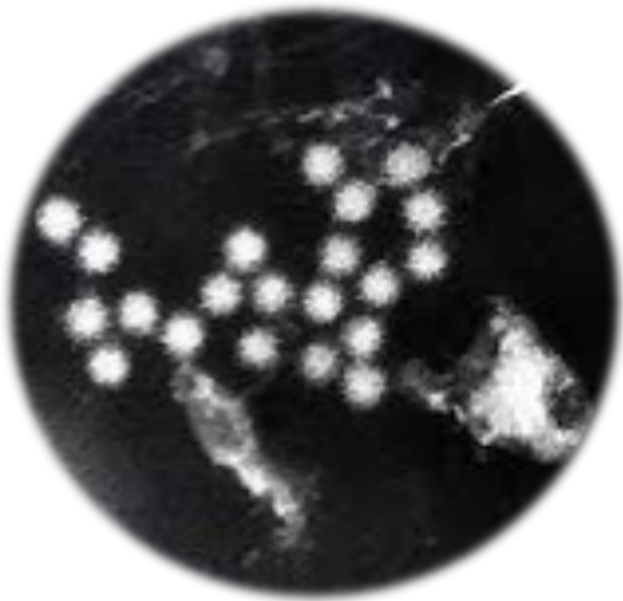
The advanced proprietary PCO technology in Puraclenz products is protected by an issued US Patent and 7 other pending patents. This proprietary PCO based technology has evolved over the past 7 years into a very powerful, safe and cost-effective solution. After significant investment and technical development provided by the principals and managers of Puraclenz, LLC, ("the Company") in partnership with UVAIRx Inc. (the patent holder) Puraclenz will launch a series of new products in late December of 2020 deploying this new proprietary PCO technology as the sole owner of the patent. Even prior to these recent events the efficacy of PCO technology has been well established through numerous independent lab tests proving PCO to be effective in inactivating (killing) dangerous viruses and bacteria – including but not limited to H5N1 and H1N1 viruses and MRSA all much harder to deactivate than Covid19.

Covid19: According to EPA and CDC guidelines, the Puraclenz technology is considered effective at inactivating/killing Covid-19 and any of its mutated versions. The Puraclenz PCO technology also effectively kills "non-enveloped viruses" like Norovirus, which has historically been the major cause of serious illnesses and deaths in nursing homes.

PCO technology has been proven both safe and effective in laboratory and industrial testing and used in medical, food, residential, commercial and hospitality and certified safe by UL, ETL, FCC, TUV, CE, CSA and CARB (California Air Resources Board). Berkley National Labs and numerous Universities have tested PCO and found it to be effective against all pathogens

The following is a summary of some of the peer reviewed testing and studies of PCO against numerous viruses and pathogens. These tests were performed by Universities, National Labs and independent labs applying earlier versions of the same PCO technology used by Puraclenz.

# VIRUSES



## NORWALK VIRUS

Norovirus are a group of related single stranded RNA, highly contagious viruses and the most common cause of acute gastroenteritis in the United States. Known by other names such as stomach flu and food poisoning, it is responsible for 50% of food – borne outbreaks of gastroenteritis. Noroviruses spread from person to person by direct contact, touching contaminated surfaces, and contaminated food and water supplies. Norovirus outbreaks happen on cruise ships, resulting in quarantine. (12)

### Effectiveness of Photocatalytic Oxidation Technology: ~

Deactivation of > **90%** of Murine Norovirus (MNV) microorganisms was achieved after 4 hours. (3)

## H1N1 VIRUS (SWINE INFLUENZA)

The H1N1 virus is a unique strain of influenza. The Centers for Disease Control determined that the strain contained genes from four different flu viruses – North American swine influenza, North American avian influenza, human influenza and swine influenza viruses typically found in Asia and Europe. The virus spreads from person to person by droplets from coughing and sneezing and by touching a person contaminated with the virus, then touching one's eyes, nose or mouth. (14)

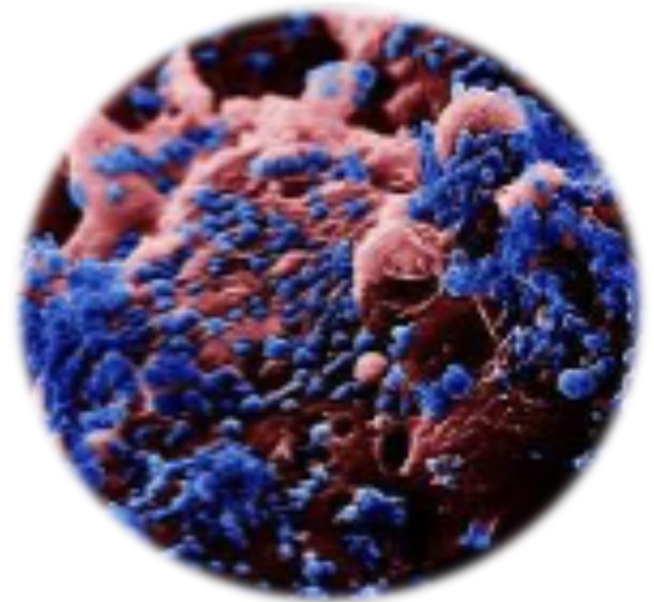
**Effectiveness of Photocatalytic Oxidation Technology: ~** Testing on stainless steel surfaces using PCO resulted in ~ **99%** microbial reductions. (3)



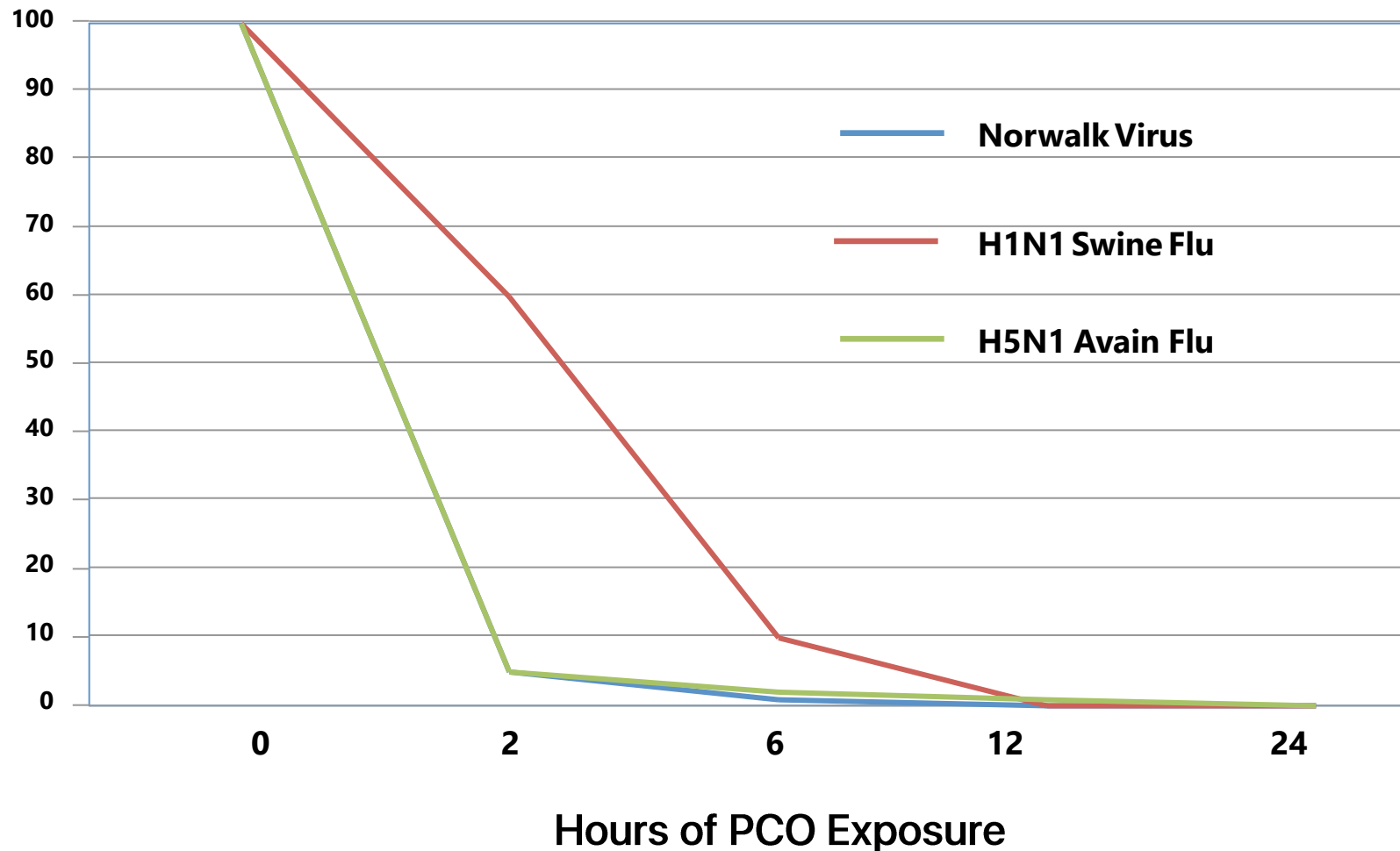
## H5N1 VIRUS AVIAN INFLUENZA (BIRD FLU)

H5N1 has evolved into a flu virus strain that infects more species than any previously known strain, is deadlier than any previously known strain, and continues to evolve, becoming both more widespread and more deadly. Epidemiologists are afraid the next time such a virus mutates, it could pass from human to human. Direct transmission of avian viruses to humans is possible. Testing of photocatalysis on H5N1 was completed at Kansas State University using H5N8 as a surrogate.

**Effectiveness of Photocatalytic Oxidation Technology:** ~ Testing on stainless steel surfaces using PCO resulted in ~ **99%** microbial reductions.

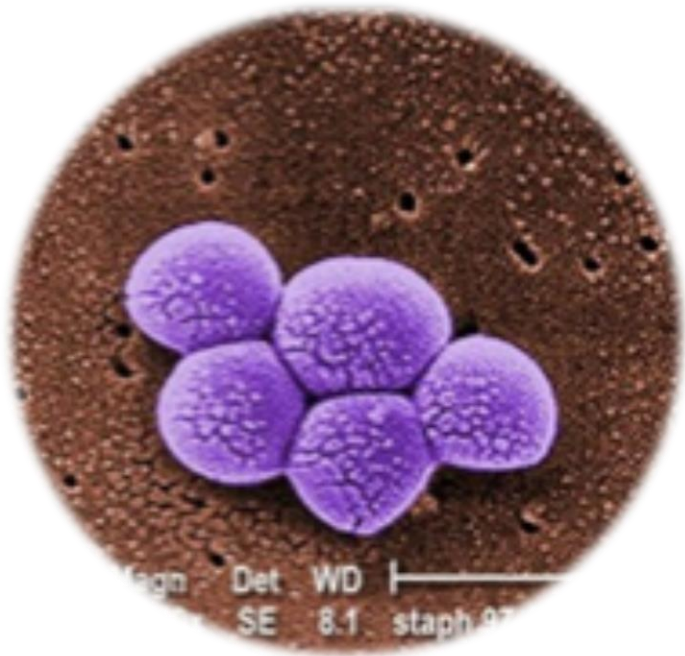


# EFFECTS OF PHOTOCATALYTIC OXIDATION ON VIRUSES



Photocatalytic oxidation is used to actively reduce airborne and surface pathogens. Selected microorganisms were prepared and placed on a stainless-steel surface, allowing analysis at 2 hours, 6 hours, 12 hours, and 24 hours. After 24 hours of exposure to PCO, the organism's viability was reduced between **96.4% and 99.9%** (11, 13).

**BACTERIA**



## METHICILLIN – RESISTANT STAPHYLOCOCCUS AUREUS (MRSA)

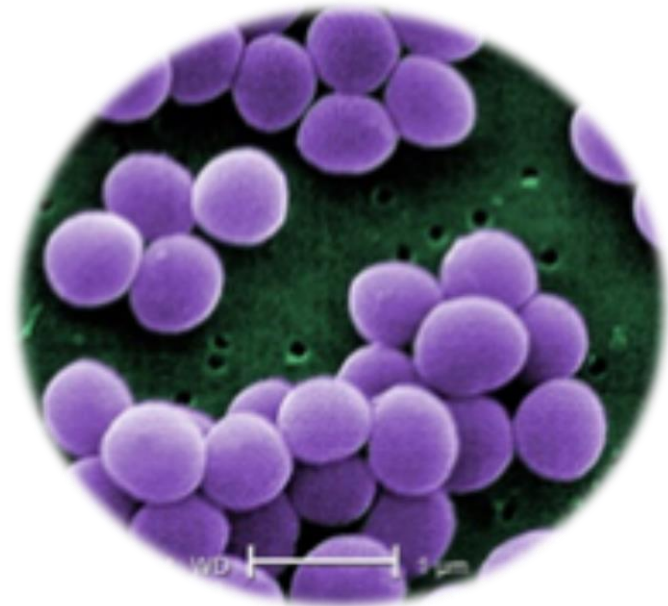
Easily transmitted in a hospital environment and resistant to most staphylococcus antibiotics including oxacillin, penicillin, amoxicillin and methicillin, MRSA has only a few expensive treatment options and there are challenging side effects.

**Effectiveness of Photocatalytic Oxidation Technology:** ~ **99.9%** reduction in viability of MRSA was observed within 80 minutes of photocatalytic treatment. (2)

## STAPHYLOCOCCUS AUREUS – “STAFF INFECTION”

Can cause a range of illnesses, from minor skin infections such as pimples, impetigo, boils (furuncles), cellulitis folliculitis, carbuncles, scalded skin syndrome and abscesses to life – threatening diseases such as pneumonia, meningitis, osteomyelitis, endocarditis, toxic shock syndrome (TSS), bacteremia and sepsis. The systems it affects range from skin, soft tissue, respiratory, bone, joint, endovascular to wound infections. It is still one of the five most common causes of nosocomial infections and is often the cause of postsurgical wound infections. Each year, some 500,000 patients in American hospitals contract a staphylococcal infection.

**Effectiveness of Photocatalytic Oxidation Technology:** ~ **99.9%** reduction in viability of Staphylococcus aureus was observed within 80 minutes of photocatalytic treatment. (3)



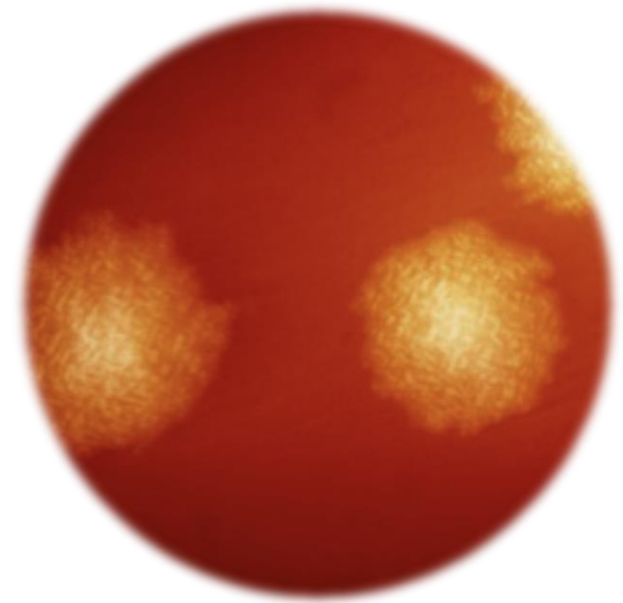


# CLOSTRIDIUM DIFFICILE (C. DIFF)

C. diff is a bacterium that can cause symptoms ranging from diarrhea to life – threatening inflammation of the colon. C.diff most commonly affects older adults in hospitals or long-term care facilities. In recent years, C. diff infections have become more frequent, more severe and more difficult to treat. While MRSA infection rates are decreasing in response to stepped – up prevention efforts within hospitals, infections caused by C. diff have increased each year since 2007. [Mayo Clinic Staff, 2010]

## Effectiveness of Photocatalytic Oxidation Technology: ~ 99.9%

reduction in viability of C. diff within 80 minutes of photocatalytic treatment. Complete surface inactivation was demonstrated and bacterial re--growth following photocatalytic treatment was not observed. (2)

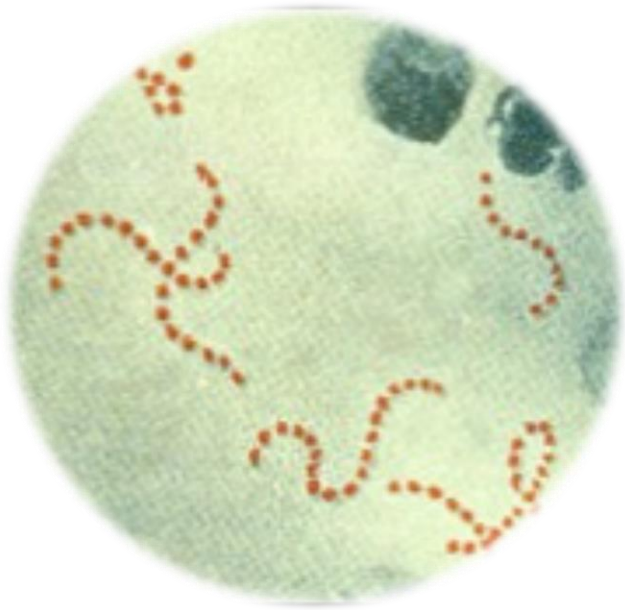


# ESCHERICHIA COLI

"E. coli" consists of a large and diverse group of bacteria. Although most strains are harmless, other strains of E. coli can cause illnesses such as diarrhea, urinary tract infections, respiratory illness and pneumonia. In most cases of disease-causing outbreaks, shiga toxins produced by E. coli are responsible. Recent multistate foodborne outbreaks include: Lebanon Bologna 2011, Hazelnuts 2011, Shredded Romaine Lettuce 2010, and Beef 2010, resulting in massive product recalls. (5)

**Effectiveness of Photocatalytic Oxidation Technology:** ~ Antibacterial activity of Ag doped TiO<sub>2</sub> showed ~ **99%** deactivation of E. coli. The doped TiO<sub>2</sub> showed enhanced efficacy as opposed to the non--doped. (6)





## GROUP A STREPTOCOCCI (GAS)

STREP is a bacterium often found in the throat and on the skin. People may carry Group A Streptococci and have no symptoms of illness.

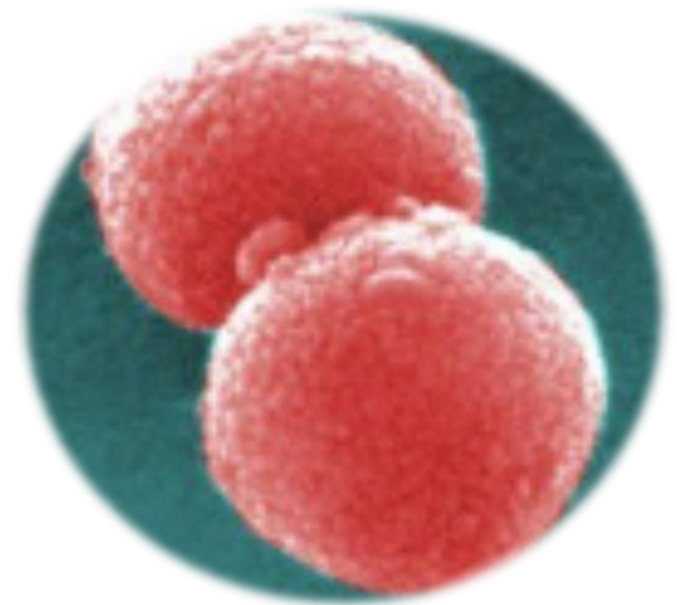
Most STREP infections are relatively mild illnesses such as "strep throat," or impetigo. Occasionally these bacteria can cause severe and even life--  
-threatening diseases when bacteria get into parts of the body where they are not usually found, such as the blood, muscle, or the lungs. These infections are termed "invasive STREP disease".

**Effectiveness of Photocatalytic Oxidation Technology:** ~ Testing on stainless steel surfaces using PCO resulted in ~ **96%** microbial reductions. (3)

## STREPTOCOCCUS PNEUMONIA

S. pneumonia typically enter the lung when airborne droplets are inhaled but can enter through the bloodstream when there is an infection in another part of the body. There were 50,774 deaths in the US in 2009 attributed to pneumonia. It is estimated that up to 2.3% of all nursing home patients have pneumonia at any given time. (8)

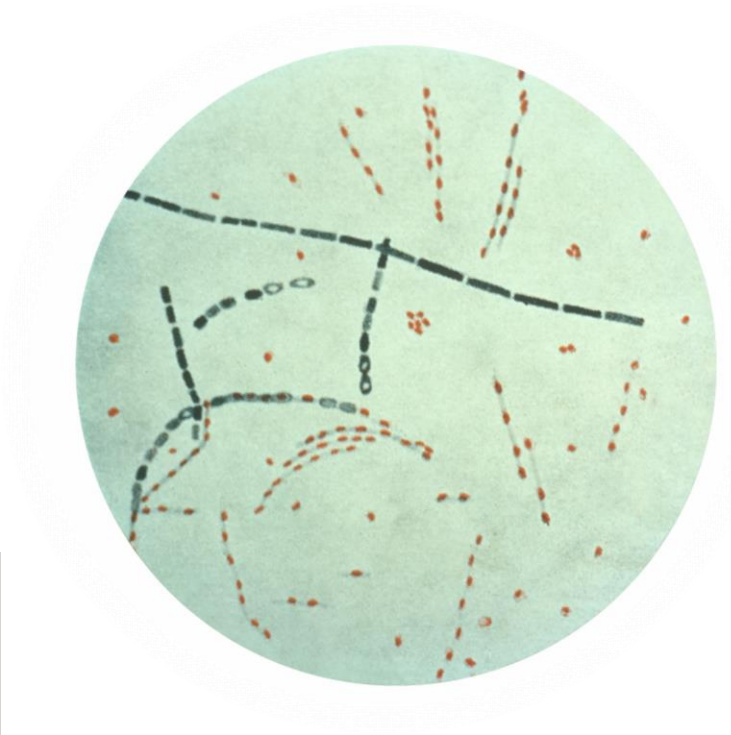
**Effectiveness of Photocatalytic Oxidation Technology:** ~ Testing on stainless steel surfaces using PCO resulted in ~ **99%** microbial reductions. (3)



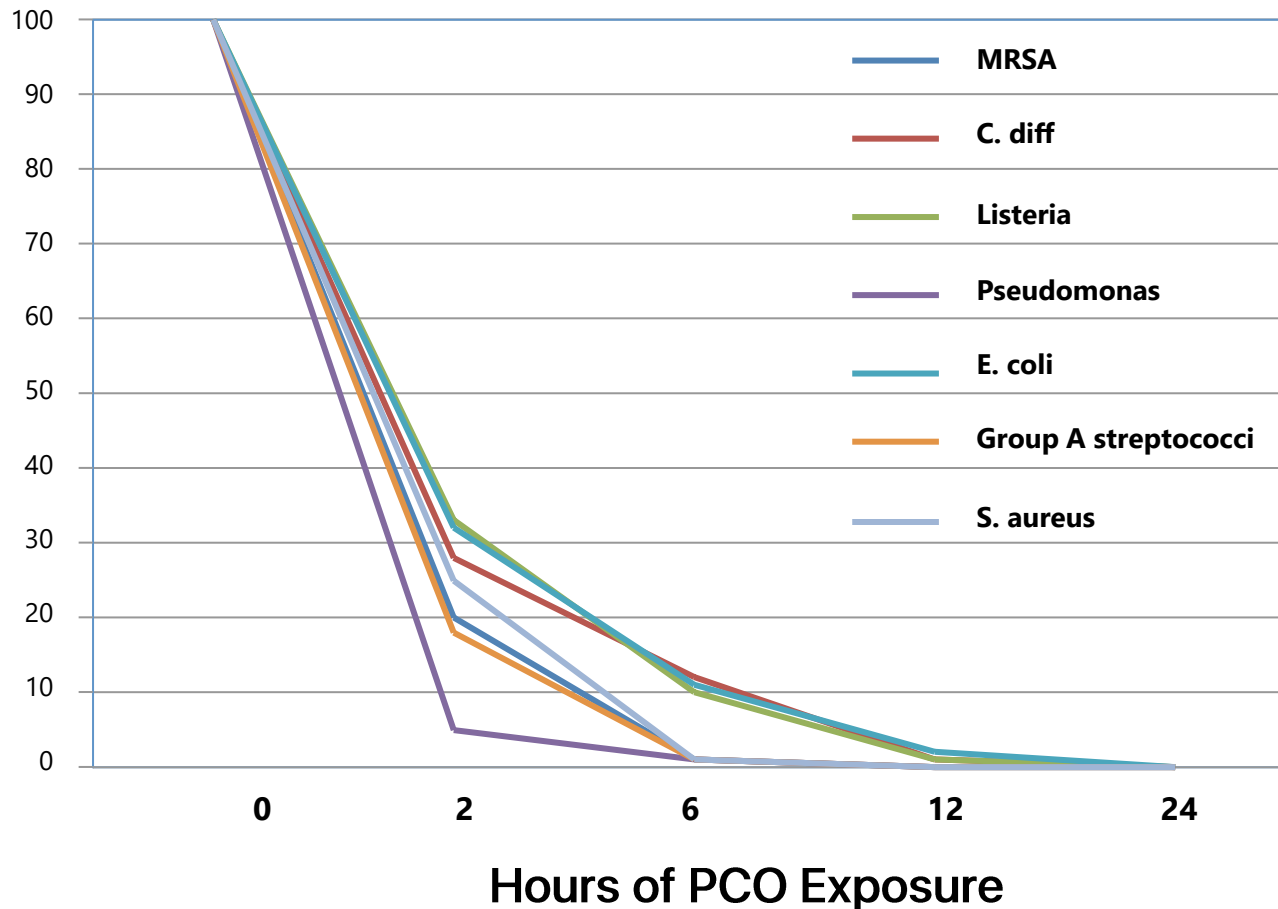
# BACILLUS ANTHRACIS

Anthrax is an acute disease caused by *Bacillus anthracis*. Most forms of the disease are lethal, and it affects both humans and other animals. Anthrax spores can be produced in vitro and used as a biological weapon. Anthrax is spread by spores of *B. anthracis*. These spores can be transported by clothing or shoes. The body of an animal that had active Anthrax at the time of death can be a source of Anthrax spores. A lethal infection is reported to result from inhalation of about 10,000 – 20,000 spores, though this dose varies among host species. Testing at the University of Cincinnati by Dr. Grinshpun used *Bacillus subtilis* as a surrogate.

**Effectiveness of Photocatalytic Oxidation Technology:** ~ Deactivation of > **90%** of microorganisms was achieved in less than 60 minutes, the majority of which occurred within 10 minutes. (10)



# EFFECTS OF PHOTOCATALYTIC OXIDATION ON BACTERIA



Photocatalytic oxidation used to actively reduce airborne and surface pathogens. Selected microorganism prepared and placed on a stainless-steel surface, allowing analysis at 2 hours, 6 hours, 12 hours, and 24 hours. After 24 hours exposure to PCO, organism's viability was reduced between **96.4% and 99.9%** (3).

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# PATHOGEN CHART

*Testing of Advanced Photocatalytic Oxidation (PCO) Technology on UVAIRx cell by Independent Laboratories, Universities & Facilities*

Pathogen	Descriptive Examples	Results	Time Tested	Test Method
Norovirus	Norwalk virus	99.6% reduction	24 hours *	Stainless, carpet & cloth
	Lab Name: <i>In vitro</i> - Radil, LLC; FDA & EPA approved - Dr. Leila Riley, DVM.*			
	<i>In vivo</i> shelter test: Aurora Animal Hospital, Dr. Nicole Bartley, DVM; State of Colorado Expert Witness for Veterinary Medicine; 3 month, double blind study.			
Methicillin-resistant Staphylococcus aureus	MRSA	99.9% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
Staphylococcus aureus	S. aureus	99.8% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
Clostridium difficile	C. diff	99.8% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
Listeria monocytogenes	Listeria	97.3% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
Group A streptococci	GAS	97.4% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
Pseudomonas aeruginosa	P. aeruginosa	99.9% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
Streptococcus pneumonia	S. pneumonia	99.9% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
Bacillus anthracis	Anthrax	97.6% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
H1N1	Swine flu	99.9% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
H5N1	Bird flu	99.9% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
Stachybotrys chartarum	Fungus and Spores	99.4% reduction	24 hours	On stainless coupons
	Lab Name: <i>In vitro</i> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			

Continued next page

# PATHOGEN CHART

Candida albicans	Molds and Spores	99.5% reduction		On stainless coupons
	Lab Name: <b>In vitro</b> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
Volatile Organic Compounds	Over 60 VOCs	Average of 91% reduction	24 hours	VOC in enclosure
	Lab Name : <b>In vitro</b> - Avomeen Analytical Services, Ann Arbor, MI, FDA, cGMP, DEA, ACIL.			
	Lab Name: <b>In vitro</b> - NREL, FDA & EPA approved, Dr. D. Tompkins, et al., summary of testing on PCO technology.			
Volatile Inorganic Compounds	Ammonia/ Nox/ H <sub>2</sub> S/ Sox/ O <sub>3</sub>	Average of 89% reduction	24 hours	VIC in enclosure
	Lab Name: <b>In vitro</b> - NREL, FDA & EPA approved, Dr. D. Tompkins, et al., summary of testing on PCO technology.			
Odors	Alkanes, Acetone, Alcohols, Ketone	Average of 87% reduction	12 hours*	Gas in enclosure
	Lab Name: <b>In vitro</b> - North Carolina State University, EPA & FDA approved, Dr. J. Peral, et al., testing on PCO technology.*			
	<b>In vivo testing:</b> C&W Engineering, Ocala, FL - Showed pet odors reduced by 72%. Used 10 person test panel with two 500 ft <sup>3</sup> test chambers.			
Basidiospores	Allergens, Fungus, Ringworm	99.4% reduction	24 hours	On stainless coupons
	Lab Name: <b>In vitro</b> - Kansas State University, FDA & EPA approved, Drs. Ortega and Marsden, et al.			
	<b>In vivo shelter test:</b> Aurora Animal Hospital, Dr. Nicole Bartley, DVM; State of Colorado Expert Witness for Veterinary Medicine; 3 month, double blind study.			
Allergens	Pet dander, dust mite antigens	Average of 91% reduction	70 minutes	In solution
	Lab Name: <b>In vitro</b> - University of Florida, EPA & FDA approved, Dr. D. Goswami; Mie University, Japan, N. Nishikawa, et al.; testing on PCO technology.			
				Copyright UVAIRx, Inc. August 2012

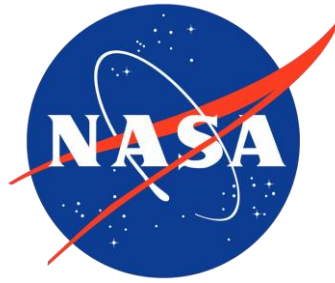
Inactivation of pathogens used the advanced photocatalytic oxidation (PCO) cells which are used in UVAIRx products, and labeled either PHI ® or RCI. All tests were done using standard and accepted test methods employed by the fully accredited test laboratories. Doctors (PhD) Marsden, Ortega, Goswami, Riley, Peral and Tompkins are all internationally recognized for their work with photocatalysis. Dr. Marsden is an internationally acclaimed expert in food safety and Dr. Riley, DVM, as an expert in veterinary medicine. Additional extensive testing has been done by Disney Cruise Lines, and the USDA in conjunction with Swift Foods and Costco.

**\* ALL UVAIRx UNITS ARE ETL, UL, FCC & CARB APPROVED \* UNITS ARE 12 VDC & ENERGY STAR COMPLIANT \***

# **SELECTED QUOTES FROM NASA AND NREL**

**Supporting the Efficacy of PCO Technology  
for Safe and Effective Pathogen Remediation**





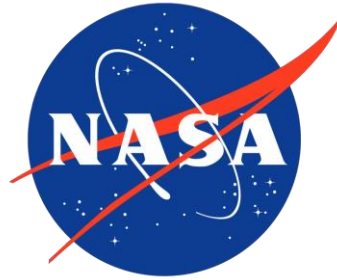
***"NASA's Potential Contributions for Using Solar Ultraviolet Radiation in Conjunction with Photocatalysis for Urban Air Pollution Mitigation" Robert E. Ryan and Lauren W Underwood; John C. Stennis Space Center, April 2007.***

"..... Photocatalysis is an area of research whose potential for environmental clean-up is rapidly developing in popularity and success. Photocatalysis, a natural chemical process, is the acceleration of a photoreaction in the presence of a catalyst. Photocatalytic agents are activated when exposed to near UV (ultraviolet) light (320-400 nm) and water."

"..... Photocatalysis ... has become more attractive for use because it is a non-invasive, non-toxic, and cost-effective method to address a wide variety of technologies related to purification and degradation processes (Choi, 2006; Cassar, 2004).

***Press release, Office of the Chief Technologist, NASA (2002):***

".... it (PCO) is the only air purifier that completely destroys airborne bacteria, mold, fungi, mycotoxins (mold), viruses, volatile organic compounds (like ethylene), and odors. What's more, the device has no filters that need changing and produce no harmful byproducts, such as the ozone created by some filtration systems."



***Press release, NASA Marshall Space Flight Center, 2002:***

"Building miniature greenhouses for experiments on the International Space Station has led to the invention of a device that annihilates anthrax – a bacteria that can be deadly when inhaled."

"the research team found that ultra-thin layers of titanium dioxide ( $\text{TiO}_2$ ) exposed to ultraviolet light converted ethylene into carbon dioxide ( $\text{CO}_2$ ) and water ( $\text{H}_2\text{O}$ ) – substances that are good for plants. Subsequently, they developed a coating technology that applies  $\text{TiO}_2$  layers to the surfaces of many materials."

"Increasing awareness of health risks associated with poor air quality in closed-environment habitats (e.g., airplanes, spacecrafts, office buildings, factories, homes, etc.) as well as increasing desire for energy conservation have provoked a high demand for more efficient and environmentally-friendly technologies for air revitalization.

"Among the photocatalysts used, titanium dioxide ( $\text{TiO}_2$ ) is the most widely implemented because it is inexpensive, nonhazardous, and chemically inert."



***“Mineralization of Bacterial Cell Mass on a Photocatalytic Surface in Air” William A. Jacoby, Pin Ching Maness, Edward J. Wolfrum. Daniel M. Blake, John A. Fennell; National Renewable Energy Laboratory (2013)***

“Whole cells deposited on a titanium dioxide coated surface have been oxidized in air to carbon dioxide via photocatalysis. This paper provides the first evidence that organic matter in whole cells can be completely oxidized (deactivated).”

***“Bacterial mode of titanium dioxide photocatalysis” Zheng Huang, Pin-Ching Maness, Daniel Blake, Edward J. Wolfrum, Sharon L. Smolinski; The National Renewable Energy Lab; William A. Jacoby, University of Missouri.***

Note: Additional NASA and NREL technical papers supporting the efficacy of PCO as a safe and effective treatment for pathogen remediation are available along with similar supportive papers from the Lawrence Berkeley National Lab, Universities of Florida, Missouri, Cincinnati, Wisconsin, Tokyo and Kansas State University.