

MCI Testing Data Executive Summary

This is an Executive Summary of brief compilation of multiple tests using individual MCI™ (Multi-Cluster Ionization) components conducted in both clinical and field environments by several testing agencies on different contaminants. Detailed testing documentation is available by request. The purpose of the summary is to verify the efficacy of the two primary components used in the trademarked MCI™ air purification equipment, namely PCO (Photo-catalytic Oxidation) and DBI (Dielectric Barrier Ionizer). Products are offered with either the low level or no ozone option. When these two components are used synergistically, the efficacy results appear to be more significant than those shown by any individually studied component.

 Indicates **FIELD** Study

 Indicates **CLINICAL** Study

PCO Bacteria Reduction (Low Level Ozone)

PRE	09/13/14	POST	10/22/14
Surgical 2	*TNTC	Surgical 1	0 cfu
		Surgical 2	1 cfu
Outpatient	1 cfu	Recovery	2 cfu
		Outpatient	8 cfu
Med Info	TNTC	Angela Office	4 cfu
Purchasing	TNTC	Pharmacy	15 cfu
		Clean Supply	12 cfu

*TNTC stands for "Too Numerous To Count" and indicates contamination above 301cfu cfu is "colony forming units"

SUMMARY—On 09/30/2014 all air purification systems for the three air conditioning zones were installed. This included MCI™ technology probes from BLS in each return plenum, supply plenum (total of twelve probes) and MCI™ BLS12Ks as stand alone units dispersed throughout the air conditioning zones (a total of stand alones). The engineering and sizing of these units was determined by NORMIPro Management in consult with the hospital's facilities maintenance staff and installed by others. Installation was completed in one working. The results are clear.

PCO Total Contaminant Reduction (No Ozone)



Sample No.	Type of Sample	Location	PRE 07/21	POST 07/28	Reduction %
#1 and #9	Air-O-Cell	Master Bedroom	Cladosporium	12	4
			Asper/Penicillium	5	0
			Hyphal Fragments	2	1
			Curvularia	1	0
			Alternaria	0	1
		TOTAL	20	6	70.00%
#2 and #8	Air-O-Cell	Kitchen	Cladosporium	9	3
			Asper/Penicillium	8	4
			Hyphal Fragments	2	2
			Curvularia	1	0
			Alternaria	2	0
		TOTAL	22	9	59.09%

SUMMARY—On 07/21/2008, this 28,500 ft³ home was tested for formaldehyde, bacteria and mold pre- and post- installation of PCO NO O³ probes in the HVAC system. After 7 days there was a reduction of between 60%-70% of all contaminants. Surface and air samples included.

PCO TVOC Reduction (Low Level Ozone)

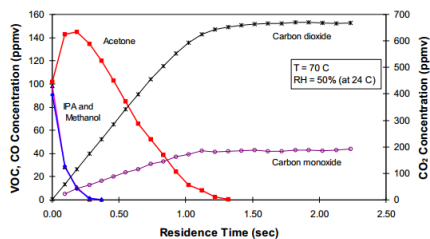


Figure 4 Conversion of the Simulated Parts Cleaning Sink Emissions at 70°C

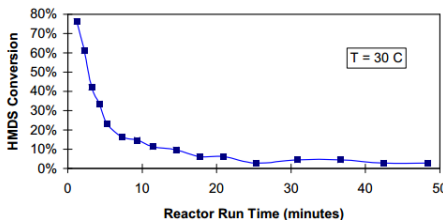


Figure 8 Catalyst Deactivation by HMDS

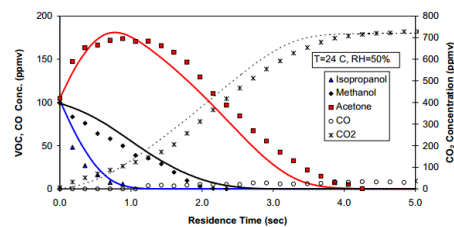


Figure 3 Conversion of the Simulated Parts Cleaning Sink Emissions in a Laboratory PCO Reactor. Lines are the Model Prediction Based on the Single Component Data.

SUMMARY—This report documents the bench scale results for the photocatalytic oxidation (PCO) of the organic air emissions from a simulated parts cleaning sink. The simulated effluent stream contained equal parts isopropanol, acetone, and methanol, at a total concentration of 400 parts per million by volume (ppmv). Under the conditions examined, >95% destruction of the incoming pollutants to carbon dioxide and water was achieved. Optimization work obtained a ten-fold rate increase in destruction efficiency compared to the base case operation conditions through proper catalyst formulation, oxidant and temperature. Aside from the acetone formed and subsequently destroyed during the destruction of isopropanol, no intermediate species were detected. In addition, the optimum catalyst produced no detectable CO.

 Indicates **FIELD** Study

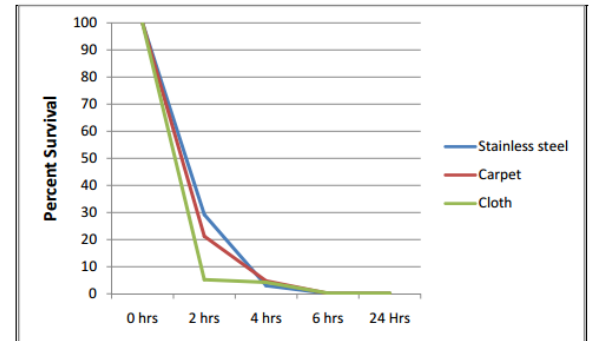
 Indicates **CLINICAL** Study

PCO Viral Reduction (No Ozone)

Table 1. Reduction in Murine Norovirus Titer Following Ecoquest's Ozone-free Treatment

Treatment time	Stainless steel			Carpet			Cloth		
	Untreated (TCID ₅₀ /ml)	Treated (TCID ₅₀ /ml)	Percent decrease from t=0	Untreated (TCID ₅₀ /ml)	Treated (TCID ₅₀ /ml)	Percent decrease from t=0	Untreated (TCID ₅₀ /ml)	Treated (TCID ₅₀ /ml)	Percent decrease from t=0
0 hrs	1.2 x 10 ⁶			1.6 x 10 ⁶			4.0 x 10 ⁵		
2 hrs		3.5 x 10 ⁵	70.8		3.4 x 10 ⁵	78.8		2.1 x 10 ⁴	94.8
4 hrs		3.6 x 10 ⁴	97.0		7.5 x 10 ⁴	95.3		1.7 x 10 ⁴	95.8
6 hrs		1 x 10 ²	99.9		<1 x 10 ³	>99.9		<1 x 10 ³	>99.8
24 hrs	1 x 10 ³	1 x 10 ²	99.9	<1 x 10 ³	<1 x 10 ³	>99.9	8.6 x 10 ²	<1 x 10 ³	>99.8

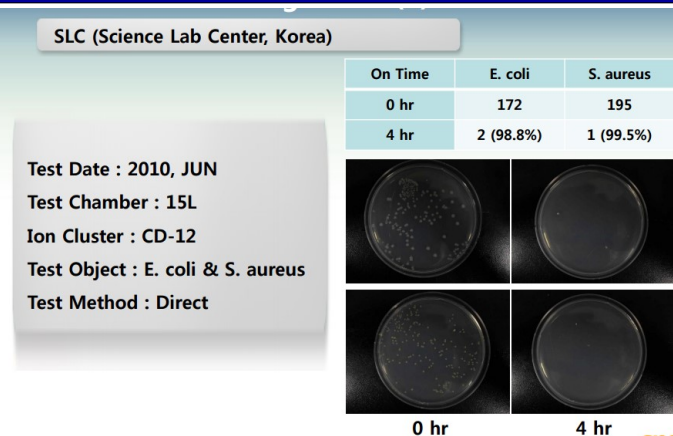
Figure 1. Survival of MNV following Ozone-Free Treatment



SUMMARY—Members of the genus *Norovirus* are nonenveloped viruses with a linear, positive-sense, single-stranded RNA genome. Noroviruses are in the family *Caliciviridae*, which also include the general *Sapovirus*, *Lagovirus*, and *Vesivirus*. Formerly known as “Norwalk-like viruses” or “small round structured viruses”, noroviruses cause acute gastroenteritis in humans, typically lasting 24k to 48h, and infect people of all ages.

Recently, the first murine norovirus, was isolated from mice. This newly described pathogen of mice can be grown in cell culture, providing the first example of a norovirus that can be cultured in vitro. In these studies, the efficacy of the decontamination platform has been evaluated against Murine norovirus (MNV), as a representative of the *Caliciviridae* family, using an in vitro culture system.

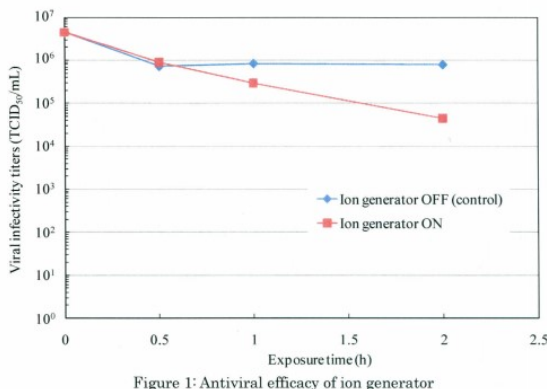
DBI Bacteria Reduction (NO Ozone)



SUMMARY—After be exposed to the DBI cell for four hours in a clinical setting (utilizing a containment), there was evidenced a reduction in both *E. coli* and *S. aureus* on surfaces which had been inoculated with these contaminants. This test was completed under clinical conditions in the SLC (Science Lab Center, Korea) and demonstrated a 98.8% reduction in *E. coli* and 99.5% reduction in *S. aureus* on surfaces.

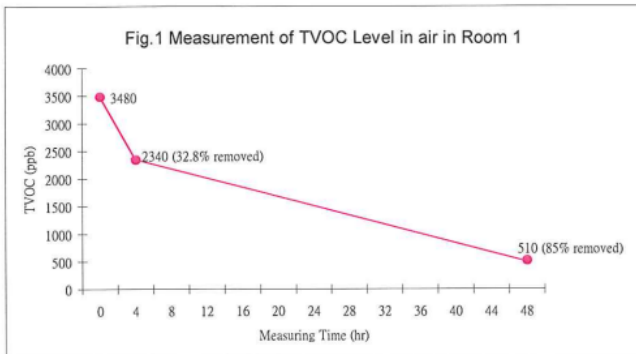
E. coli is of special concern in the food manufacturing industry while *S. aureus* is problematic in medical settings. Utilizing the DBI technology keeps the surfaces clean and can be used in conjunction with standard sanitization protocols.

DBI Viral Reduction (NO Ozone)



SUMMARY—In the present investigation, the antiviral efficacy of ion generator against influenza A virus was examined. In this test method, it appears to be effective against influenza A virus, which indicates a 1.2log₁₀ reduction (the difference of log reduction value between ion generator OFF and ion generator ON) at 2 hours.

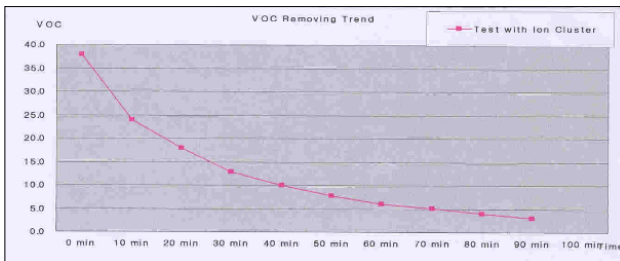
During the experiment, the ozone concentration became up to 0.05ppm into the test chamber. Because ozone possessed antiviral activity, it is considered that the decreasing of viral infectivity by the device is presumably attributed to the combination effect of ozone and ion. NOTE: 0.05ppm is the PEL of ozone in indoor environments as established by the EPA.

Indicates **FIELD** StudyIndicates **CLINICAL** Study**DBI TVOC Reduction (NO Ozone)****Remarks:**

- Log 2 was taken at room 1 with the air purification unit has not started running.
- Log 3 was taken at room 1 with the air purification unit has started running since 10:15 18 Aug 08.
- Log 6 was taken at room 1 with the air purification unit has been running since 10:15 18 Aug 08 and stopped at 10:47 20 Aug 08.
- For picture description of the sampling, please refer to the appendix.

SUMMARY—TVOC concentration level in air was measured at a classroom against different times. The area of Room 1 was 37m² and its height was 2.52m. Storage racks, desk and flooring in the rooms was mainly constituted of polymer coating while the walls were coated by emulsion paints as reported by client. All windows and doors were shut during the measurement period.

TVOC sensor was placed in the room to record the ambient TVOC concentration with a measurement schedule stated in the later section. An air purification unit *(utilizing the DB cell) was placed in the room for the purpose of lowering TVOC concentration level and the results are recorded here to the left indicating a significant reduction in TVOCs.

DBI Cigarette Smoke Reduction (NO Ozone)**Test Results**

Introduce cigarette smoke into chamber and measured the airborne particles count after 120 minutes of Ion cluster operation.

Particle Size (microns)	Back Ground Count	Particle Count after cigarette smoke introduction	Count after Ion counter operation during 120 minutes	Removal Ratio (%)
0.3	29,461	1,246,109	2,176	99.83 %
0.5	3963	307,364	257	99.92 %
1.0	51	4,831	4	99.92 %
5.0	0	0	0	

* Note : These results are expressed as particles per 2.83 liters air. (0.1 ft³ = 2.83 liter)

SUMMARY—This test report is for removal of VOC in cigarette smoke by DBI (SPE Ion cluster). The DBI cell produces negative ions, positive ions, radicals and clustered ions which react with impurities in the air and decompose hazard chemicals. Main ingredients of cigarette consist of VOC and harmful to humans. This is the data which measured the VOC counts in cigarette smoke in every 10 minutes intervals after operating the DBI cell.

NOTE: DBI (SPE Ion Cluster) has good efficiency to remove 90% of VOC in cigarette smoke. And the smoke in the chamber almost disappeared in 25 minutes by visual check.

DBI Ammonia Reduction (NO Ozone)**Results:**

Viable count UFC	Time 0	1H	Logarithmic Reduction	%	2H	Logarithmic Reduction	4H	Logarithmic Reduction	%
Negative control	/	1.2 10E4	/		2.0 10E4	/	3.5 10E4	/	
Bacteria	/	20	2,8	>95	17	3,1	22	3,2	>99,9
Fungi	/	46	2,4	>95	18	3,0	24	3,2	>99,9
S.aureus	1.2 10E5	17	3,9	>99,9	/	/	18	3,8	>99,9
E.coli	1.6 10E5	2	4,9	>99,9	/	/	4	4,6	>99,9

UFC means: Unit Forming Colony

Conclusion:

BW60 shows under these experimental conditions a significant reduction of pathogen viability. BW60 shows a significant airborne diminution (2 log and more for logarithmic reduction) of total viable bacteria and fungi at 1 hour, 2 hours and 4 hours time contact for 60 m³ air volume.

SUMMARY—Experimental conditions included time contact 1 hour, 2 hours and 4 hours.

Bacteria: Staphylococcus aureus
Escherichia coli
Total viable count (Bacteria)
Fungi

Airborne collector: Sampl' Air (from AES-Chemunex)

Total air volume collected:

60 m³ total volume for total viable count

75m³ total volume for pathogen (S. aureus/E. coli)

Reference Page

- ¹**NORMIPRO Management, Inc.**, 10/25/2014, *Southern Hospital Study*, Surgical Center
- ²**EnviroScreening Lab, LLC**, 07/21/2008 *Evaluation of activTek InDuct NO Ozone 10000*, Waldheim Residence
- ³**Sematech, Inc.**, 08/21/1995, *Destruction of Volatile Organic Compound (VOC) Emissions by Photocatalytic Oxidation (PCO): Benchscale Test Results & Cost Analysis*, Craig S. Turchi, Toberto Rabago, Avtar Jassal
- ⁴**Radil, LLC**, 11/18/2008, *Evaluation of the Efficacy of Ecoquest's Decontamination Systems in Reducing Murine Norovirus Titers*, Dr. Lela Riley
- ⁵**SUDO Premium Engineering**, 02/24/2014, *Bacterial Tests*, Yuman Kim
- ⁶**Kitasato Research Center of Environmental Sciences**, 09/01/2010, *Antiviral Efficacy of Ion Generator*, Toshihiro, ITOH, Ph.D
- ⁷**SGS Hong Kong, LTD**, 09/10/2008, *Test Report (Classroom Study)*, Brook Want, Technologist
- ⁸**Samsung Electronics Co, LTD.**, 06/27/2007, *Quality Control Standard Measurement (Cigarette Smoke)*
- ⁹**Scientec Lab Center Co., LTD.**, 06/18/2010, *Certificate of Analysis (E.coli Performance)*

Hazardous Substance	Type	Verified by	Period
Viruses	H1N1	Kitasato Environment Science Center	Sep. 2003
	Human Influenza Virus	Seoul National University, Korea	Sep. 2003
		Preventive Medicine Institute, Shanghai, China	Dec. 2003
		Kitasato Medical Center Hospital, Kitasato Institute	Feb. 2004
	H5N1	Retroscreen Virology, UK	May 2005
	Bird Influenza Virus		Aug. 2008
Germes	New H1N1 Influenza Virus	Retroscreen Virology, UK	Nov. 2009
	SARS Virus	Retroscreen Virology, UK	Oct. 2005
	Polio Virus	Kitasato Environment Science Center	Sep. 2002
	Coxsackie Virus	Kitasato Environment Science Center	Sep. 2002
	Corona Virus	Kitasato Medical Center Hospital, Kitasato Institute	Jul. 2004
	Serratia	Professor Emeritus Mervin First, Public Health School, Harvard University, U.S.	Mar. 2007
Allergen	Colon Bacillus	Isikawa Preventive Medicine Association	Sep. 2000
	Colon Bacillus, White Staphylococcus, Candida	Preventive Medicine Institute, Shanghai, China	Oct. 2001
	Bacillus	Kitasato Environment Science Center	Sep. 2002
	MRSA (Methicillin-Resistant Staphylococcus Aureus)	T&T (Professor Atman, Aachen University of Applied Science, Germany)	Nov. 2004
	MRPA (Multi-Drug-Resistant Pseudomonas Aeruginosa)	Kitasato Medical Center Hospital, Kitasato Institute	Sep. 2002
	Pseudomonas, Enterocococcus, Staphylococcus	University of Lübeck, Germany	Nov. 2004
Mycete	Enterococcus, Staphylococcus, Sarcina, Micrococcus	CT&T (Professor Atman, Aachen University of Applied Science, Germany)	Feb. 2002
	Coxsackie virus		Nov. 2004
	Mold, Pollen	Advanced Material Department, Hiroshima University Graduate School	Sep. 2003
	Mold	Molecular Pathology Lab, Medical Research Department, Osaka Municipal University Graduate School	Jul. 2009
	Cladosporium (black mold, mildew)	Isikawa Preventive Medicine Association	Sep. 2000
	Penicillium, Aspergillus	University of Lübeck, Germany (Proliferation Suppression)	Feb. 2002
	Aspergillus, Penicillium (Two Types), Stachybotrys, Alternaria, Mucor	CT&T (Professor Atman, Aachen University of Applied Science, Germany)	Nov. 2004

MCI™ (Multi-cluster Ionization) is a trademarked technology (USR Reg. 4,320,186) owned by Best Living Systems, LLC and has become the next generation of PCO (Photo-catalytic Oxidation) that had its beginning in the late 70's. By combining proven technologies (PCO, DBI, Filtration, Ionization and others), MCI™ takes a holistic synergistic approach to improving indoor air quality by designing products for specific applications. Through the years many companies have performed efficacy and safety studies/testing on these various components and it has resulted in some improvement. In many cases those studies were peer-reviewed and conducted, by commission, by independent laboratories and Universities.

Only Best Living Systems, LLC provides the trademarked, and award-winning MCI™ technology. The components of this enhanced synergistic approach have proven their effectiveness, efficacy and safety for decades but only now, since combined, have these technologies reached a point where increasing its cleaning power is possible. Many attempts have been made to reconfigure the target, increase or decrease the intensity of the bulb, lengthen or shorten the target plate, utilize a different coating, etc. and these have resulted in slight increases in its ability to be effective. However, once the actual real kill mechanism was understood (the multi-cluster ions), and when working in synergy with dielectric barrier ionization, improvements could be made to this proactive technology.