AIR QUALITY TECHNOLOGIES
Indoor Air Specialists

CIMR® – Continuous Infectious Microbial Reduction Overview

Introduction

CIMR air purification technology has significant potential to benefit residential and commercial clients. It is capable of disinfecting viruses, bacteria, mold, and fungi both in the air and on surfaces. A few locations where products powered by CIMR technology were used are at Fort Hood and during the stabilization and remediation phases of remediation at hurricane-damaged Lamar University after Hurricane Rita. The products were used to stabilize and remediate extensive mold contamination at a fraction of the cost and time of conventional methods. Hi-Tech added a prevention phase to the remediation process by installing CIMR powered units in HVAC systems to prevent new mold growth.

University studies conducted on CIMR technology have been impressive. Kansas State University observed that CIMR technology demonstrated the ability to disinfect 96.4% to 99.93% of viruses, bacteria, and mold spores on surfaces within two hours. The University of Cincinnati noted that units, powered by CIMR technology, demonstrated that within one hour it could kill 90% of airborne virus and 70% of airborne bacteria.

Units powered by CIMR technology have demonstrated the capability to oxidize volatile organic hydrocarbons (VOC's), but higher system capacity is required to do so.

Hi-Tech Systems specializes in the application of CIMR technology and has developed proprietary processes that maximize the effectiveness of their technology, lower the cost of its application, and have made new applications of CIMR technology possible.

Proprietary Processes

Hi-Tech does not fully disclose its proprietary processes; however, our effectiveness in mold remediation cannot be disputed. Our cost-effectiveness is outstanding, remediating sites at a fraction of the cost of traditional processes.

Traditional remediation processes first create conditions unfavorable to mold growth, then remove and dispose of contaminated materials and follow this with reconstruction. This approach is costly in terms of man-hours, equipment rental, materials, and reconstruction costs.

Hi-Tech processes kill mold under ambient conditions traditional remediation companies seek to avoid, reducing climate control costs. Mold organisms remain more vulnerable under these conditions and are more easily killed. Within days, established mold colonies die, decomposing into a fine powder that is easily removed by HEPA vacuum without the need for disposal of the affected surface unless it has been physically damaged by prolonged mold growth. Once the site has been remediated, as long as inexpensive maintenance systems remain in place and the source of moisture is controlled, mold does not re-establish and repeated post-remediation testing by testing companies and the Army Corps of Engineers, has demonstrated lower spore counts than traditional remediation methods achieve.

Core Technology Description

The core technology of CIMR is inexpensive to operate and install. CIMR works by creating 0.02 parts per million (ppm) of non-aqueous hydrogen peroxide (H_2O_2) from the oxygen and humidity that already exists in the air; therefore, requiring no consumable supplies. The CIMR then diffuses everywhere air travels, continuously disinfecting microbes in places that other technologies cannot reach. The CIMR molecules have both localized positive and negative charges; they are literally drawn to viruses, bacteria and mold by electromagnetic attraction and are destroyed. CIMR does not create ozone and is safe for humans, animals and other life forms.

The Challenge

Viruses, Infectious Bacteria and Fungi continue to be a worldwide threat to the health of humans and other life forms. Current infection control protocols continue to struggle against these threats. The struggle is becoming more complicated despite all of the preventive precautions. The interconnectedness of the world is problematic as we try to avoid diseases and sickness.

Current Technology and Strategies

The most prevalent technologies currently used are: air filtration, electronic air filters/plasma, hydrogen peroxide misting systems (aqueous), chemical misting systems (aqueous), ozone (O_3) systems, ionic technology, ultraviolet lights, and chemical disinfectants.

Passive Systems

Each of the current technologies and solutions currently in place have limitations. All filtration systems (standard, HEPA, electronic, electronic plasma, etc.) are passive technologies that rely on the air and pathogens to travel to the system. They will have no effect on the pathogens that do not make it to the system. Non-electronic systems will not kill the smaller pathogenic particulates which will pass through because of their microscopic size.

The following are some of the major limitations of the current technologies and solutions:

Air Filtration, Electronic Air Filters/Plasma

- Passive, rely on pathogens to travel to the filter
- Fails to kill smaller particulates
- Surfaces are not decontaminated
- Ongoing cost with filter replacement and/or maintenance
- No HVAC decontamination feature

Hydrogen Peroxide Misting Systems, Chemical Misting Systems and Ozone Systems

- Overly aggressive
- Not safe in areas occupied by humans or other life forms
- Not continuous
- No HVAC decontamination feature
- Relies on human programming and deployment
- Labor costs
- Ongoing costs of chemicals
- Ozone does not self-regulate and is banned from use in many locations

Ionic Technologies

- Does not kill pathogens
- No HVAC decontamination feature
- Surfaces are not decontaminated
- Air is not decontaminated

Ulttraviolet Lights

- Limited effect on moving air
- Only line of sight protection
- Distances decrease effectiveness

Chemical Disinfectants (Janitorial)

- Not continuous
- No HVAC decontamination feature
- Subject to human error
- Chemical dilution issues
- Protocol compliance issues
- Recurring labor expense
- Ongoing costs of chemicals and application supplies

Current Technology Pitfalls

All current strategies outlined previously have significant flaws. This fact is obvious and substantiated by evidence documented by multiple sources in the United States and throughout the world. The guidelines have not evolved and do not use current technology and are plagued by human error and lack of compliance. The current technologies are either reactionary or ongoing procedures that are not comprehensive.

CIMR - Innovative and the Most Comprehensive Strategy

The CIMR technology rapidly inactivates and eliminates viruses, bacteria, germs, fungi and molds as well as other volatile organic compounds (VOC's). CIMR has been proven effective against many infectious micro-organisms, including:

- Norovirus, E-Coli
- H5N8 Virus
- MRSA (Methicillin Resistant Staphylococcus Aureus)
- Streptococcus (Strep)
- Pseudomonas, Swine Flu (H1N1)
- nonresistant Staphylococcus Aureus
- Listeria Monocytogenes
- Stachybotrys Chartarum (Black Mold)
- Candida Albicans
- Fungi CNS
- Aspergillus
- Bacillus Subtillus

CIMR Key Features

- Preemptively seeks and destroys infectious microbes
- Continuously working
- Safe – produces .02 ppm H_2O_2 molecules which is 1/50 of OSHA safe limit
- Kills even the smallest micro-organic pathogens – viruses, bacteria, mold, VOC's and odors
- Kills germs in the air and on every surface
- Through oxidation, microbial pathogens are decomposed and rendered harmless
- Filtrates everywhere air can travel
- Odorless
- Kills fungi/mold
- Easily installed into HVAC systems
- Low Maintenance
- **Does NOT** produce ozone

CIMR Differentiating Technology Factors

The ozone-free continuous preemptive component of infectious microbial reduction is an extremely significant leap forward in the fight against pathogens. We know of no other technology that is continuous, ozone–free, and safe to use constantly in the presence of humans, animals and other life forms. CIMR is the most comprehensive technology available and oxidizes the smallest know microbes.

Return on Investment Considerations

- Healthcare Acquired Infection (HAI) costs
- Influenza outbreak costs
- Absenteeism (Cascading effect of errors if short staffed)
- Legal – limit potential exposure to losses
- Marketing Advantage
- HVAC benefits
- Mold/Fungus elimination
- Reputation

For more information, images of products and product specifications visit our website – www.airqualitytechnologies.com

Selected Studies

Hospital

Enhanced Environmental Cleaning with Hydrogen Peroxide (H_2O_2) Gas and the Effect on Hospital-Acquired Infection (HAI) Rates and Acquisition of Methicillin Resistant Staph Aureus (MRSA) and Vancomycin Resistant Enterococci (VRE) Presented at: Fifth Decennial International Conference on Healthcare-Associated Infections, March 18 - 22, 2010.

- Sandra Silvestri, BSN, RN, CIC, University of Pittsburgh Medical Center, Pittsburgh, PA 15213
- Dr. Carlene A. Muto, MD, University of Pittsburgh Medical Center, Pittsburgh, PA 15213

Conclusions

- Hospital-Acquired Infection (HAI) Rate was reduced by 48%
- Vancomycin Resistant Enterococci (VRE) Rate was reduced by 56%
- Methicillin Resistant Staph Aureus A (MRSA A) was low in both time periods in both units (CIMR & Control)

Biosecurity Laboratory Food Safety Systems

Continuous Infectious Microbial Reduction (CIMR®) technology is effective at reducing populations of Methicillin Resistant Staphylococcus Aureus (a/k/a MRSA) and Listeria Monocytogenes on stainless steel surfaces.

Kansas State University and Sandia Laboratories

This methodology found that within 24 hours, 96.4% to 99.9% microbial reduction was noted on surfaces contaminated with Staphylococcus Aureus, Escherichia Coli (E. coli), Listeria Monocytogenes, Candida Albicans, Streptococcus, and Pseudomonas; and thereafter new microbe reduction was virtually instantaneous.

Based on the results of this study, the Continuous Infectious Microbial Reduction (CIMR®) system has the potential to reduce sources of microbial contamination in health care and other indoor air environments. This technology is effective at reducing populations of Methicillin resistant Staphylococcus Aureus and Listeria Monocytogenes on stainless steel surfaces.

The active antimicrobial in the CIMR System is Vaporized Hydrogen Peroxide.

The system does not produce measurable levels of ozone.

Frequently Asked Questions

What is CIMR Infection Control Technology?

CIMR Infection Control Technology continuously disinfects viruses, bacteria, mold and other fungi, while patients, staffs and visitors are present. This is accomplished by producing 0.02 ppm of hydrogen peroxide gas from oxygen and water vapor in the air. This is 1/50 OSHA daily limits for occupied areas.

A Photo Catalytic process produces a gaseous hydrogen peroxide. The technology is effective against microbes both in the air and on surfaces because the hydrogen peroxide molecules have both localized positive and negative charges that are literally drawn to viruses and bacteria by electrostatic attraction, disinfecting microbes in places that other technologies can't even reach. For example: The gaseous hydrogen peroxide first sanitizes the air ducts, then sanitizes the air and exposed surfaces, and over time diffuses into every crack and crevice that air can penetrate, disinfecting microbes in places that other processes or wipe- downs and chemical disinfectants cannot reach. CIMR Infection Control Technology can inactivate and reduce the viability of microorganisms greater than 95% in as little as two hours.

What is the advantage of using CIMR Infection Control Technology?

Since CIMR Infection Control Technology employs a gaseous hydrogen peroxide disinfection process, it provides aggressive infection control strategies to combat various types of contamination. Additionally, CIMR Infection Control Technology provides:

- Massive cost avoidance
- Lower cost of prevention
- Lower cost of remediation or sanitization
- Rapid return on investment
- Reduces the risk of spreading or cross contaminating people or building
- Low up-front cost compared to other chemicals and systems
- 24 hour protection reduces the spread of germs, bacteria, viruses and mold
- Stabilization of areas before remediation can begin
- Low maintenance; replace cell every 3 years
- Better indoor air quality for workers and clients
- Less absenteeism from workers

What does CIMR Infection Control Technology do?

What does CIMR Infection Control Technology do? What does CIMR Infection Control Technology do? CIMR Infection Control Technology provides excellent indoor air quality by disinfecting existing microbial contamination then continues to safeguard the protected area against the introduction of new viruses, bacteria, mold and other fungi. CIMR Infection Control Technology first sanitizes air ducts; then sanitizes the air and exposed surfaces in the protected areas; then over time, hydrogen peroxide gas in the air treated by CIMR Infection Control Technology diffuses into *every crack and crevice* that air can penetrate, disinfecting microbes in places that other processes cannot reach.

CIMR Infection Control Technology creates a safe and pleasant environment to live and work.

Is CIMR Infection Control Technology Safe?

Yes, 0.02 ppm of hydrogen peroxide gas is just one fiftieth of the amount that OSHA tells us is safe throughout a standard workday. The hydrogen peroxide gas concentration is also self-regulating. (This was confirmed by Dr. James I. Marsden, Ph.D. at Kansas State University). If hydrogen peroxide gas increases above 0.02 ppm, it starts reacting with itself until the concentration drops back down to 0.02 ppm. CIMR Infection Control Technology Units actually produce much higher concentrations of hydrogen peroxide gas immediately around the units themselves, but the hydrogen peroxide gas reacts with itself so fast that the concentration drops to 0.02 ppm within approximately an inch of the unit. When hydrogen peroxide gas reacts with itself, it breaks down into non-toxic oxygen and water vapor.

Okay, how can such a small amount possibly be effective?

Well, there are billions of gas molecules in air. Even at 0.02 ppm, there are still 500,000,000,000 hydrogen peroxide gas molecules in a single liter of air at room temperature. That means that the hydrogen peroxide gas molecules are only 1.25 to 1.5 microns apart. Bacteria are about one micron in size, so they can't move very far without running into several hydrogen peroxide molecules. Viruses can be as small as 0.1 microns, but they will still run into hydrogen peroxide molecules if they move just fifteen times their own length.

The real advantage is that hydrogen peroxide molecules don't simply bump into microbes on a random basis, they are actually attracted to the microbes. Like water, hydrogen peroxide has both localized positive charged points (the hydrogen atoms) and localized negative charged points (the oxygen atoms) on each molecule. So, hydrogen peroxide gas molecules are actually attracted to positive and negative charges on the surface of microbes and are drawn to microbes through the air by electrostatic attraction.

Are you sure CIMR Infection Control Technology is Safe for Long Term Use?

Yes, as we mentioned above, 0.02 ppm of hydrogen peroxide gas is just one fiftieth of the amount that OSHA tells us is safe throughout a standard workday. Air containing 0.02 ppm of hydrogen peroxide gas is also safer than outside air containing 0.04 ppm to 0.08 ppm ozone, a much stronger oxidizer. An added benefit of hydrogen peroxide gas is that it helps to control the amount of ozone in incoming air.

Can CIMR Infection Control Technology Help with High Ozone Levels in our air?

If CIMR Infection Control Technology Units are placed in the air intakes, as air is brought in from outside, hydrogen peroxide gas will react with the ozone to produce oxygen and water vapor, bringing the ozone concentration down to 0.02 ppm in the incoming air.

What does the air Treated By CIMR Infection Control Technology Smell like?

It is odorless. At 0.02 ppm, hydrogen peroxide gas is undetectable by the human nose, so CIMR Infection Control Technology Units do not produce a smell. CIMR Infection Control Technology will, however, eliminate some smells by disinfecting molds, mildew, and other microbes that produce smells. As smell-producing microbes are disinfected, they will stop producing new odors, and old odors produced before the disinfection will dissipate over time.

I've heard about other Hydrogen Peroxide Systems in the past, don't they have limitations?

There are other hydrogen peroxide disinfection processes available, and they do have limitations compared to CIMR Infection Control Technology. Other hydrogen peroxide processes vaporize liquid hydrogen peroxide solutions to create a mist of water droplets containing hydrogen peroxide. The hydrogen peroxide mist contains hundreds and sometimes thousands of parts per million of hydrogen peroxide, so they can't be used in occupied spaces. Also the droplets precipitate out of the air, so they have trouble spreading all the way through a facility. But the biggest disadvantage for these systems is that the hydrogen peroxide in the water droplets is surrounded by water. This insulates the hydrogen peroxide molecules in the droplets and prevents them from being drawn to microbes in the air or on surfaces by electrostatic attraction.

Because CIMR Infection Control Technology uses oxygen gas and water in gas form to begin with it produces hydrogen peroxide in true gas form. Hydrogen peroxide gas molecules produced CIMR Infection Control Technology are not trapped in water droplets and are able to diffuse through the air like any other gas, even into cracks and crevices. Because they are not insulated by water molecules, they can be drawn to microbes by electrostatic attraction. This makes a much, much smaller amount of hydrogen peroxide gas much, much, more effective and lets us provide you with an effective infection control technology that can be safely used in occupied spaces.

What types of CIMR Infection Control Technology units are in Production?

CIMR Infection Control Technology systems come in a variety of sizes, from units large enough to safeguard up to 80,000 cubic feet, to those small enough for a single room.

CIMR Infection Control Technology can be installed in air intakes, air ducts, in single-room heating and cooling units, or purchased in portable stand-alone units.

Do You Have Proof? -- YES!

CIMR Infection Control Technology systems have been in the field for years. They have been used in catastrophic events such as hurricane Rita, Ike, Katrina, etc. In all cases our CIMR systems were successful in the stabilization and remedial cleanup of the buildings.

When users of CIMR Infection Control Technology reported that it was killing the black mold in their homes and that absenteeism in their preschools dropped by 70%, three studies were undertaken.

Successful implementation of CIMR Technology is acclaimed by the following:

- University of Pittsburgh Medical Center
- US Military Facilities - Army, Air Force & Navy
- U.S. Army Corps of Engineers
- FEMA (Federal Emergency Management Agency)
- National Historical Society
- Lamar University, Beaumont, TX
- Texas Educational System
- National Insurance Companies

Dr. Carlene A. Muto, MD, an infectious disease specialist, and Sandra Silvestri, BSN, RN, CIC, both of the University of Pittsburgh Medical Center (UPMC), presented at the Fifth Decennial International Conference of Healthcare-Associated Infections, March 18 - 22, 2010.

The University of Pittsburgh Medical Center, Presbyterian is an 766-bed tertiary care facility. The Cardiac Thoracic Intensive Critical Care (CTICU) consists of two units: CT10 & CT11, each with 10 beds and similar populations. During July 2008, the CIMR Infection Control Technology was installed in CT11. This technology continuously disinfects viruses, bacteria, mold, and other fungi by producing 0.02 ppm of hydrogen peroxide (H2O2) gas from oxygen and water vapor in the air. This methodology found that within 24 hours, 96.4% to 99.9% microbial reduction was noted of surfaces contaminated with Staphylococcusaureus, E-Coli, Listeria Monocytogenes, Candida Albicans, Streptococcus, and Pseudomonas; and thereafter new microbe reduction was virtually instantaneous. (Kansas State University and Sandia Labs)

Methods: CT11 was selected as our test (T) unit where on average 59% of patients were colonized with at least 1 significant pathogen. CT10 served as the control (C) unit. The unit was installed in the Air Handler Unit (AHU).

Positioning the H_2O_2 unit in the AHU as opposed to the air ducts serving the CT1I was done to ensure that all air entering the CT was treated and not mixed with untreated air. HAIs were defined using National Health System Network (NHSN) criteria. MRSA and VRE screening is routine in our hospital and "As" was defined as a positive following a negative screen. A six month period of HAI and MRSA/VRE As were compared pre- and post-installation and the T unit was compared to the C unit.

Results

Periods	HAIs	Patient Days	HAI rate	OR (CI)	P value	MRSA As	MRSA A rate	OR (CI)	P value	VRE As	VRE A rate	OR (CI)	P value
CT11 Pre	19	2158	8.8	1.89 (0.81, 4.53)	0.16	4	1.9	1.19 (0.23,6.68)	1.0	20	9.3	2.25 (0.9,5.6)	0.07
CT11 Post	9	1928	4.6			3	1.5			8	4.1		
CT10 Pre	26	1854	14.0	1.35 (0.76, 2.41)	0.38	1	0.5	0.52 (0.02,7.25)	1.0	7	3.8	0.5 (0.2,1.3)	0.16
CT10 Post	20	1924	10.3			2	1.0			15	7.8		
CT11 vs CT10 Pre			HAI rate	0.62 (0.33, 1.17)	0.16	MRSA A rate		3.44 (0.37,80.9)	0.38	VRE A rate		2.4 (1.0,6.4)	0.05
CT11 vs CT10 Post			HAI rate	0.45 (0.19,1.03)	0.06	MRSA A rate		1.5 (0.2,12.8)	1.0	VRE A rate		0.5 (0.2,1.3)	0.21
All rates in #/1,000 pt-days													

Conclusions:

- CT11 HAI rate was reduced by 48% (8.8 vs 4.6) and the VRE A rate reduced by 56% (9.3 vs 4.1) during the post period, MRSA A rate was unchanged (1.5 vs 1.9).
- VRE A rates were significantly lower in the T vs C unit in the post period and the HAI rate trended towards significance. MRSA A was low in both time periods and in both units.
- Ongoing analysis is planned and further investigation of this technology is merited.

The full report of the UPMC study is available for review upon request.

Kansas State University and Sandia Labs found that hydrogen peroxide gas technology disinfected 99.99% of the H5N8 virus on surfaces within two hours.

Dr. James L. Marsden, Ph.D. of Kansas State University also had this to say based on his research: "Kansas State University found that the hydrogen peroxide gas technology disinfected surfaces contaminated with MRSA (Methicillin Resistant Staphylococcus Aureus), nonresistant Staphylococcus Aureus, Escherichia Coli (a/k/a E. coli), Listeria Monocytogenes, Candida Albicans, Stachybotrus Chartarum (a/k/a black mold), Streptococcus, Pseudomonas, and Bacillus Subtilis. This study demonstrated microbial reduction on contaminated surfaces by 96.4% to 99.9% within the first twenty four hours."

Effective at Reducing Microbial Populations on Surfaces

Staphylococcus aureus:	*98.50% reduction*
MRSA - *Staphylococcus aureus (Methycillin Resistant):*	*99.80% reduction*
Escherichia coli:	*98.10% reduction*
Bacillus spp	*99.38% reduction*
Streptococcus spp.:	*96.40% reduction*
Pseudomonas aureuginosa:	*99.00% reduction*
Listeria monocytogenes	*99.75% reduction*
Candida albicans:	*99.92% reduction*
Stachybotrys chartarum:	*99.93% reduction*
Norovirus:	*99.90% reduction*

Kansas State University