



ECO-SHIELD CHEMICAL FREE AIR SANITATION

Eco-Shield is our new concept for building a fortress of safety around your products, your plant and staff; and our innovative chemical free air sanitation systems are a foundation of this.

Key Diagnostics believes that protecting the health and safety of everyone, including our planet, is paramount.

Our desire isn't just to provide substitutes but to find solutions that are greener and safer whilst providing scalable improvements.

Share our World Where Food Safety is Powerful, Yet Pure.

Sounds great, but what is it?

MDBD (Modulated Dielectric Barrier Discharge) cold plasma technology converts the moisture in the air into Reactive Oxygen Species (ROS), which includes Hydrogen Peroxide, Hydroxyl Radicals and Superoxides. ROS kills bacteria, viruses and spores - up to 7 log reduction in 30 secs, in controlled conditions. ROS is also active in destroying other harmful compounds and gases, providing a safe and chemical free environment. They are also eco-friendly as they also break back down into oxygen and water.



Rapid & continual antimicrobial technology reduces bioburden and improves indoor air quality



Disinfection for both air and surfaces - from floor to ceiling



Perfectly safe for occupied spaces - when protection is needed the most



Requires no chemicals and leaves behind no residue



Long-term cost savings in chemical use and staff labor



Destroys Volatile Organic Compounds (VOCs) including formaldehyde, toluene, and benzene



Potential HVAC energy savings by reducing amount of outside air needed

The Technology

MDBD (Modulated Dielectric Barrier Discharge) is a form of non-thermal (cold) plasma generated between two electrodes separated by a dielectric barrier. The system uses ambient air and a controlled electrical field to generate plasma without producing heat or sparks.

This plasma creates a cascade of **Reactive Oxygen Species (ROS)**, including:

- Hydrogen Peroxide (H_2O_2)
 - A powerful, natural antimicrobial agent
- Hydroxyl Radicals ($\cdot OH$)
 - Among nature's most reactive oxidisers
- Superoxide ($O_2\cdot^-$)
 - Destabilizes microbial cell structures
- Singlet Oxygen (1O_2)
 - Reacts rapidly with organic pollutants

These ROS exist in trace concentrations (30–40 ppb) and are short-lived, making them safe for humans and animals while being highly effective against a wide range of biological and chemical contaminants. They break down pathogens, neutralise gases like ethylene, carbon dioxide, ammonia, and oxidize harmful VOCs.

But how does it work?

1. First, ambient air and moisture are captured and exposed to high-frequency controlled electrical pulses (MDBD) within the system's chamber and broken down at the molecular level.
2. This creates a burst of highly reactive molecules with powerful biocidal properties.
3. These reactive particles are then dispersed through the air via the HVAC/air handling system or standalone unit acting as airborne neutralising agents.
4. This treatment destroys microbial DNA/RNA to render them inactive.

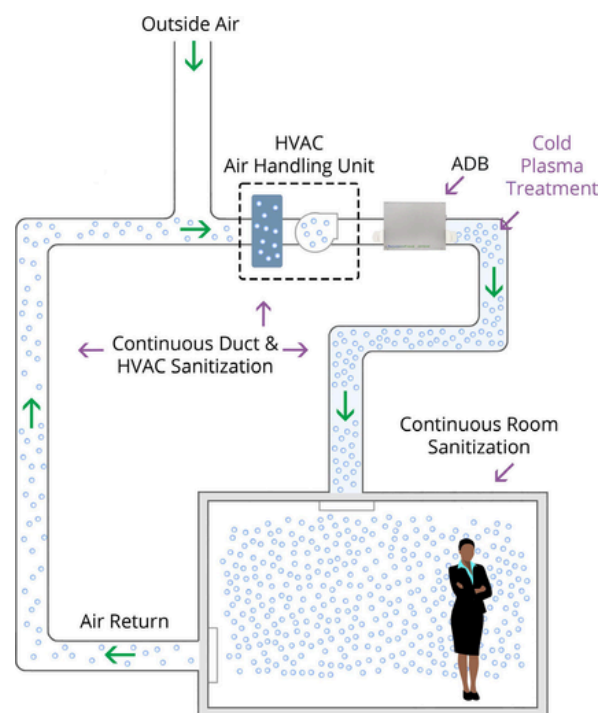
Our Natural Immune System

It mimics our own body's immune system, when a microbe is recognised by phagocytes and engulfed, a natural immune response process called respiratory burst is initiated. Our own body's immune response centres around this very reaction of superoxide and water to create H_2O_2 , which will destroy microbial DNA/RNA. Once the reaction is complete, we are left with water vapor and non-reactive oxygen.

Benefits

MDBD is an activate system that can attack contamination threats 24/7 without the use of chemicals, but is safe for your product, your staff and the planet.

- Highly Effective Microbial Control
 - Up to 7 log reduction in 30 seconds
- Additional destroys harmful gases
 - Volatile Organic Chemicals
 - Formaldehyde
 - Toluene
 - Ethanol
 - Hydrogen sulphide
 - Benzene
 - Ammonia
- Effective Odour Control
- Safe and Effective
 - Safely Use during production
 - Reduces disease - less sick days
- Fully Automated And Ubiquitous
- Low Maintenance
- No Disruption To Daily Operations
- Total Disinfections Without Adding Staff Hours
 - From the floor to the ceiling
 - Difficult to reach spaces
- No Chemicals or Residues - only water
- No Consumables Required
- Custom-Tailored, Scalable Solutions
- Low Energy Consumption
 - (0.1 - .3 Watts/Cubic Metre)
- IoT Control Monitoring Available



Frequently Asked Questions

What MBBD Technology isn't.

MBDB technology is new to Australia and it is unlikely you have experienced it yet. However, there are many technologies that have promised what MBBD can deliver but fallen short of delivering. MBBD is total different to the following technologies

- Ozone Gas
- UV-C Irradiation
- Bipolar Ionisation
- Photocatalytic Oxidation

In a study by the Mayo Clinic College, most of these technologies failed to achieve even a 1 log reduction in bacteria and viruses in the same time MBBD delivered a 7 log reduction. Ozone wasn't one of the technologies used in this study but some countries have strict regulations on ozone gas emissions to protect public health, especially for vulnerable groups.

How Safe Is ROS?

Safe Work Australia has regulated that workplace exposure limit for hydrogen peroxide is 1 ppm (1.4 mg/m³) as an 8-hour Time Weighted Average. Our technology achieves a 7 log reductions with only 30-40 ppb.

The MBBD systems not only sanitises pathogens in the air but continues to kill microbial hazards on surfaces. This reduces the cross infection of diseases between staff both from airborne transmission as well as from cross contaminated surfaces. ROS sanitises all the surface it touches, from the floor to the ceiling, making it a safe workplace. This technology is not only for the production floor but can be installed in air conditioning systems for office staff protection.

ROS can also reduce microbial contamination on product surfaces, extending the shelf life or restricting pathogen growth in storages areas, including cool rooms.

Why haven't I heard about ROS?

Reactive Oxygen Species Sanitation is not new, but most often it has been associated with ozone production, which is problematic. Some governments have now regulated restriction not only on its use but on technology that produce ozone as a byproduct.

Our MBBD technology represents a new generation of technology and is the first to produce ROS on an industrial level at an affordable price.

What is Eco-Shield?

Eco-Shield creating a fortress of safety around your plant, your products and your staff that is both economical but is eco-friendly for the planet. Air Sanitation is only one part of our solution, which is built on four pillars;

- Monitoring Tools - this is what our company was built on, providing innovative HACCP monitoring tools for food safety
- Real Time Biofilm Detection - our Bactiscan range utilising revolutionary UV detection
- Air Sanitation - As detailed in this white paper.
- Water Sanitation - Converts water and salt into hypochlorous acid that is 100 times more effective than bleach and delivers a 7 log reduction in 30 seconds.



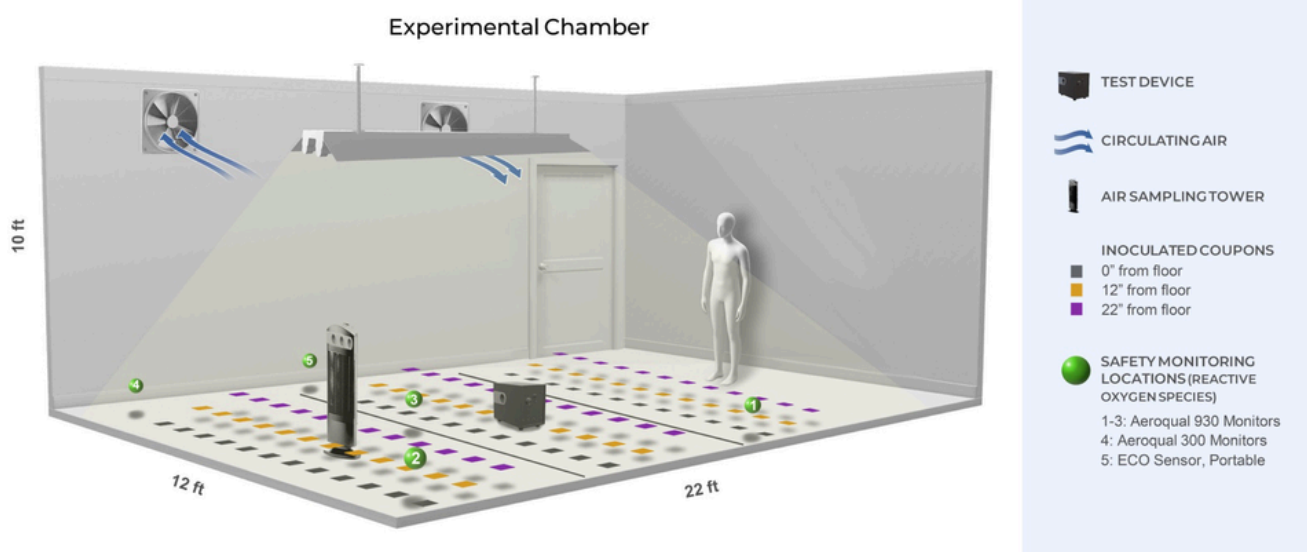
How is ROS Eco-Friendly?

- Created from just moisture in the air, no chemicals
- Breaks back down into oxygen and water, no accumulated environmental residues
- Safe for staff to breath during product and actually protects them from disease transmission
- No persistent or toxic chemical residues remain
- Not only sanitises air but continues to reduce microbial loads on surfaces, and has the potential to reduce the use or frequency of surface sanitisers
- Lower Energy Footprint
 - No transport costs - created on demand
 - Low power usage - max 54W

Validation

The efficacy of ADB technology is validated by international studies conducted by Food Safety & Process Technology, Scientific Air Solutions, Kansas State University Food Science Institute, USDA Agricultural Research Service and Food Safety Laboratory in the USA; Cesmec (Chile), Ch. University (Chile), PUC (Chile), Ainia (Spain), Tecnalia (Spain), SGS (Intl.), Intertek (Intl.), and the Certification of the European Community (EU).

The MDBD process is approved by USDA National Organic Program as a chemical free sanitizer/disinfectant. Additionally, the technology has been approved and registered for use in organic products with the EU Organic Program. A peer-reviewed study by USDA Food Safety Laboratory concludes, "reduction of airborne microorganisms using the nonthermal plasma generating system" appeared "more efficient than those reported with other approaches, such as electrostatic precipitation and germicidal (UV) air purification console units."



Evaluation

A 2021 study by Emeritus Professor Mark Ereth - Mayo Clinic and Scientific Air Solutions used a dedicated 12x22x10 cubic ft control room to compare the performance of five air sanitation systems using a range of technologies.

This study examined both bacteria and virus contamination both airborne and on a range of surfaces including stainless steel, plastic, linoleum and fabric. Bacterial study used enterococcus faecium, an acceptable nonpathogenic surrogate for Clostridium sordellii, Influenza A, MRSA, Staphylococcus aureus, Klebsiella pneumonia, and Pseudomonas aeruginosa. Viral study used The F-9 strain of Feline Calicivirus, an approved surrogate for SARS-CoV-2).

For the air study these organisms were suspending in a sterile buffer and atomised into 26 micron droplets. For the surface testing 2x2cm coupons were inoculated with the virus and bacterial cultures for each of the four surface materials; stainless steel, plastic, linoleum and fabric.

Controls were also used to measure any die off from the organisms due to environmental factors such as air exposure and dehydration. These control were treated in the same manner except they were not exposures to any of the air treatment systems.

Bacteria and virus samples were collected at 0, 5, 10, 15, 30, 40, 50, 60, 90, 120, and 150 minutes. Sampling was done 8-10 ft from the test devices.



Results

		AIR		SURFACE	
		Bacteria(2 minutes) Log Reduction / %	Virus(1 minute) Log Reduction / %	Bacteria (30 minutes) Log Reduction / %	Virus (15 minutes) Log Reduction / %
MDBD		7.82 / 99.99998	7.74 / 99.99998	MDBD 7.89 / 99.99998%	MDBD 7.70 / 99.99998%
BPI-1		0.19 / 34.35115	0.02 / 4.90909	bipolar ionization 0.54 / 71.15385%	bipolar ionization 0.42 / 62.00000%
BP1-2		0.32 / 52.21374	0.12 / 23.94000	bipolar ionization 0.40 / 60.25641%	bipolar ionization 0.15 / 30.00000%
PCO		0.06 / 13.23206	0.05 / 11.54555	photocatalytic oxidation 0.44 / 23.07692%	photocatalytic oxidation 0.24 / 58.00000%
UV-C		0.06 / 12.21374	0.03 / 6.96909	UV Germicidal air chamber 0.04 / 8.33333%	UV Germicidal air chamber 0.15 / 29.00000%

Conclusion

MDBD was reported to be faster and more effective against air and surface bacteria and virus, outperforming Bipolar ionization (BPI), Photocatalytic oxidation (PCO), and a UV-C germicidal air box (UV-C). MDBD technology was effective in delivering;

- Air borne Virus 7.82 log reduction in 1 minute
- Surface Virus 7.70 log reduction in 15 minutes
- Airborne Bacteria 7.82 log reduction in 2 minutes
- Surface Bacteria 7.74 log reduction in 2 minutes

All other technologies only produced a microbial reduction of less than 0.5 Log and in some cases as low as 0.04 log reduction. The alternative technologies did achieve a 7 log reduction over time but it only achieved this with 15 to 90 times longer exposure than with MDBD technology. The 7-log reduction achieved by the control group within 150–240 minutes implies that part of the microbial load decrease in less effective air units was influenced, in part, by environmental factors rather than purely the technology itself.

“After an extensive review of over 40 research studies, it appears that PathogenFocus ADB system's near-instantaneous inactivation of pathogens in breathing-zone air, and the corresponding significant reduction in bioburden, make this technology an innovative and important part of infection prevention.”

**Mark H. Ereth, MD, Emeritus Professor,
Mayo Clinic College of Medicine and Science**

