

An Overview of Needlepoint Bipolar Ionization

WHITE PAPER

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WHAT IS AN ION?

An ion is a charged atom or molecule. It is charged because the number of electrons does not equal the number of protons in the atom or molecule. An atom can acquire a positive charge or a negative charge depending on whether the number of electrons in the atom is greater or less than the number of protons in the atom.

The atom is called an ion when an atom is attracted to another atom because it has an unequal number of electrons and protons. If the atom has more electrons than protons, it is a negative ion, or ANION. If the atom has more protons than electrons, it is a positive ion, or CATION.

HISTORY OF AIR IONIZATION

Corona discharge ionization systems have been operating since the late 1800s. They were originally developed by Sir William Crooks. They were marketed as the "Crooks Tube," and sometimes called a cathode ray tube. Around 1928 William Langmuir changed the name to "plasma tube." Corona discharge ionization products have been in the market for a long time. They are also marketed as bipolar ionization systems, ionization systems, corona discharge tubes (CDT) or dielectric barrier discharge (DBD) systems. No matter what they are called, they are constructed in the same general manner. Many companies use CDT/DBD to generate ozone for various odor control applications, but generally the ozone produced is not discharged into an occupied space. In short, if you use corona CDT/DBD based ionization technology, there will be ozone as a byproduct, contrary to what some marketing materials from various manufacturers suggest. Some manufacturers try to disguise the ozone output by calling it activated oxygen, triatomic oxygen or activated plasma, to name a few. These name variations have caused confusion in the market.

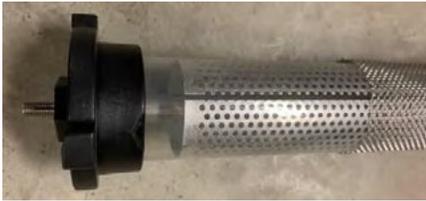


Figure 1 shows an example of a bipolar ionization CDT. There is an inner filament, a glass tube, and an outer filament. The glass is the "dielectric," or resistance to the voltage path to ground. The dielectric can be glass, quartz, mica, ceramic, or any other material that has a high dielectric (insulating) value. For a corona discharge system to operate, the voltage and current must be high enough to break down the dielectric material in order to complete the electrical path to ground. When the

power output is sufficiently high and the path to ground is achieved due to the dielectric breakdown, a corona discharge is formed. The corona discharge is best seen in total darkness. It appears as a purple glow down the entire tube. Where you see the purple glow, ozone is being produced.



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UNDERSTANDING EV POTENTIAL

The power required to make most dielectrics break down is greater than 12.07eV (electron volts). Every gas has an electron volt potential. Figure 2 shows a sample of eV potential for several compounds. Oxygen has an electron volt potential of 12.07eV, as shown in Figure 2. When the power input is greater than 12.07eV, ozone is created due to oxygen being ionized, or "activated." Every gas in the atmosphere has an electron volt potential. Understanding the relationship of power to eV is critical when designing air purification systems to produce the desired effect, while avoiding the formation of ozone and other by-products. Needlepoint bipolar ionization (NPBI) is uniquely different from corona discharge ionization systems. NPBI does not use a dielectric. The power output is controlled to less than 12.07eV to prevent the formation of ozone. GPS' NPBI technology has been certified by UL 867 and UL 2998 as an ozone free technology. Therefore, ozone, aldehydes and ultra-fine particles are not created. In fact, GPS' NPBI is used by multiple cleanroom manufacturers to reduce ultra-fine particles. NPBI has been successfully used in hospitals, offices, airports, schools, arenas, airplanes, veterinary offices and vivariums, to name a few applications.

CHEMICAL	FORMULA	Electron Volt
Xylene*	C ₈ H ₁₀	7.89
Styrene*	C ₈ H ₈	8.46
Methyl Ethyl Keton*	C ₂ H ₈ O	9.52
Ammonia*	NH ₃	10.07
Acetaldehyde*	CH ₃ CHO	10.23
Ethyl Alcohol*	C ₂ H ₅ OH	10.48
Formaldehyde*	CH ₂ O	10.88
Oxygen	O ₂	12.07
Glass tubes require > 12.07 to break down the dielectric		

Figure 2

- * Typical contaminants of concern as contained within ASHRAE 62.1
- Electron Volt Energy greater than 12Ev, creates ozone (O₃)

NEEDLEPOINT BIPOLAR DISCHARGE

NPBI electrodes, or "needles," are made from carbon fiber (see Figure 3), titanium, silver, gold, stainless, or any other corrosion resistant, conductive material. As you can see from Figure 3, the electrodes are attached to the flexible circuit and there is no dielectric.

NPBI has been used for particle reduction, odor control, pathogen control, energy savings and static electricity control for more than 10 years. The production of unwanted by-products, including ozone, associated with corona discharge air cleaners are avoided when using NPBI. GPS' patented needlepoint bipolar ionization technology should NOT be associated with the older, ozone producing, corona discharge ionization systems. If it doesn't state needlepoint bipolar ionization, be careful!



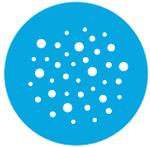
Figure 3



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Benefits of GPS' Needlepoint Bipolar Ionization

GPS DELIVERS...



TARGETS PARTICLES

When ions disperse throughout a room, they combine with particles suspended in the air. This creates a snowball effect, in which particles of opposite polarity cluster together. The larger a particle becomes, the easier it is to capture in filtration systems.



REDUCES PATHOGENS

During the NPBI™ process, contact with ions disrupts pathogens' surface proteins, rendering them inactive and unable to replicate.



ELIMINATES ODORS

GPS' NPBI™ technology breaks down chemical, pet, cooking and other odors into basic harmless compounds, leaving indoor air fresh smelling and free of odor causing VOCs.



SAVE ENERGY

By keeping indoor air cleaner, NPBI reduces the amount of air required from outside to keep things fresh saving you initial ventilation equipment costs and up to 30% on energy consumption.

INDEPENDENT LABORATORY TESTING RESULTS SUMMARY

Pathogen	SARS-CoV-2	Norovirus*	Human Coronavirus 229E	Legionella	Clostridium Difficile	Tuberculosis	MRSA	Staphylococcus	E. Coli
Time In Chamber	30 min	30 min	60 min	30 min	30 min	60 min	30 min	30 min	15 min
Rate Of Reduction	99.4%	93.5%	90.0%	99.7%	86.8%	69.0%	96.2%	96.2%	99.6%
Testing Lab	INNOVATIVE BIGANALYSIS	ATS LABS	ALG LAB GROUP	EMSL	EMSL	EMSL	EMSL	EMSL	EMSL

Needlepoint Bipolar Ionization (NPBI) is NOT corona discharge.



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