The ABCs of NPBI

Needlepoint Bipolar Ionization

What it is - how it works - and much more…

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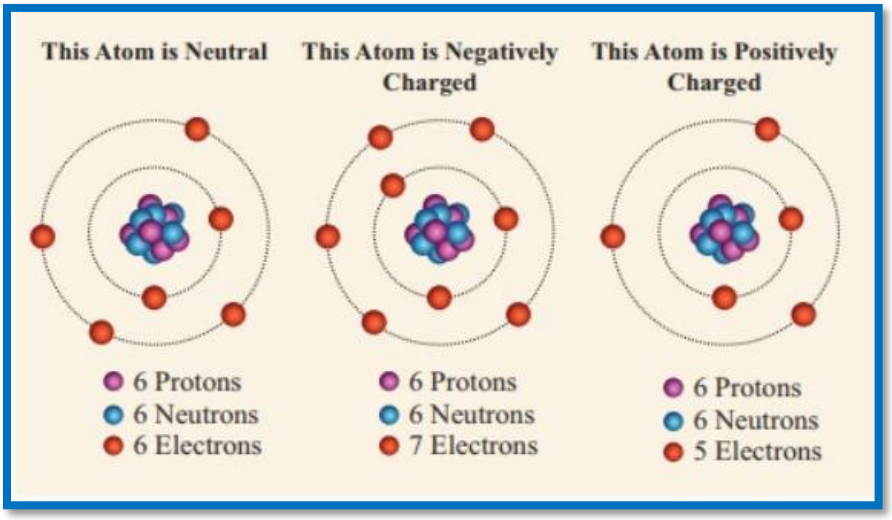
What is an Ion?

An ion is a charged atom or molecule. It is charged because its number of electrons do not equal the number of its protons. An atom can acquire a positive charge or a negative charge depending on whether the number of electrons is greater or less than the number of protons. When an atom is attracted to another atom because it has an unequal number of electrons and protons, that atom is called an ion (ION). If the atom has more electrons than protons, it is a negative ion (ANION). If it has more protons than electrons, it is a positive ion (CATION). Because these atoms and molecules have energy potential they have the innate ability to help rid the air of various pollutants and other harmful compounds they interact with.



Where do ions come from?

Ions occur naturally and are prevalent in the air we breathe. They are simply electrically charged atmospheric molecules or atoms that have lost or gained electrons to impart a net positive or negative charge. Atmospheric air ions are generated from natural sources, such as changes in atmospheric and weather conditions including lightning, sunlight, rain, wind, waterfalls, and snow, as well as from plants, natural radioactivity in geological formations, cosmic radiation, and combustion processes. The production of positive and negative air ions is a natural and reoccurring part of our eco-environment, having the effect of helping clean the atmosphere by removing particulates, chemicals, and various other pollutants. Ions can also be artificially generated by manmade air purification technologies, engineered to help keep indoor clean in the same way nature does outdoors.

How many ions are in the air we breathe?

Scientists and meteorologists have measured variations of the electrical charge in the air for more than 100 years (see the photo below of a hand held ion counter owned by the author). Naturally occurring levels of outdoor ions are greatest where the air is the cleanest, for example at the beach (near the ocean) or on a mountain top. Ions counts at these locations may measure as anywhere from 2000-4000 (or more) ions per cubic meter (ions/cm3). As we move our way into more polluted environments, such as an inner city, natural ions levels become depleted and may measure as low as 500 ions/cm3 (or less). Inside

buildings these level may be diminished even further as any remaining ions struggle to help purify these contaminated environments. The acceptable minimum concentration of ions for indoor air is approximately 200-300 ions/cm3, but an optimal level is closer to 1000-1500 ions/cm3. The sad reality is that the concentration of ions in the outdoor air is sometimes far below this acceptable minimal value, especially in urban environments. The situation is worsened by the fact that polluted air has the effect of reducing the amount of naturally available ionization. This results in buildings experiencing subpar levels of indoor air quality which expose occupants to health and safety issues as a consequence. The concept of artificially ionizing the air is simply to replenish the concentration of indoor ions to a level more consistent with that of the outdoors, where the air is the cleanest. The NPBI ions that are produced can be both measured and verified so we can be assured the technology is working effectively.

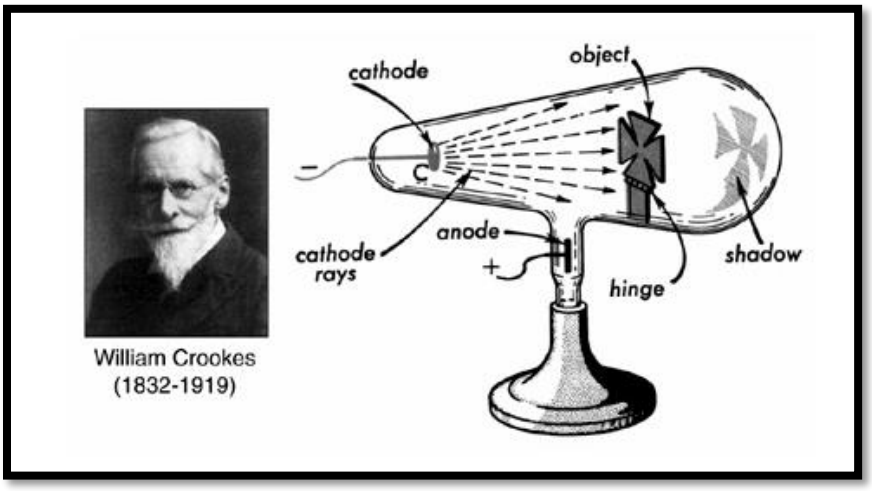
Are ions harmful to humans?

Ions occur naturally and in abundance in the clean air around us. A variety of positive physiological or health effects in relation to exposure to charged air ions have been tested and documented. In general, researchers have found beneficial or therapeutic effects on lung function, metabolic measures, and asthmatic

symptoms after exposure. Characteristics of the indoor environment that result in poor air quality can be improved, leading to a profound impact on the health and wellbeing of building occupants. There have been hundreds of research projects performed and papers written on this topic (see the references at the end of this article for just a few).

How long has ionization been around?

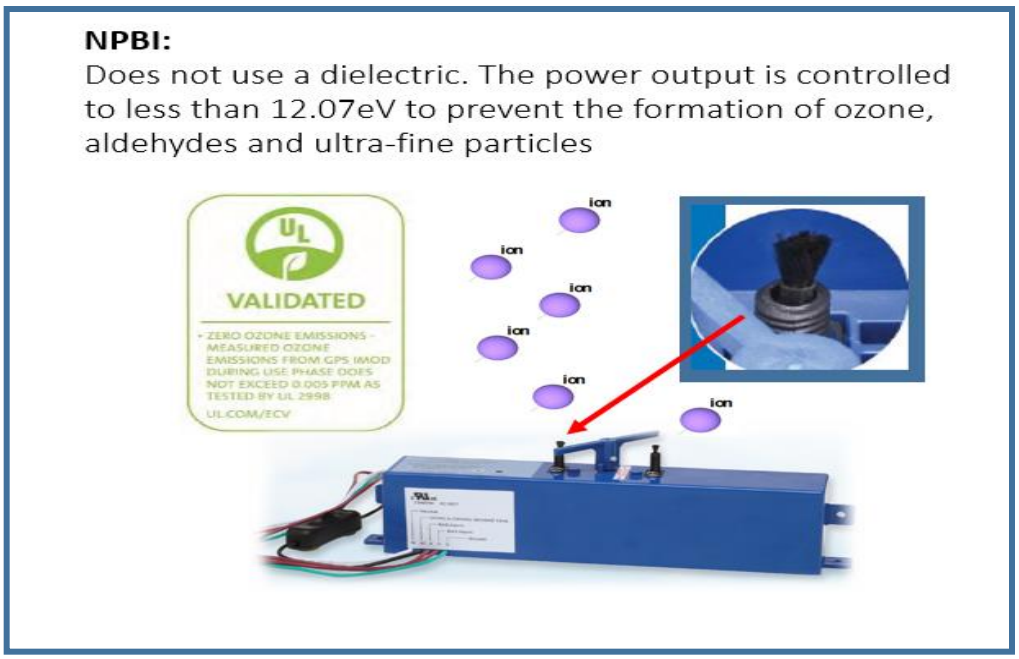
Ionization (Plasma) was first identified by Sir William Crooks in his invention the Crooks Tube, which he described by calling it "radiant matter". Crookes discovered that these rays move in a straight line, cause glass to glow, carry negative charges, and are capable of causing a pinwheel in their path to spin, indicating they have mass.



This technology has evolved considerably in the last 150-years to that which today is used both therapeutically (in healthcare) and physically within indoor built environments in order to improve the health and wellbeing of our modern society. Over the past 15-years, Global Plasma Solutions (GPS) has engineered their NPBI technology to produce high levels of indoor bipolar air ionization without producing harmful byproducts such as ozone as a result of its operation. The production of unacceptable levels of ozone has been a major hurdle for the acceptance of artificial air ionization, up until the development of NPBI technology that is.

What is Needlepoint Bipolar Ionization (NPBI)?

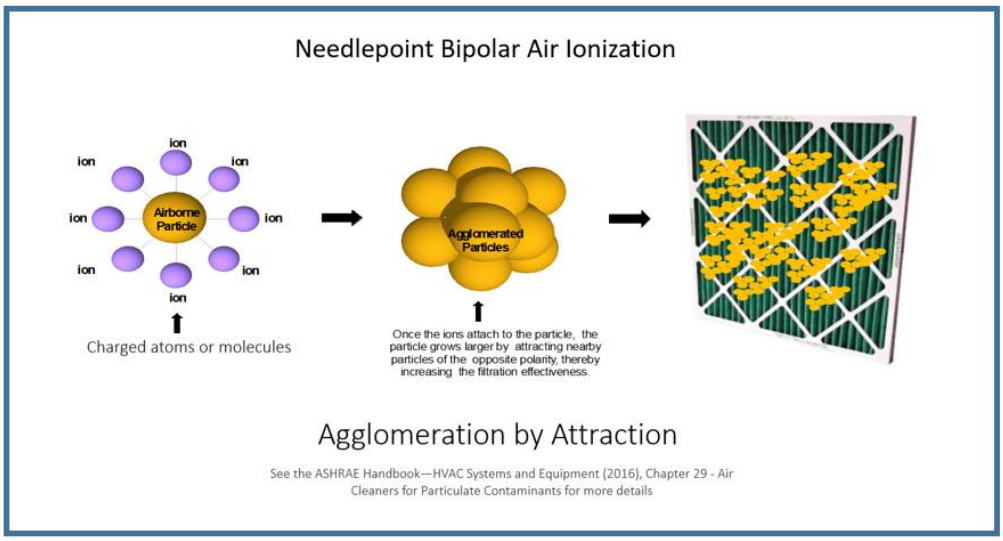
Bipolar Air Ionization (BPI) simply describes a process in which both positively and negatively charged ions are produced. Global Plasma Solution (GPS) of Charlotte, NC (USA) manufactures a patented NPBI technology that uses an electronic charge to create a plasma or electromagnetic field which produces a high concentration of both positively and negatively charged ions. If a charged conductor or electrode is in the form of a needle with a sharp point, the electric field around the tip will be significantly higher than at other parts, and air near the electrode will become ionized. Because NPBI technology disperses ions directly into the air (using no dielectric barrier as many other manufactures do), it allows for the creation of more abundant ions while producing no harmful byproducts, such as ozone. The NPBI needlepoints are manufactured from a carbon fiber material which will not wear out or deteriorate over time, and requires no maintenance.



With nearly 250,000 installations worldwide and almost 15-years of manufacturing experience, the GPS NPBI technology is a proven platform for creating better indoor environments. The product with its advanced technology is easily adaptable in both new construction and retrofit applications.

What do Needlepoint ions do?

As the produced ions travel through the airstream of the HVAC system and into occupied spaces, they attach to and attack particles, pathogens, and gasses in the environment. They help to purify the space air and disinfect hard surfaces everywhere the ions travel. They will do so continuously as long as the system fan and NPBI device are in operation and air is being circulated. Here are a few of the things NPBI ions can accomplish:



The U.S. Environmental Protection Agency (EPA) has identified indoor air quality as one of the most urgent environmental risks to public health. The air we breathe may contain a variety of contaminants such as viruses, bacteria, pollen, dust, smoke, and volatile organic compounds (VOCs). Note that all of these are a particle or gas.

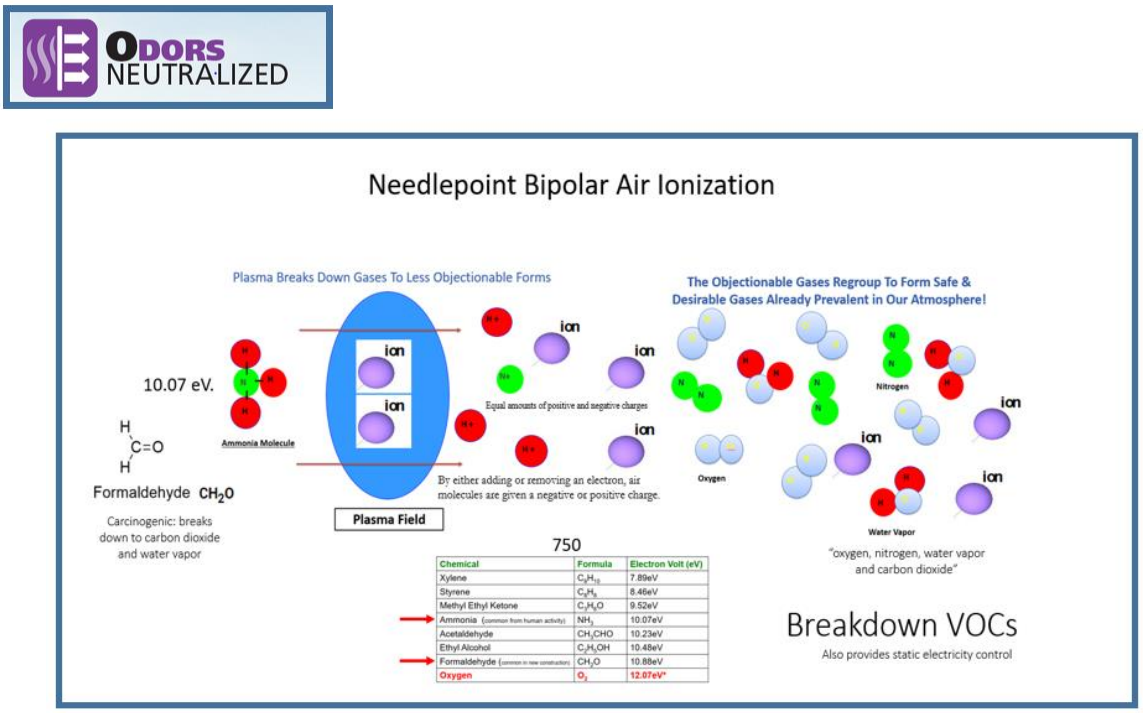
An extensive body of scientific evidence demonstrates that short-and long-term exposure to particle and gas pollution negatively affects our health and wellbeing. The world's leading health-related organizations consider fine particulate matter (the really small stuff) the most dangerous for humans because they penetrate

deep into the lungs and bloodstream where they pose a grave threat to human health. Much of the fine particulate existing within the indoor air is too small in size or light in weight to be removed from the occupied space by the influence of air-motion alone; it therefore can remain suspended in the air indefinitely. It may include viral material and other pathogens as part of these airborne particles which then act as a transport mechanism for respiratory infection between individuals breathing this air. Traditional HVAC ventilation and filtration strategies may have little impact on cleaning the indoor environment as these small particles of concern cannot be moved out of the space and into the HVAC system to be exhausted, filtered, or treated. Technologies which help remediate this problem, similar to those used in cleanroom applications, should therefore be considered.

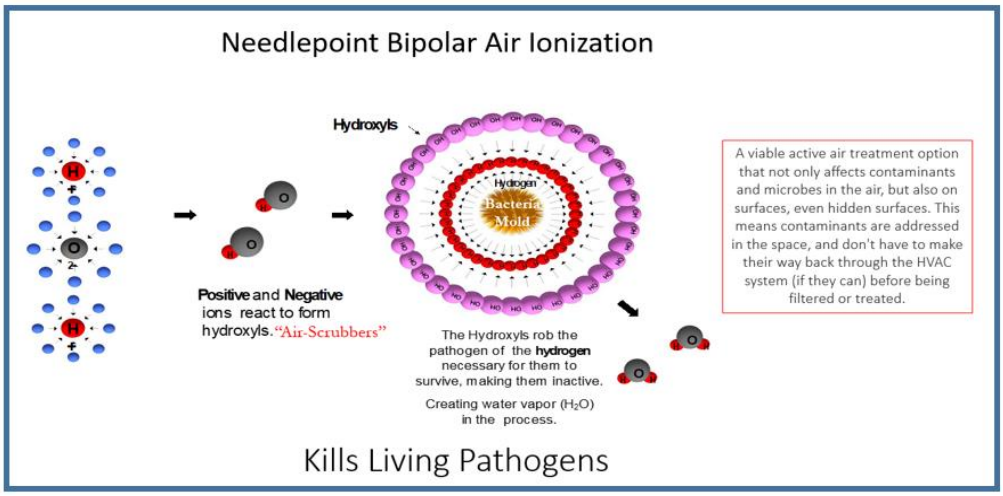
If the particles and gasses in the space are removed they are no longer of concern. NPBI is capable of helping improve traditional ventilation and filtration by influencing the removal of small airborne particulate from the environment based on the principle of electrostatic attraction (agglomeration). Ions, like those already prevalent in cleaner outdoor air, are artificially generated within the HVAC system so that when released and distributed throughout the building, they mix with room air and attach (electrostatically) to airborne particles. As these charged particles are increasingly attracted and joined to one another, their size and weight is increased to the point where they are now large and heavy enough to be moved with the HVAC system's air movement. They can now be effectively removed from the space and exhausted, filtered, or treated. Air filters now become more efficient at removing these larger particles from the air, while internally mounted HVAC air purification

devices can actually come in contact with the pollutants they have been tasked with cleaning, those which before had remained in the space.

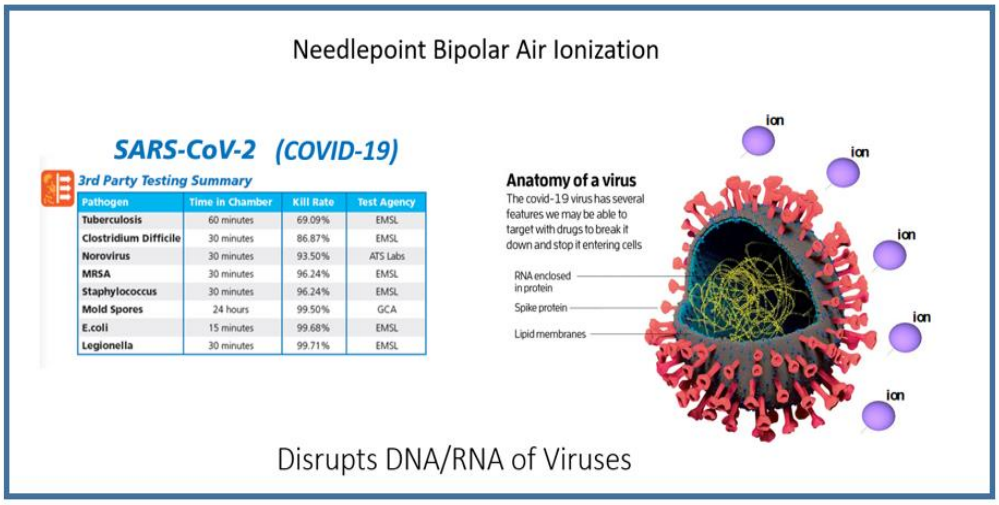
NPBI has been successfully used in cleanroom applications to help reduce airborne particle counts and create the cleanest indoor environments possible for critical pharmaceutical, food processing, and manufacturing processes. A large number of studies have demonstrated that air ionization is efficient at removing aerosols and particles from the environment, proving significant reductions in particulate concentrations. The HVAC system fan and NPBI device should be left on continuously to recirculate space air in order to produce the best results.



Needlepoint Bipolar Ionization can breakdown harmful Volatile Organic Compounds (VOCs) in the air into harmless composites like oxygen, carbon dioxide, nitrogen, and water vapor which are already prevalent in our atmosphere. By the energy potential imparted to these ions through the NPBI process, they are capable of breaking apart VOCs of concern with an electron volt potential (eV) of 12 or less. Because oxygen (O2) has an eV of 12.07, NPBI ions do not interact with or oxidize O2. It's important to note that ionization above an eV of 12 will create ozone (O3) as a byproduct, which is considered a toxic gas.



Based on the energy imparted to the ions through the NPBI process, they can kill living pathogens such as bacteria or fungi by clustering around its surface and creating a reaction that extracts the hydrogen molecules from its cell wall. This renders pathogens of concern incapable of reproducing or causing further harm. If the NPBI device is installed in an air-handling unit (AHU) upstream of its cooling coil, it is a proven solution for helping keep wet or high-humidity surfaces like cooling coils, fans, filters, and ductwork free of biofilm and microbial growth, which is both an occupant health hazard and a detriment to system energy-efficiency.



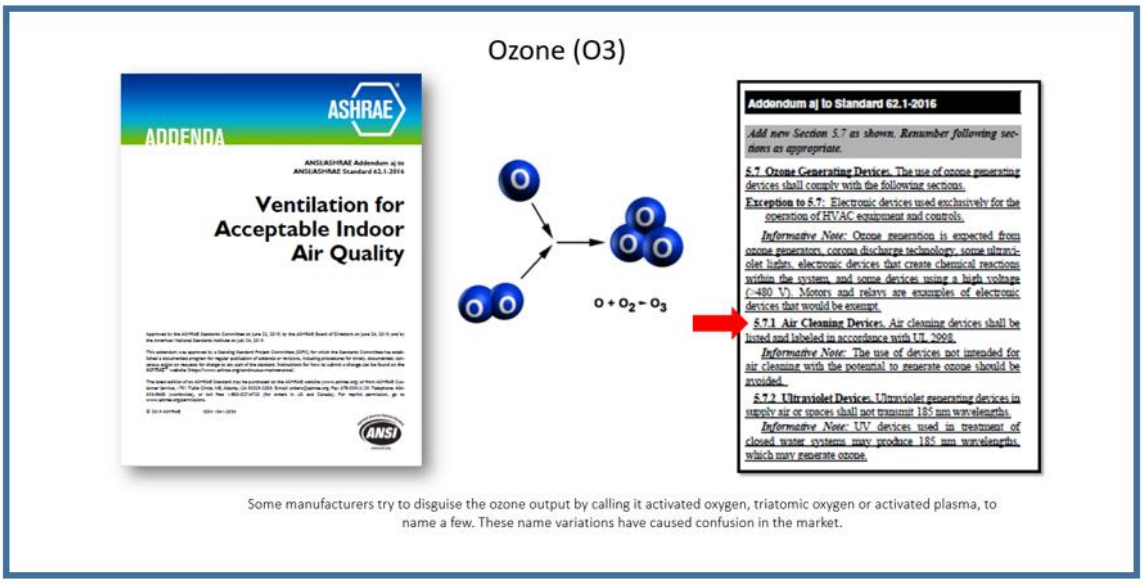
Based on the energy imparted to the ions through the NPBI process, they can help inactivate viruses and diseases such as SARS-CoV-2/COVID-19 along with many others. Ions cluster around the virus, severing the proteins of its cell membrane and destroying the surface structure, which then results in damage to the virons genetic material. This renders the virus incapable of infectivity when inhaled into the respiratory system of a susceptible human host.

Needlepoint Bipolar Ionization provides tremendous energy-saving opportunities for buildings and structures that must comply with ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality. When using the Indoor Air Quality (IAQ) procedure for calculating outdoor air ventilation requirements, prescribed outdoor air rates (cfm/person) may be reduced by as much as 50-75% when compared to the more traditionally used ventilation rate procedure (VRP). By decreasing outdoor air quantities, substantial energy costs savings can be garnered as well as reductions in heating and cooling capacity which may result in significant HVAC equipment cost-savings. When applied appropriately, internal AHU components will remain free of biofilm and microbial growth, contributing to higher overall energy-efficiency and decreased utility and maintenance costs.

What about ions and ozone?

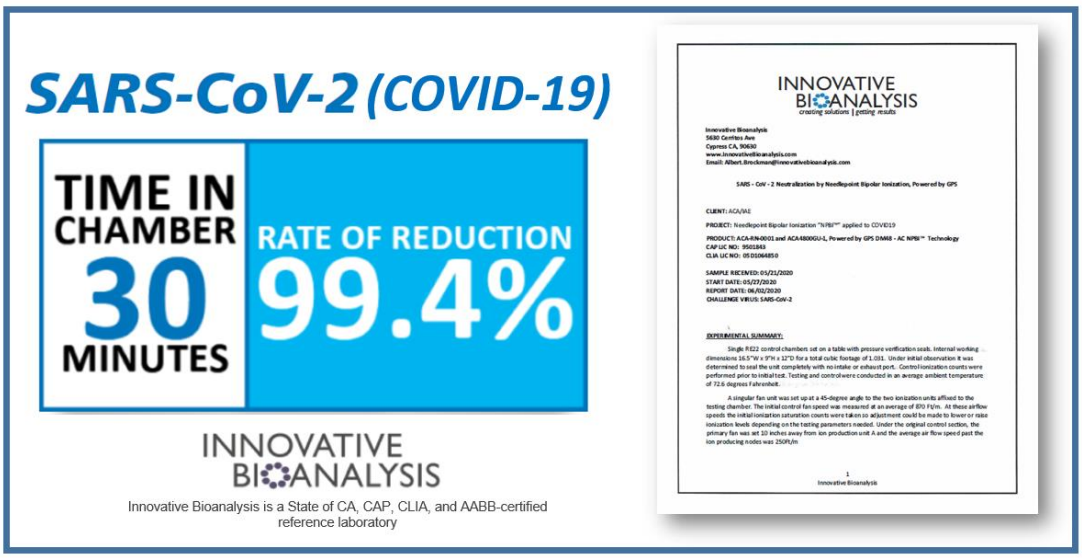
A very important concern with any electrically-powered IAQ devices is that of ozone production. The U.S. Environmental Protection Agency says that when inhaled, ozone can damage the lungs. Relatively low amounts can cause chest pain, coughing, shortness of breath, and throat irritation. Ozone may also worsen chronic respiratory diseases such as asthma and compromise the ability of the body to fight respiratory infections. Manufacturers and vendors may use misleading terms to describe ozone, words such as "energized-oxygen" or "pure-air" suggest that ozone is a healthy kind of oxygen. Ozone is a toxic gas with vastly different chemical and toxicological properties from oxygen. Several federal agencies have established health standards or recommendations to limit human exposure to ozone.

ASHRAE has issued guidance for the allowable limits of ozone production deemed appropriate for HVAC systems serving occupants within the built environment. ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality details these restrictions with stringent requirements stating that air cleaning devices shall be labeled and listed in accordance with UL 2998 for zero ozone production, even as an unintentional byproduct of the unit's operation.



What about testing and verification?

Proof of efficacy with regard to the specific virus or pathogen of concern should be documented by a credible third-party laboratory testing agency, with a written report detailing exactly how the test was performed along with verified results. In advertising documents and brochures this information may appear as displayed below on the left, but always insist on seeing the full independent test data report as shown on the right. Credible manufactures will be happy to provide this documentation upon request.



Is the NPBI product maintenance intensive?

The GPS NPBI product offering is virtually maintenance free. It does not require expensive replacement parts like filters, bulbs, ballasts, substrates, sensors, or transformers. There is no need for personal protective equipment (PPE) or the disposal of hazardous materials. There are no concerns for technician safety or issues with the degradation of non-metallic components (unlike UVC light, PCO, and some BPI systems). This eliminates time consuming and expensive maintenance costs. The only requirement for continuous and trouble free operation is to keep the product clean, and several models include a programmable self-cleaning mechanism that automatically accomplishes this task.

Are satisfied user references available?

A complete listing of user references is available upon request to the manufacturer, but a short list of notable installations is referenced below:

Article References:

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