Ozone: The Ultimate Decontaminate

by Richard Lee

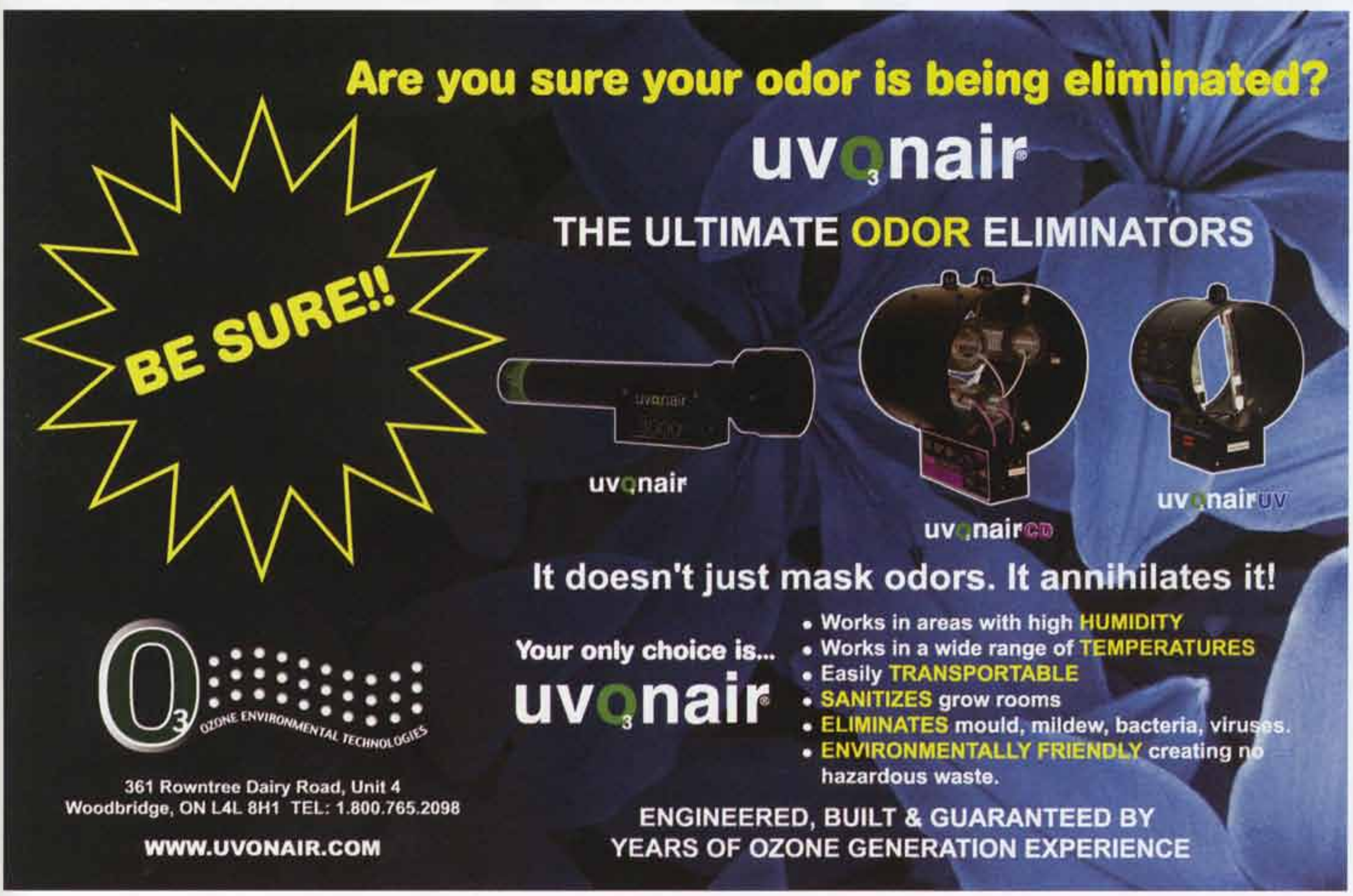
Ozone is all around us. In our natural environment we breathe approximately .02ppm to .05ppm on a daily basis. As part of nature, ozone is created to protect us from the sun's harmful ultraviolet rays and to keep in check harmful pollutants that would otherwise make this earth uninhabitable. On the other hand, in highly populated areas with elevated pollutant levels, ozone is being used up faster than it can be regenerated. With this in mind, the decision to generate and use ozone in a hydroponics setting may be one of the most natural choices a hydroponics gardener could make. What other man-made, non-chemical substance can completely oxidize odor, bacteria, mold, yeast, and mildew, even volatile organic compounds, with no cleanup or disposal required? When used properly, ozone can be the answer to many problems and questions encountered by the hydroponics gardener.

Ozone is a powerful oxidizing agent that destroys grow-room and green house odors. It not only gets rid of odors, it eliminates the source. As it passes through the air, it is able to sanitize and disinfect all areas. Naturally occurring elements such as mildew, yeast, viruses, mold and bacteria, which can interfere with producing a healthier and more robust plant, are completely eliminated via exposure to controlled ozone. Because of its many beneficial applications to hydroponics, Ozone is the most popular hands-off combined air and crop treatment known.

The reason ozone is worthy of such a confident preface is because of its incredible ability to destroy any microorganism it comes into contact with due to its remarkably unstable molecular structure. Normal oxygen molecules are made up of two oxygen atoms (O_2). When normal oxygen is passed through an electrical field or over ultraviolet rays, the O_2 is broken apart or "split". Shell-shocked and confused, the atoms quickly jump back together into a cluster of three instead of two which creates ozone (O_3). This state is sometimes referred to as "activated oxygen". These three unsettled molecules are destined to separate as the urge to regress back into oxygen (O_2) drives the third oxygen-charged molecule (O_1) into the environment to attach itself to a molecule of other origin. During the process of decomposing back into oxygen; the O_1 absorbs and destroys the offending substance it has adhered to in a microscopic explosion (oxidization) leaving the other two molecules to survive as pure oxygen. The end result is the complete elimination of all bacteria it encounters, both airborne and surface.

If by chance the third atom (O_1) does not find its "twin" or an unsuspecting host to absorb, it will actually attack itself in an effort to change its molecular configuration back to normal oxygen (O_2). The life span (half-life) of ozone can alter greatly depending on the complexity of the area being treated, the amount of surfaces and wall space present and the extent of airborne contaminants needed to be destroyed. Any unused generated ozone will decompose back into oxygen within 20 to 30 minutes at normal room temperature and average humidity. It does so at a rate of half the amount equal to itself, thus the half-life reference. For example, there would be half as much ozone present of the residual ozone generated as was present 20 to 30 minutes earlier. With this in mind, even if an ozone destruct unit is not present, ozone will eventually transform back into oxygen on its own. Any "unused" ozone can always be detected by a distinct "electrical" smell in the air. When referring to levels of ozone, it is generally measured in ppm (parts per million).

The altering of oxygen atoms and the resulting oxidization of offending microorganisms makes ozone ten times more efficient than most disinfectants on the market today only with the added benefit of being non-toxic, and having a much higher germicidal effect. It has been described as being "3000 times as germicidal as chlorine". Ozone's natural properties make it an intense, thorough and non-chemical way to destroy odor, mold, mildew, bacteria, algae, yeast, fungus, pollen and hydrocarbons within the hydroponics environment. At ambient temperatures, ozone is the only substance that can be used as a complete sterilizing agent and substitute



zone: Ultimate Decontaminate

for extreme heat. Microbial pathogens, toxic to people, are unaffected after intense heat sterilization because they adhere firmly to effected areas and can only be removed by exposure to high temperatures for prolonged periods of time. Ozone, with its exclusive ability to completely weaken and destroy these pathogens has the obvious advantage over other sterilization processes. An ozone level of .01ppm to .04ppm will completely decontaminate a Bioclean room, which is the optimal sterile environment for the culturing of orchids.

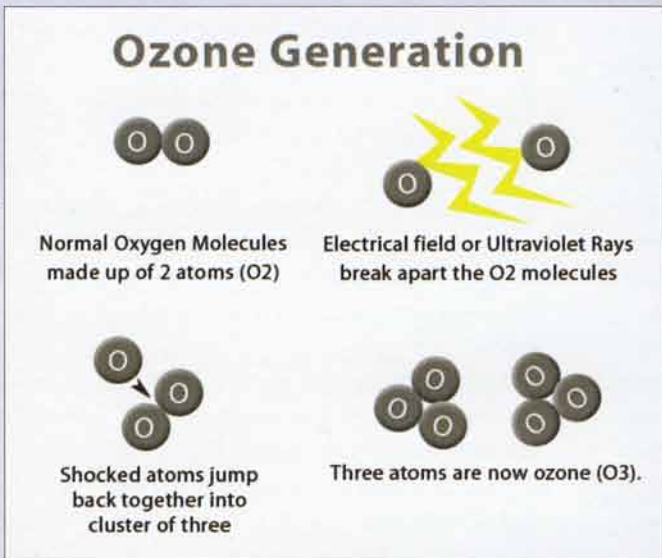
In fact, for years industries have been successfully using ozone for uses such as algae removal in ponds, fire damage restoration, food processing and food preservation, bacteria/pathogen reduction, fish farming, odor control for highly pungent properties, enzyme plant odor control, spa purification and even carbon air filter pretreatment. All these applications in one way or another require ozone's tremendous ability to reduce and remove unwanted ecological by-products. For example: With apple processing, ozone (instead of chlorine) is inserted into washing vats for cleaning and yeast control. Meat packing plants expose forequarters of beef to ozone prior to processing to control bacteria. Fish farming uses ozone because of its relentless ability to rid the inhabited water of viruses responsible for most diseases found in fish culture and for longer storage capabilities. And finally, carbon air filter pretreatment because in a humid atmosphere thick with polluted air, filters can become overloaded by contaminated particles. Ozone has been used as a precursor to air filtration, thereby lightening the ingoing load.

Technological advances in ozone generation have made its use popular in the hydroponics industry for many years. Well designed ozone generators make dosage and exposure easy to control. Ozone can be conveniently produced on-demand or as needed with the use of a 24 hour timer device. Microorganisms can never become resistant to ozone and no residue is ever left on plants or surfaces. Best of all, when ozone has done its job, it simply decays back into oxygen. There is no cleanup or disposal necessary as with other air cleaning systems. With properties and benefits such as these, ozone has become the fastest-acting and most powerful man-made oxidizer known.

The actual discovery and naming of ozone was by Christian Frederic Schonbein back in 1840. During electricity based experiments, he noticed a distinct presence of odor in the air. The "effected" air was aptly named ozein after the Greek word meaning "to smell". Other than the documentation of this turning point, not much more was written about the development of ozone until 1857 when Werner Von Siemans designed an ozone generator. To this day cylindrical dielectric type ozone generators are sometimes referred to as the "Siemans Type". While in 1893, in Oudshoorn, Holland, the very first drinking water plant to use ozone was built. However it is the city of Nice (France) that holds the title "birthplace of ozonation for drinking water treatment," since it has been home to the Bon Voyage (ozone treated) drinking water plant since 1906.

Ozone is all around us as a naturally occurring component of fresh air. It is created when ultraviolet rays from the sun react with the earth's upper atmosphere, which in turn triggers the continuous generation of the "ozone layer". With an ozone content of 10ppm, it serves as a barrier to the ultraviolet radiation that comes from the sun, protecting earth-bound plants and animals from harmful exposure and deterring heat loss.

Ozone is also generated by nature through lightning during a thunderstorm. The electrical charge that comes from lightning changes the molecular structure of the oxygen rich air around it, turning it into ozone. Ozone, with its natural inclination to oxidize immediately, cleanses the air and destroys any pollutants within its grasp. That is why air acquires a "fresh" smell after a lightning storm. Average outdoor unpolluted ozone levels are as high as .03ppm to .05ppm. This explains why air is so much more refreshing and enjoyable near seashore, mountain regions and the forest where there is an abundance of naturally occurring ozone.



On days when weather forces industrial gasses to remain closer to the ground rather than dispersing into the atmosphere, ozone's presence changes in stature. When the sun's rays react with air polluted with hydrocarbons and nitrogen oxide produced by vehicle exhaust and industrial airborne byproducts, a chemical reaction occurs. Ozone is produced and immediately it begins oxidizing the atmosphere. However, because the air is saturated with pollution, it will then become saturated with ozone at possibly four to five times acceptable levels. It is at 1.5ppm that the properties of ozone become offensive, thus the resulting lung and eye irritation that arise during high smog levels.

For hydroponics applications it is important to remember that ozone is first and foremost a powerful, and in higher doses, an aggressive oxidizer. It must always be monitored and checked for optimum usage

Ozone: Ultimate Decontaminate

results. However, the use of ozone to remove odors, bacteria, yeast and other unwanted microorganisms is highly effective and environmentally friendly when done properly.

There are two common methods of generating ozone for hydroponics usage which are corona discharge (CD) and ultraviolet light (UV).

Corona discharge ozone generation involves passing dried oxygen or gas containing oxygen through an electrical field, or "corona". The electrical charge used to "split" the oxygen atoms is between 5,000 and 10,000 volts. It can be operated at a low cost and the ozone produced is highly effective on odors, bacteria and mold. The level of ozone deployed into a grow-room or green house can be regularly monitored and controlled.

The technique of using ultraviolet lamps for ozone generation has been used for decades. Today, you can find UV lamps being used for a variety of uses including tanning beds. Ambient air (20% 0_2) is passed across an ultraviolet light source at a rate between 185 and 210 nanometers (nm). When shown on an electromagnetic scale; ultraviolet light frequency is considerably higher than your average light source and invisible to the human eye. Oxygen passed over the ultraviolet light "splits" and the ozone generation process begins. The ultraviolet systems have a lower cost than corona discharge systems but also a more limited output.

With both of these ozone generating processes, the ozone is injected into an air stream or waterway where it proceeds to disperse and attach itself to pollutants and contaminants, thus destroying them upon decomposition. In combination with ozone generating units, fans with a lower cubic feet per minute (CFMs) can be used and duct models use smaller fans than other filter media.

In making a decision about which system is best for your purposes, consider not only the square footage of the targeted area but its general contents and surface area as well. Calculate how much ozone will be required for the desired outcome and consult with an experienced and knowledgeable manufacturer. Also look for cost efficiency and reliability factors when choosing the system that is right for you. Ozone generating units are light weight and can be easily shipped. Also, any reputable ozone generator manufacturer will provide an ozone detector to ensure safe levels of O_3 are present.

In hydroponics applications, ozone is in a class by itself in comparison to other air filtration, grow-room sanitizing or crop preservation methods. Ethylene filters, used mostly for produce storage, are made to absorb ethylene gas within a confined area and need to be replaced monthly, which can be costly. Ionization machines, which place a negative charge on air particles causing them to gravitate toward floors and surfaces within a room, only move the contaminants around. Carbon filters merely clean the air that passes through them, and unlike ozone, cannot destroy large amounts of iron, manganese, nitrates or chlorides. Carbon filters must be replaced frequently to avoid bacteria build-up. Also, at room temperature with approximately 70% humidity, carbon filters lose the ability to effectively contain odor. In fact, if not used frequently or changed at proper intervals, filters may in turn promote bacterial growth, which could pose an environmental hazard. Filter replacement costs and the disposal of spent units may also be an issue.

In comparison to these other air filtering procedures, ozone is unequaled in its ability to completely destroy the source of unwanted contaminants and odors. Ozone oxidizes natural organic compounds like acetic and oxalic acids, herbicides, detergents and pesticides. Unlike carbon filters ozone can oxidize inorganic elements such as sulfides, iron and manganese and nitrates in water. Ozone is also used to slow the ripening of fruits and vegetables by eliminating ethylene gas and odors that are produced by decay. It also kills spiders and mites as it attacks cell walls and inner components of organisms, breaking down membranes with its oxidizing procedure and destroying them. It can also be used to clean used carbon filters.

It is interesting to note that the high humidity content in a grow-room or green house, makes the ozone oxidizing affect that much more efficient. In areas with over 50% humidity, ozone is at its most effective state as the targeted surfaces and microorganisms become more porous therefore easier to penetrate when they are moist. With ozone, humidity speeds the destruction of the fungi, viruses and bacteria that cause odor. In addition to all of its other benefits to the hydroponics industry, ozone is the ultimate odor and pathogen removal treatment for high humidity environments. Not true for other air filtration processes that seem to waver in performance when operating in areas with higher than average humidity levels.

There are government guidelines that refer to acceptable ozone levels in occupied spaces. In British Columbia, Canada, Workers' Compensation Board guidelines: Continuous exposure of eight hours per day for five days per week. Environment containing .1ppm of ozone is considered a safe level. Normal effective hydroponics applications are between .01ppm and .03ppm which is well within the WBC guidelines. At .01ppm to .05ppm, ozone will leave a "fresh and pleasant feeling" to treated air while still eliminating offending pathogens. It's important to remember that the right level of ozone is when it is all being "used up". Residual or unused concentrations leave a tell-tale "electrical" odor which lets the operator know the current levels are too high, that all the ozone being generated is not being used up and the levels need to be adjusted. When measured properly, ozone is hundreds of times more effective than any odor control material available on the market today. It is the "ultimate decontaminate" when it comes to eradicating the source of odor and bacteria within a growing area and is unmatched as a deodorizer and sanitizer due to its remarkable molecular structure and effectiveness against airborne microorganisms. The hydroponics enthusiast can only benefit from the usage of ozone.

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