

Ozone: Nature's Powerful Deodorizer

by Ronald G. Fink

Despite ozone's "discovery" in 1840, little is known or written about this mystery gas. For years, many have blamed it for its alleged contribution to the smog that contaminates the air of every major city nationwide. Conversely, today many industry experts tout it as a "natural" air sanitizer and deodorizer, proclaiming it is not a cause, but rather a solution, to poor air quality. Indeed, the questions are many.

Is ozone the cause of urban air pollution or does it protect us from the sun? Can it really "sterilize air" and destroy odors "naturally" without leaving a residue? Is ozone safe: What is its effect on humans and the environment? Moreover, if ozone's air purifying capabilities are as great as some maintain, why do so few of us know about and use it?

This article will answer many of the questions and concerns about ozone, review its use as air purifier and deodorizer, and show how, when applied responsibly, it can bring a "breath of fresh air" to your facility.

Scientifically Speaking

Let's start with natural ozone in the atmosphere. The "ozonosphere" is a protective layer of ozone six to 30 miles above the earth's surface that contains approximately 10 ppm (parts per million) of ozone. This layer of ozone protects the earth's surface from harmful ultraviolet (UV) light radiation and prevents heat loss. The layer is created by the sun's UV waves bombarding oxygen (O_2) molecules. This bombardment causes an oxygen molecule to split, allowing the "stray" oxygen atom to attach itself to another oxygen molecule, thus forming ozone, or O_3 . The third atom is loosely held to the new ozone molecule, which gives it a 20-to100-hour half-life. (Every 20 to 100 hours, one-half reverts to O_2 , or oxygen.)

Nature produces ozone in other ways, too. The electrical discharge of lightning creates ozone, which is why the air smells so fresh and clean after a thunderstorm. The ozone has oxidized the pollutants in the air. Many people even hang their laundry out to dry after a thunderstorm to capture the fresh scent.

Ozone is also created naturally through photosynthesis, the solar-powered respiration of plants through which carbon dioxide (CO_2) is converted into oxygen molecules.

Nature's Delicate Balance

PPM = Parts Per Million

1 ppm = 1 inch in 16 miles

1 ppm = 1 minute in 2 years

1 ppm – 1 penny in \$10,000

The sun is continuously converting O_2 to O_3 and vice versa to retain nature's delicate balance. Added to this fragile balance, however, are artificial chlorofluorocarbons (CFCs) such as those found in many soon-to-be-banned refrigerants, which are known as ozone-depleting substances (ODS). These gases attack and destroy ozone. Conversely, however, ozone will destroy ODS, but like a bee that stings and then dies, its mission is suicidal. In order for the O_3 to destroy the ODS, it must give up its third atom, so the ozone "dies" or is converted to oxygen.

This scenario seems like a good arrangement, until you consider it takes 10,000 ozone molecules to destroy one ODS molecule. This potentially dangerous imbalance is the theory behind ozone-layer depletion.

Dangers of Excess

If ozone is so good, and the ozonosphere is so far away from the earth (6 to 30 miles), why do major cities post ozone levels as part of their air pollution reports?

One of the major benefits of ozone is its tremendous ability to oxidize substances: it is thousands of times faster than chlorine and disinfects water three to four times more efficiently. Yet, like most things in nature, there is danger in excess.

Ozone's third atom, the loosely held or "unstable" atom, has a strong tendency to break away and attach itself to other substances. While the original ozone molecule reverts back to O_2 , the loose molecule attaches itself to a new host substance and oxidizes it. It sounds like the perfect scenario for air-pollution cleanup. The problem is ozone wants to oxidize everything; excessive exposure can irritate people's lungs, eyes, and skin, which is why cities post ozone levels. It is also why many scientists believe ozone is good and helps clean up pollution, while others believe the negative health effects of ozone outweigh its benefits.

The Environmental Protection Agency (EPA) limits for ozone levels in urban areas is .12 ppm. The level of ozone in Los Angeles is often three times this limit, and the .12 ppm level is frequently exceeded by many other cities as well.

To understand these high levels, we must return to the sun's UV light waves. Only this time, instead of bombarding oxygen, they are striking nitrogen-oxide molecules and other pollutants from auto exhaust, factory emissions, and other contaminators and converting them to ozone.

Again, in theory, this seems an ideal solution to air pollution. If only we could leave our pollution-plagued planet for a few days and douse the atmosphere with ozone, it would oxidize all the pollutants and we could start over. Yet, which is worse, breathing ozone or nitrogen oxide?

Just as fire oxidizes organic matter and changes one substance to another substance, ozone will destroy a molecule through oxidization. Certainly, there is no doubt concerning its ability to oxidize organic substances, sterilize air, and destroy toxic fumes, bacteria, algae, fungus, mildew, mold, and odor.

Unfortunately, this naturally occurring gas, which is such an excellent oxidizer and is capable of eliminating air and water pollutants, also can oxidize us – ozone cannot differentiate between "good" organic molecules and "bad" ones.

Ozone is listed by the EPA and Occupational Safety and Health Administration (OSHA) as a toxic and hazardous gas, even though no human death has ever been recorded due to ozone over-exposure. OSHA and the British Health and Safety Department document ozone toxicity to humans as irritation to mucous membranes or eyes and respiratory tract, premature aging, pulmonary edema, and aggressive behavior.

Does this mean we should not use ozone because it is potentially dangerous? There are some that would say yes. Yet fire destroys, kills and pollutes – was *it* better left undiscovered?

A History of Use

The use of ozone to purify air is effective when done properly. Decades ago, scientists discovered how to artificially produce ozone through electrical discharge. The method has been rapidly gaining popularity in municipal water plants in the United States.

In the 1970s, an inexpensive and reliable method of making low levels of ozone was discovered utilizing a specific wave of UV light. Ozone generated from UV light is just as effective as ozone produced from electrical discharge or naturally occurring ozone. This production method is preferred based on cost, reliability, and maintenance.

Industries have been using ozone successfully for many years in a wide range of applications, including food processing and preservation, smoke stack emission control, odor control, smoke damage restoration, beverage processing, swimming pool clean up, algae removal in ponds, and spa purification. In recent years, ozone's benefits also have been realized in the wastewater cleanup business.

Using Ozone Safely

Like all oxidizers, from fire to chlorine, the safe use of ozone requires taking appropriate safety precautions. An effective and responsible air purification or deodorizing program using ozone requires: evacuation of the area, ozonation to levels suitable for oxidation, and adequate ventilation before re-occupancy of the area. In short, it should be done professionally by a company or staff trained in correct and safe ozone application procedures.

Maintenance managers considering the use of this effective means of "natural" air improvement must be familiar with these proper procedures.

Just as doctors today practice defensive medicine, a prudent ozone purification service company or trained in-house staff must practice defensive ozone application techniques.

A responsible and safe commercial ozone sterilization or deodorizing service program should consist of the following:

- Operator training
- Breathing masks for operators
- Caution signs
- Ozone-level meters
- Preplanning and dose-level calculations
- Personnel evacuation

When applied using proper safety precaution and common sense procedures, the types of facilities that can benefit from using ozone as an oxidizer and deodorizer to improve indoor air quality (IAQ) are virtually infinite. In fact, as the industry continues to move toward more "natural" cleaning and maintenance methods, ozone could well be *the* air purification method of the 21st century.