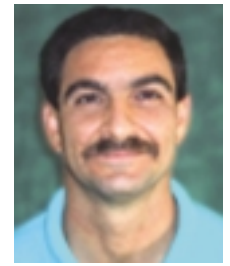


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By Roger Nathanson

The O-Zone

Today's Lesson: Back to Basics

This article will cover the basics of ozone and the ozone unit.

What is Ozone?

Ozone is not some magical gas from the planet "O." Ozone is an extremely active form of oxygen. Lightning is nature's ozone generator. Every time you see lightning you are witnessing the generation of ozone on a massive scale. If you have ever noticed a clean/different smell after a lightning storm, then you have smelled the cleansing effects of ozone.

The chemical sign for ozone is O₃, which contains +2 and -1 oxygen. The triatomic, bipolar characteristics are what make ozone an extremely strong disinfectant, oxidizer and micro-flocculent. Ozone is detectable by most properly functioning olfactory senses (your nose) at 0.05 ppm. Ozone reverts back to oxygen quickly, which means that maintaining a residual can be difficult. This means that the detrimental effects of a long-lasting chemical such as chlorine are eliminated.

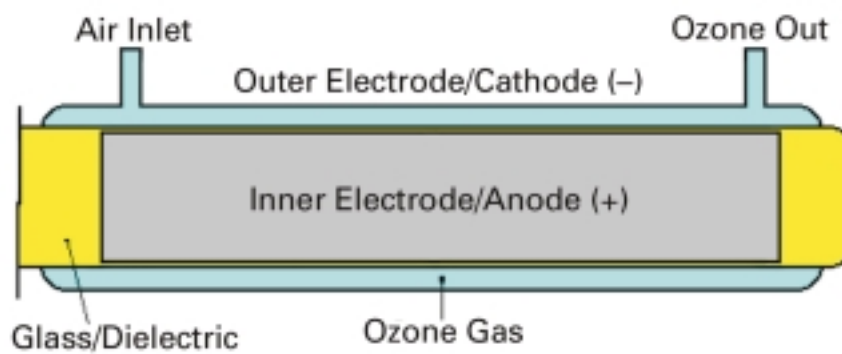
Maintaining ozone residual is necessary only in a limited number of applications, which are uncommon to most domestic water treatment applications.

Ozone is the most powerful natural oxidizer and disinfectant of practical use that we know. It is safe and easy to use and can be applied by using existing water treatment equipment and technology.

Ozone Unit (Ozonator)

Ozone is produced by two practical methods.

- **Corona discharge (CD)**, the spark method, is similar to lightning discharge. The CD method involves three parts.
 - **Anode.** The center electrode where the high voltage positive charge is applied.
 - **Cathode.** The outer conductor (negative charge) that draws the arc/electrical discharge from the Anode.
 - **Dielectric.** The insulator between the anode and cathode.
- **Ultraviolet light (UV).** Ozone is produced by the interaction of air



and UV radiation between the bulb and the inside of the shield. The UV ozone generation method is not to be confused with an in-line water flow UV light.

How Does Ozone Work?

To understand how ozone accomplishes disinfection you must first understand what "oxidation" means. Oxidation means to

- change the form by combining with or adding oxygen and
- increase the valence of an element by the loss of electrons.

Valence is defined as the combining power of an atom as shown by the number of its electrons that are lost, gained or shared in the formation of chemical bonds.

Ozone kills bacteria by oxidizing the organic material in bacterial membranes, which weakens the cell wall and leads to cellular rupture. This exposes the organism to the external environment, which causes almost immediate death of the cell. The process is similar to being cut open by a knife.

Iron/iron bacteria. Soluble divalent ferrous iron is oxidized rapidly to trivalent ferric iron, which hydrolyzes and precipitates as ferric hydroxide. This insoluble form of iron then absorbs some polar organics in the coagulation process and can be easily removed with filtration.

Sulfur/sulfur bacteria. Odorous hydrogen sulfide, which is not filterable, is quickly converted into elemental sulfur, which is easily filtered. A portion of the sulfur is devolatilized and off gassed. The iron or sulfur bacteria are killed (as described above) quite rapidly (if enough ozone is injected) then removed via filtration.

Manganese is oxidized and filtered in the same manner as iron and/or sulfur.

In short, ozone acts as a magnet for iron, sulfur, manganese and similarly charge particles. It brings them together forming a larger particle that is removed easily by filtration.

How Much Ozone is Necessary?

This probably is the most debated question in the industry. What is the correlation between commercial/industrial (C/I) and domestic ozone treatment? There is no correlation.

In other words, the amount of ozone required to oxidize iron, sulfur and manganese in domestic applications is

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