Ozone

By Jeff Swanson, OAWU Circuit Rider

I'm sure that many of you have heard of using ozone in water treatment, but why use it? Many of the comments that circulate in the public water communities evolve around it being too expensive, yet that's what used to be said about membrane filtration technology as well. Now, many public surface water systems are installing micro-filtration treatment systems with encouraging results. New regulations pertaining to Disinfection By-Products (DBPs), are forcing water treatment facilities to consider alternatives to pre-treatment using chlorine because of the DBP threat. Additionally, seasonal changes create taste and odor problems that usually require some kind of pre-treatment. One might consider that when asking for additional revenues to meet budget needs through higher water rates, an outcry of resentment will be the operative if the water stinks or tastes bad. Isn't that one of the reasons for buying bottled water? Now, if you think that ozone is just a surface water issue, think again. Algae and associated taste and odor producing organic contaminants are not to be outdone by their groundwater counterparts such as iron and manganese. Ozone can be used for both pre-treatment in the elimination of DBP production as well as the elimination of aesthetically unpleasing contaminants found in both surface and groundwater supplies.

Is this a new invention? Early scientists of the late 1700s and early 1800s experienced mysterious odors around their various experimental electrical devices. In 1840 a name was given to the odor, ozone, from the Greek word "ozein" – to smell. In 1857 Werner Von Siemans designed an ozone generator that has since evolved in to the present day generators. The first drinking water plant to use ozone was built in Holland in 1893 and the next in France in 1906. The French water plant has been using it since that time. The use of ozone in the U.S. can be traced back to the 1940's, (ARCE Systems, Inc.).

Ozone in it's natural form exists in the upper atmosphere due to a balance between ultraviolet (UV) light from the sun, oxygen, temperature and pressure. The UV rays in the range of (<200nm wavelength) entering the atmosphere 'split' the oxygen (O2) molecules into unstable oxygen (O) atoms. These single "O" atoms combine to form ozone or (O3) until such a time, this new and highly unstable molecule is converted back to it's former stable form as oxygen. Ozone can be created on an industrial scale back here on earth by creating a "corona (silent) discharge" by manipulating electrical current within an ozone generator. Have you ever smelled the ozone smell after an electrical storm or in the office when the copy machine is highly active? In the generation process, a high voltage differential is applied across two electrodes separated by a dielectric barrier and a gas space. The oxygen containing gas is then split into oxygen atoms (O) by the electrical current and attach themselves to the free oxygen (O2) forming ozone (O3). This can be accomplished by using 'dried' air from the atmosphere and capturing the oxygen or by connecting oxygen cylinders and utilizing 'pure' oxygen.

The resulting ozone can now be 'injected' or 'diffused' into various water treatment applications. The term 'sidestream' injection process uses venturi injectors to add the ozone gas into the water. A less expensive but perhaps more cumbersome and maintenance intensive method is the 'bubbler' diffusion process. In this process, the generated ozone gas is diffused through bubbler stones into columns of water.

In the spring and summer, algae blooms can create by-products known as geosmins. These by-products are responsible for many customer complaints for tastes and odors. Some of these odors may be described as – earthy, peaty, pig-pen, musty, grassy, or just disagreeable. Historically, chlorine has been a popular pre-treatment process to help eliminate some of these algae produced tastes and odors. However with the harmful DBPs being created in this process, ozone can be considered as a viable alternative. Ozone with its powerful oxidative strength helps in the reduction of color, taste, and odor. With the addition of contact chambers to allow a sufficient contact time of 10 – 15 minutes, the algae itself may be reduced to an oxidized sludge as well. Additionally as a powerful oxidant, it is deadly to microorganisms in a much shorter period of time than other disinfectants. Not only does it effectively eliminate bacteria, and viruses, it is also very effective with protozoa such as Cryptosporidium. It could also prove useful in

controlling TOCs. Many attempts to eliminate taste and odor problems have been done with powdered activated carbon (PAC). However, some plants have experienced high solids loading when attempting to use enough PAC to get the job done. In some pilot studies, geosmins were reduced with an application of ozone in concentrations of 1.0 – 1.5 mg/L. Although there is some concern with byproducts from ozone itself, the resulting byproducts in the form of bromate depend on the initial raw water concentration of bromide. If the initial bromide concentration is low then ensuing DBPs will not be an issue.

For groundwater systems as well as some surface water systems, ozone is also used to oxidize heavy metals. Iron and manganese can be reduced to very low, safe levels in water supplies through ozone oxidation. This process allows for precipitates to form that can be more easily filtered downstream. Another important aspect to this application is the liberation of organically bound heavy metals. Iron bacteria have plagued many wells around the country for years. Ozone can oxidize both the organic and inorganic substances simultaneously.

Consider ozone for your future needs in both water and wastewater applications. A key reason for using ozone has been to avoid chlorination. When you realize that the main chemical is oxygen, and the relatively safe working environment when using ozone, it may prove to be a new asset to your water system. . Some systems have also noticed a savings in some of their post-treatment chemicals as well. Even though it's been around for a long time, the true benefits may not be acknowledged until you make the move. Feel free to inquire further about the possibilities. The Medford Water Commission has implemented the ozone treatment for their system with extremely positive results. Thank you to Jim Stockton with the Medford Water Commission for his help in providing useful information about the use of ozone by sharing his recent experiences with the application.