Ozone *Optimized*

By Michael Doran

Ozone disinfection options for systems large and small

The primary focus of water treatment, regardless of source, is to optimize treatment equipment options and methods to provide consistent, potable water quality to the end user. The main immediate concern is the elimination of dangerous biological contamination through disinfection. As the industry develops new methods and learns more about historic processes, there is a series of options to utilize with various advantages and disadvantages. As the options grow, so does the knowledge required to properly implement them into treatment trains for specific solutions that deal with variable water qualities, water sources and existing infrastructure.

In general, there are three main methods of ensuring that water is disinfected and safe for consumption:

1. Physical removal through ultrafiltration (UF);
2. Chemical disinfection to kill biological contamination; and
3. Sterilization with ultraviolet (UV) light to prevent biological replication and colonization in the consumer.

There is no one-size-fits-all solution in water treatment, and specific situations and contaminants require treatment trains to provide functional layers of protection and long-lasting, consistent water quality. Disinfection and the removal of other harmful contaminants, such as total dissolved solids (TDS), lead or arsenic, tend to also require significantly different methods of treatment to optimize a water system's operation.

An optimized water treatment train tends to first remove any coarse sediment or material through coarse filtration, such as screens, followed by flocculation of suspended solids. Typically, disinfection and oxidation with post-filtration follow. If additional removal of non-biological contaminants, such as TDS, is required through reverse osmosis (RO) or other membrane filtration, it typically is enhanced by the removal of contaminants during the previous stages, because they would otherwise foul the membranes.

Post-chlorination typically is the last stage, in order to provide a chlorine residual, if required, for distribution systems. Trihalomethane formation, however, is greatly lowered through primary treatment that leads to organic removal. Alternative options, such as UV, typically involve the above stages focused on oxidation and filtration, and rely on UV for sterilization, but organics may persist.

Ozone Options

The familiarity of treatment equipment options and the implementation of these options changes for designers, engineers and operators as new technologies emerge. Chemically assisted disinfection typically is an effective method. It has the added benefit of oxidation and is applicable to water not suitable for UV sterilization, such as water with high levels of tannins and total suspended solids.

One technology for chemically assisted disinfection and oxidation that is not new to the North American water market is ozone. There tends to be a lack of familiarity, however, with ozone and its advantages and implementation in the U.S. and Canada. For instance, ozone can be utilized at different dose rates in the same treatment train to provide flocculation, disinfection, oxidation, organic removal and aeration. It can perform multiple functions when implemented in an optimized method. Ozone is one of the strongest disinfectants and oxidants available, and it is simple to implement.

A standard ozone system involves source gas of dry air or oxygen, an ozone generator that converts oxygen to ozone, a mass transfer device to put the ozone into the water stream, and a suitable contact and mixing system for disinfection CT values (the dissolved ozone concentration multiplied by the contact time).

Due to the strength of ozone, substantially less contact time, associated footprint and costs are required than conventional chlorination. Historically, ozone has been associated with high capital and operational costs; however, through new technology developments, these costs have been significantly reduced to make it a cost-comparative option with numerous operational benefits.

Additionally, ozone used to be available only in large municipal applications due to costs. Currently, numerous ozone systems exist that provide an overall savings to operators over the lifespan of the treatment equipment for numerous markets and applications, spanning municipal to agricultural to industrial, right down to residential point-of-entry systems.

Added Benefits

Although European countries have steadily utilized ozone for more 125 years, it is not a common option in North America. It is emerging on this continent as a viable and adaptable solution for disinfection, especially when retrofitting existing plants. The incorporation of ozone into existing plants means a more efficient method and less overall infrastructure changes to achieve a log 2 *Cryptosporidium* inactivation CT value than with various forms of chlorine.

The multifunctional nature of ozone also allows for its application to the oxidation of iron, sulfur and other contaminants for removal via

The author and Adam Doran, vice president of sales and marketing for Aclarus, demonstrate the company's ozone systems, all of which are NSF certified.

post-filtration. This makes it adaptable to situations in which disinfection and/or oxidation are required, yet allows for smaller contact tanks and residency times. In addition, with ozone being made on site, there are lower operational costs and fewer handling risks associated with sourcing, transporting and implementing chemicals or equipment.

An additional benefit to the application of ozone is the removal of emerging contaminants, such as hormones, pesticides and personal care products. Various studies of ozone's effectiveness at removal of these contaminants on top of disinfection and oxidation add another level of adaptability to this technology.

With these advancements and the increasing knowledge of safe application and usage, ozone systems are coming into favor for applications in which disinfection, cleaning and high-quality water are required. This is due to ozone's quick treatment ability, lower costs and safer operations/products. Ozone is produced on site without consumables, and is best used in cold-water conditions, which helps save on costs for clean-in-place systems.

Ozone systems, like this 15-gpm unit, can effectively disinfect water in a variety of applications.

UF and UV provide significant safety factors where redundancy is required and water undergoes some level of pretreatment to remove contaminants that foul that equipment. A downside to using UF or UV as primary disinfection is the need for constant cleaning and replacement, which could lead to other environmental issues such as mercury in the environment. Using UF or UV downstream of ozone disinfection, oxidation and filtration, however, provides strong protection and increases equipment lifecycles. Chlorine will continue to have a place in line sanitation and residual disinfection for distribution lines.

Through the continued education and exposure of applications of ozone water treatment systems, growth of applications of the technology and continued improvements to ozone systems can occur. This increasing familiarity with ozone in water treatment trains will increase the manufacturing base, lower capital costs and lead to an increase in the versatility of ozone systems that will benefit operators and end users. *wqp*

Michael Doran is vice president of operations and R&D for Aclarus Inc. Doran can be reached at mdoran@aclarus.ca or 705.927.4052.

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