THE TREATMENT ROOM

Water treatment specialist Judith Herschell examines the advanced oxidation processes in today's market.

The dam breaks

Historically, the sole oxidant for the disinfection of drinking water has been chlorine. Scientists initially prepared and studied the elemental form of chlorine near the end of the 18th century. Its use as an antiseptic additive to water occurred in Austria in 1847, and in 1918, the U.S. government recognized the health benefits of treating drinking water with chlorine and directed its municipal utilization. Since that time, chlorine became the standard disinfectant for potable water. Today, numerous utilities continue to use chlorine as their primary disinfectant – representing nearly a century of use.

Over the course of time, it was determined that high concentrations of free chlorine resulted in negative health effects. Over the last three decades, the identification and mitigation of chlorine-associated disinfection-by-products (DBP) has become a primary regulatory focus. In combination, these considerations have contributed to the research and development of alternate disinfectants and utilization strategies. These disinfectants include ozone, potassium permanganate, ultraviolet light, hydrogen peroxide, chlorine dioxide and mixed oxidants – just to name a few.

More recently, the drinking water industry has borne witness to a surge of "advanced oxidation processes" (AOP). These innovative disinfectant processes combine commonly used water treatment chemicals and oxidation processes. They are moving the industry into the future and a new phase of disinfection technology. These processes exhibit an ability to address TOC, COD, THM, HAA, taste and odor, iron, manganese, color, radium, arsenic and organics. They are capturing the interest of the industry for good reason. They offer advantages in their ability to react more quickly, disinfect more completely, mitigate DBP and be cost effective and competitive.

By definition, AOP refers specifically to those disinfection processes in which oxidation of organic contaminants occurs primarily through reactions with hydroxyl radicals. Hydroxyl radicals have more than twice the oxidation potential that chlorine has, 1.5 times the strength of hydrogen peroxide and 1.35 times the strength of ozone.

Looking to the future, the field of disinfectant chemicals and processes is widening. Innovative technologies that are coming forward include vacuum UV, UVC irradiation, ferrate and the utilization of nanomaterials. There are a number of companies already engaged in bringing these disinfection options to the market. One example is Ferrate Treatment Technologies (FTT). The FTT process combines hypochlorite, sodium hydroxide and ferric chloride to form an iron molecule in the +6 oxidation state, referred to as "ferrate." It has the unique capability of being a powerful oxidant when initially added to water, and then becoming a coagulant when it reduces to a +3 oxidation state.

Another example is MIOX Corporation, which offers a highly developed advanced oxidant utilizing salt, water and power. Accordingly, MIOX is able to offer a competitive solution due to an avoidance of exotic chemicals. In addition, MIOX offers its technology as "box" choices, whereby the best technology can be selected based on specific water treatment objectives. Both the FTT and MIOX processes use an on-site generation concept.

AOP are designed to both efficiently produce and use hydroxyl ions for oxidation. They have a wide range of applications in a myriad of industries, including water reclamation/reuse, potable water, food and beverage, oil and gas, industrial wastewater, municipal wastewater, process water, power, ultrapure water for the electronic and pharmaceutical industries, and cooling water systems. The municipal drinking water market is attractive to AOP suppliers because of its size and need for alternate solutions. However, it is well known that this sector is slow to adopt new technologies. Further hindering the advancement of AOP in drinking water is the process of regulatory compliance and the enormous task of testing, proving and adding an alternate disinfectant to the EPA microbial toolbox (along with the modification of all associated regulations).

The following table illustrates the compound annual growth rate estimated for the AOP technologies in various industries over the next several years.

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AOP MARKETS – CAGR