SCADA Market for Water & Wastewater: Running at Full Speed
Ozone: The Solution to Water Quality Issues

Water quality issues plague communities worldwide... issues ranging from oxidation to disinfection to aesthetics. One treatment solves all these problems—ozone. Ozone is a naturally occurring molecule in the form of a gas that is a powerful oxidizer and strong disinfectant. When ozone is dissolved into water in the proper amount, it rapidly reacts with contaminants and readily inactivates organisms, leaving behind pure, clean water. It greatly reduces or eliminates the need for chemicals, such as chlorine, which are not only environmentally problematic but also unpleasant tasting. The use of ozone as a disinfectant is not a new idea. In 1840, a German chemist, Schönbein, discovered ozone (O₃). After his discovery, many studies on the disinfection mechanism of ozone followed. The transfer of ozone gas into water was found to rapidly kill micro-organisms. Through the years, purified ozone gas has become a primary water disinfectant used throughout the world.

Although ozone was used widely for disinfection in Europe, chlorine remained the primary form of disinfectant in U.S. drinking water plants until 1993, when contamination of the Milwaukee, Wisconsin (U.S.A.), drinking water supply caused widespread gastrointestinal illness. The contaminated water afflicted more than 400,000 and claimed the lives of 111 people. Following the contamination, investigators quickly determined that a parasite in animal feces, Cryptosporidium parvum (C. parvum), was responsible for the outbreak. Laboratory studies revealed that C. parvum was highly resistant to chlorine and able to infect even after a 24-hour immersion in bleach. Extensive U.S. government-sponsored research eventually determined that a small amount of ozone would destroy Cryptosporidium in less than 10 minutes. Ozone began to emerge as an effective and safe drinking water disinfectant in the U.S.A. after this outbreak.

Drinking water again dominated the news headlines in the U.S.A. in early 2008, when investigations revealed that trace levels of pharmaceuticals were present in U.S. drinking water supplies. To members of the world water treatment industry, this news came as no surprise—years of discussion and research had been dedicated to the issue of pharmaceutical agents in drinking water. That discussion and research heated up in the U.S. as the general public started paying more attention to the problem and as municipal wastewater plants continued to discharge pharmaceutical agents into the primary water source for the majority of U.S. public drinking water systems—rivers and streams. Pharmaceutical agents known as endocrine disruptors pose a serious threat to wildlife and human health today. Medical research has shown that these pharmaceutical agents can disrupt the body’s endocrine system, affecting the development of young people and impacting the reproductive and neurological functions of adults. As a result, removal of endocrine disruptors from drinking water is a major priority. Endocrine disruptors are unaffected by standard wastewater treatment methods, and research into the treatment methods for removing endocrine disruptors has resulted in the emergence of ozone as a cost effective method.

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Ozone provides an excellent alternative to chlorine and does not yield notorious disinfection byproducts (DBPs), such as trihaloethanes (THMs) or haloacetic acids (HAA), like chlorine does. But, if ozone has a substantially long contact time with bromine in water, the reaction can yield bromate, an undesirable DBP. To prevent the formation of bromate—and simultaneously improve the energy efficiency of ozone systems while maximizing taste, odor and color control of water—the mass transfer of ozone into the water source must be optimized and contact time minimized. Early ozone systems relied on bubble diffusers to mix ozone with water, a laborious, large footprint process with a mass transfer rate in the range of about 10 percent. Contrast this with sidestream systems using Venturi injection, where mass transfer rates are closer to 90 percent or better. The unique geometry of these injectors causes ozone to be drawn in when there is a pressure differential from the inlet to the outlet due to the Venturi effect.
This treated sidestream is then released and mixed rapidly with the bulk water, with minimal contact time. Since only a fraction of the main flow is required to drive the highly efficient sidestream Venturi injection system, capital cost, footprint, and energy consumption is drastically reduced.

When the Four Way Special Utility District in Texas (U.S.A.) drilled a 750-gallon-per-minute (gpm) well in Angelina County in the summer of 2013, color and odor management immediately became a priority. The well water was tinted by tannic acid, contained hydrogen sulfide and was also contaminated with sulfur-reducing bacteria. The district eliminated chlorination as an option due to the creation of trihalomethanes; instead the managers turned to ozone... yet there was a concern that a long contact time and excess ozone in the contact tower could allow bromates to form. It was determined that a precisely delivered dose of no more than 3.0 mg/l of ozone through a Mazzei® 3090 GDT™ Ozone Transfer system would provide the ozone mass transfer needed to remove color and odor while minimizing the production of bromates. This Mazzei GDT skid-mounted ozonation system includes a Venturi injector for mixing ozone with water, an off-gas separator with a gas destruck system to eliminate undissolved ozone, and a set of carefully designed nozzles in a spool of pipe, called a Pipeline Flash Reactor™ (PFR), to inject the ozonated water sidestream into the main pipeline and ensure thorough mixing with the bulk flow. A dissolved ozone sensor and PLC PID loop governs the process, ensuring efficacy, safety and efficiency. With an ozone generator producing 730 grams of ozone per hour, the system achieves its performance objectives with a rate of just 2.6 mg/l of ozone. Water providers today must be extremely prudent with their infrastructure investments. In addition to seeking out proven technologies that have low cost of ownership and minimal maintenance demands, they must be comfortable that the systems will work for their source water. Mazzei has responded to this need in two key ways. First, computational fluid dynamics (CFD) modeling allows the company’s designers to optimize all aspects of a system for top performance, from the plumbing in the water treatment facility to the sizing and positioning of the nozzles in the Pipeline Flash Reactor.

On a physical level, the portability and small footprint of the company’s GDT Ozone Transfer skids enables them to function as pilot systems for in-situ testing. Several utilities have utilized pilot systems to prove to themselves and local stakeholders that ozonation with sidestream Venturi injection delivers the performance, reliability and low-maintenance operation that are vitally important to water systems. GDT Systems can also be utilized with aeration to oxidize iron, H₂S, and manganese.

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تعصف قضايا جودة المياه في المجتمعات في جميع أنحاء العالم... وتتراوح هذه القضايا بين الأكاسدة والتطهير وصولاً إلى علم الجمال. يتوزع علاج واحد لحل كل هذه المشاكل، الأوزون هو الأوزون. الأوزون هو جذيري يظهر بشكل طبيعي على شكل غاز مؤكسد قوي ومظهر فعال. فعندما يذوب الأوزون في المياه بمقدار مناسب، يتفاعل بسرعة مع الملوثات ويعمل الأكسجين الحيوي، وتبدأ التفاعلات الكيميائية. ويبلغ الأوزون، أو يبلغ إلى حد كبير الحاجة إلى المواد الكيميائية مثل الكلور الذي لا يسبب مشاكل بيئة، وقد يتسبب في مساهمها غير منتظم أيضاً. ولا يُعدّ استخدام الأوزون كمظهر للبيئة فكرة جيدة. في عام 1950، اكتشف الكيميائي الألماني شوابيغ أوزون. وأظهر ذلك دراسات عدة جديرًا حول آليات التطور بفعل الأوزون. وأظهرت هذه الدراسات أن تقلل غاز الأوزون إلى الدهون يساعد على فتر الميكروبات بسرعة فائقة. وأصبح غاز الأوزون القياسي على مر الستين متر المطهر للمياه الأساسي المستخدم في جميع أنحاء العالم. لقد زاد ارتفاع تكاليف المعالجة للمياه من تحديات المحافظة على المياه نظيفة. يُوفر الأوزون بديلًا ممتازًا عن الكلور، ولا تسفر عنه منتجات جانبية مطهرة بنية السامة مثل تشريحة ميثان أو أحماض الخل كما حل الكلور. ولكن إذا احتك الأوزون لمدة طويلة، وليست كبر على الدهون في الماء، فكما أن تنتج مرادف مواد، والمنتجات جانبية مطهرة غير مرغوب فيها.

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