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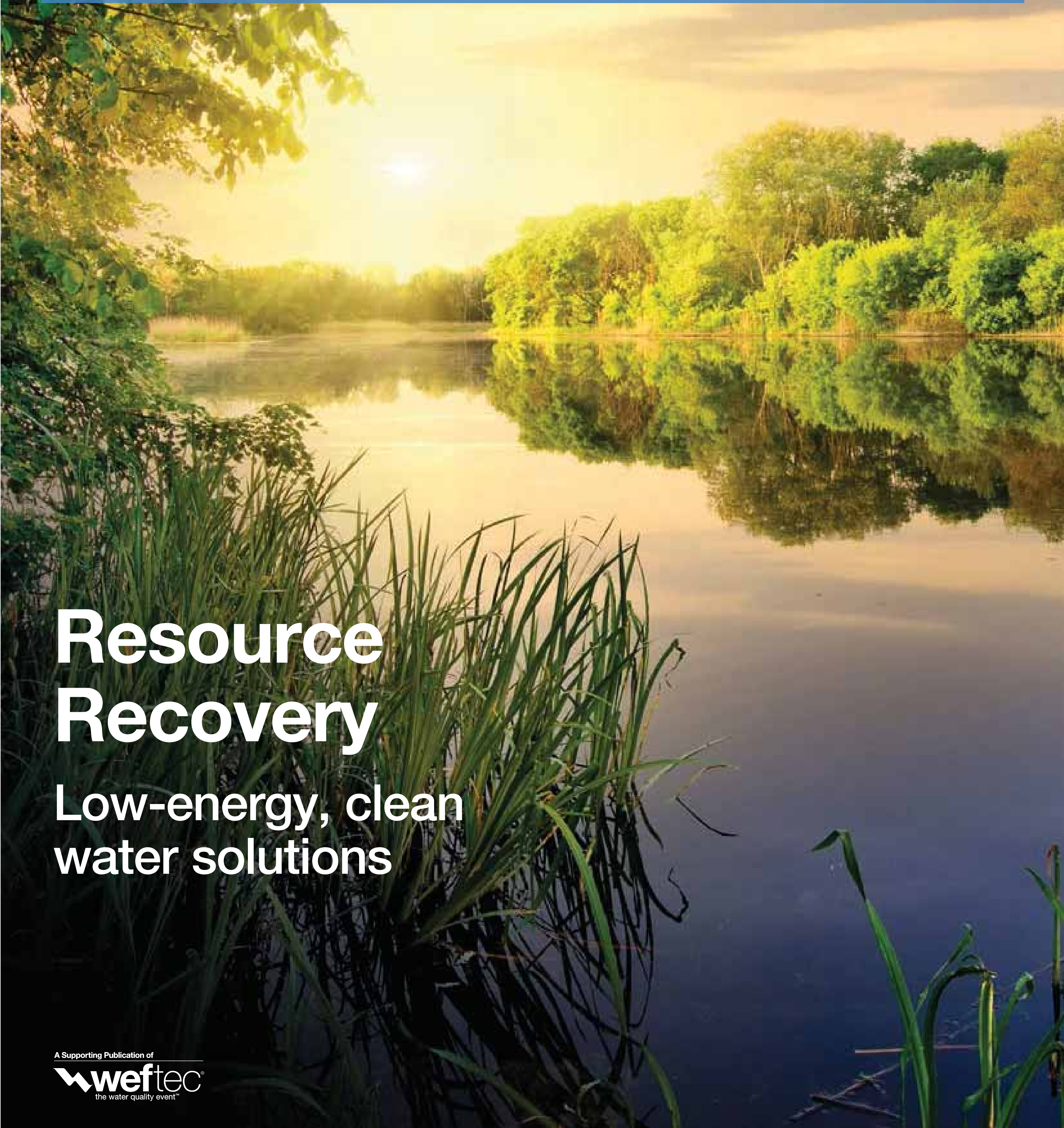
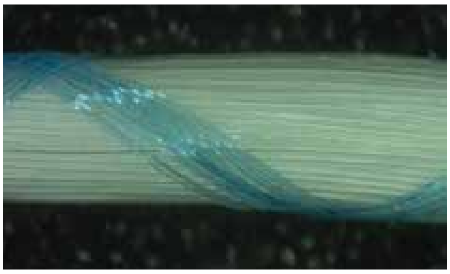
world water



Resource Recovery

Low-energy, clean water solutions

A Supporting Publication of weftec the water quality event™



Energy neutrality is possible because the amount of energy present in wastewater is two to four times greater than the amount that is required to treat it.

Above: ZeeLung MABR's unique cord structure.
Photo by GE

treatment while increasing energy production.

- Advanced anaerobic digestion: The organics removed in enhanced primary treatment and the waste activated sludge from biological treatment are processed through advanced anaerobic digestion, converting sludge into biogas that can then be converted to electricity while producing biosolids for agriculture or other beneficial use.
- Energy recovery: Biogas produced during advanced anaerobic digestion is converted into electricity and heat by gas engines or recovered as natural gas.

Why harnessing energy matters

In the United States, the EPA has reported that community drinking water and publicly owned wastewater systems use 75 billion kWh of energy per year, an amount equivalent to the pulp and paper and petroleum industries combined. The EPA has also identified energy as the second-highest cost item for municipal drinking water and wastewater facilities, after only labor costs. With utilities spending about US$4 billion annually on energy, energy consumption can account for 30 to 40 percent of a utility's total energy bill. The cost of energy continues to rise so that the goal of becoming more energy efficient, or moving toward energy neutrality, makes good business sense.

Accelerating innovation

While innovation can advance the industry, utilities have not been quick historically to adopt new technologies. This precedent is related to the huge responsibilities of municipalities, including the regulatory framework under which they operate. To accelerate adoption, companies who have invented new technologies can partner with utilities to prove the technology under real-world operating conditions.

One example of this process is evident in a yearlong demonstration of ZeeLung MABR technology with the Metropolitan Water Reclamation District of Greater Chicago (MWRD) in the US state of Illinois. The MWRD demonstration proved the potential of the technology to upgrade the O'Brien Water Reclamation Plant in Skokie, Illinois, to intensify nutrient removal and enable enhanced biological phosphorous removal in existing tank volumes without the need to build new infrastructure.

It also demonstrated the ability to improve the performance for total suspended solids and ammonia removal during cold temperatures while reducing energy demand of its aeration system by about 30 percent over the current mode of operation. Supported by the demonstration results, two other utilities, one in North America and one in Europe, have decided to implement ZeeLung MABR technology in their wastewater treatment plants.

As the industry continues to evolve, there is an opportunity to increase investment in innovation and develop technologies such as ZeeLung MABR that address the challenges we face. The overall goal is to enable all utilities to become Utilities of the Future and to ensure their communities continue to have the water they need to thrive.

Author's Note

Jeff Peeters, PE, is a senior product manager at GE Water & Process Technologies, with more than 15 years of experience developing and commercializing innovative technologies.

Second-generation deammonification advances energy self-sufficiency

Continuous Deammonification (conDEA™) technology makes nitrogen removal more cost effective and sustainable at water resource recovery facilities. World Water Works' Chief Technology Officer, Chandler Johnson reports on the significance of this innovative advance and on the company's decision to exclusively deliver the technology to the North American market.

The second generation of deammonification, Continuous Deammonification (conDEA™), tested and implemented at the Strass wastewater treatment plant (WWTP) in Tyrol, Austria, achieved greater than 90-percent ammonia removal during the winter months of 2016 during peak loads at greater than 1.4 kilograms of nitrogen per cubic meters per day. The conDEA process delivers low cost, sustainable ammonia removal from water and is considered a major step toward achieving energy self-sufficiency at municipal wastewater treatment plants, which are more aptly described as water resource recovery facilities.

At the Strass facility, a 50-micron micro screen is used to retain anaerobic ammonium oxidation (or anammox) bacteria while removing the nitrite oxidizing bacteria (NOB) from the system. The successful implementation of the micro screen is now being implemented in the new conDEA flow scheme, which allows the system to be transferred from a sequential batch reactor (SBR) mode to continuous mode while having superior retention of the anammox bacteria.

Beginning in 2004, the Strass treatment facility was the first to implement the pH-controlled deammonification anammox treatment system into its high ammonia-based sidestream treatment stream. Since 2011, the inventor of the deammonification anammox treatment system, Dr. Bernard Wett, along with ARA Consult, University of Innsbruck, Strass treatment plant, and the US water utility DC Water have continued conducting research and development on sidestream and mainstream processes, which led to the second-generation system.

The US company World Water Works, which specializes in the design and manufacturing of wastewater solutions, has been selected to bring this technology to the North American market. The company installed the first operating deammonification system in North America at the York River Treatment Plant in Seaford, Virginia, USA, a facility operated by the regional wastewater treatment utility Hampton Roads Sanitation District.

Anammox is a globally important microbial process of the nitrogen cycle, within which nitrite and ammonium are converted directly into dinitrogen gas. This process occurs naturally in places such as deep oceans and other oxygen-minimized zones. The discovery of this biological process and the bacteria mediating the process started to spur new disruptive and innovative technologies.

The conDEA treatment system for removal of nitrogen is a continuous-flow, sidestream treatment system providing reliable performance and numerous benefits over traditional nitrification-denitrification systems. Unlike the traditional expensive nitrification-denitrification method for removing nitrogen, which requires large amounts of energy and possible external carbon and alkalinity, the conDEA process uses ammonia-oxidizing bacteria (AOB) and anammox bacteria to efficiently and reliably remove ammonia from wastewater. The process is ideal for municipal clients that have wastewater streams with high ammonia concentrations typical of anaerobically digested sludge liquors. This system also plays an important role in wastewater treatment energy self-sufficiency, reducing costs and optimizing the facility's footprint, helping to achieve more efficient and effective treatment.

ConDEA differs from the first generation of deammonification, as it is now a continuous process instead of an SBR. This second-generation technology offers smaller equalization (EQ) requirements, smaller installed horsepower (HP) for blowers and feed pumps, and easier control systems to manage processes, and it eliminates the need for a post-EQ tank due to flow surges from SBR decanters.

The anammox-based deammonification system, which offers one of the lowest cost total nitrogen (TN) removal processes available, uses 60 percent less energy, completely eliminating the need for external carbon addition, and produces 90 percent less sludge than traditional systems. The system also reduces costs and is environmentally friendly with a low-carbon footprint. The updated conDEA system operates at a higher loading rate, with consistently greater than 90 percent ammonia removal, which translates into more capacity in a smaller footprint. Beyond delivering continuous operation, this technology greatly enhances the robustness and simplicity of operation.

Energy innovation goals

Significant improvements in energy efficiency at municipal wastewater treatment facilities should be a top priority for current and future research and development. The energy for wastewater treatment facilities to meet discharge standards has always been a fairly large burden on the taxpayer; in most rural towns, wastewater treatment consumes the most energy. The adoption of deammonification in wastewater treatment operations could significantly reduce energy costs and even increase revenues through energy production.

Currently, there is a solid understanding of the process and the bacteria, so now the task involves figuring out how to apply these microbial populations in the most energy-efficient manner possible. The industry, as a whole, is moving away from the term "wastewater treatment plants" and is adopting a more accurate term, "water resource recovery facilities," given the expanded role of these facilities in recovering resources such as water, nutrients, and energy from wastewater. The sector is experiencing a renaissance of new ideas and approaches, which is leading to some very exciting leaps in technology developments.

Predictive analytics is one field that offers great potential. Advanced biological processes have often been considered too complicated and not able to be controlled easily; however, this perception is changing. Understanding the bacterial process and the ways in which control and automation technologies can increase efficiency and improve operations of treatment facilities could help operators more effectively recover resources from plants as they continue to become more and more complex. Predictive analytics could be implemented to arrive at decisions made based upon a plethora of data, comparing current trends to past trends so that the facility can ensure discharge compliance at the lowest energy output.

The evolution of technology has helped wastewater solution providers innovate more efficient water resource recovery facilities. For this reason, World Water Works is striving to take new technologies such as the second-generation deammonification method, conDEA, to benefit municipalities in North America and across the globe. By viewing wastewater treatment differently, the industry and cities around the world can meet stringent requirements while taking advantage of flexible solutions that can adapt to future challenges.

Author's Note

Chandler Johnson is the chief technology officer at World Water Works, Inc., a manufacturer of specialized process and wastewater treatment technologies based in Oklahoma City, Oklahoma, United States. He has presented and published numerous technical papers and is active in industry organizations such as Water Environment Federation. Chandler earned a bachelor of science degree in civil and environmental engineering from the University of Wisconsin-Madison and a master of science degree in environmental engineering from the Rensselaer Polytechnic Institute.

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