



2015 North American Water Treatment New Product Innovation Award



F R O S T & S U L L I V A N



50 Years of Growth, Innovation & Leadership

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Background and Company Performance

Industry Challenges

Tertiary and advanced wastewater treatment (WWT) is one of three stages in the cleaning of wastewater generated by the municipal and industrial sectors. Building on and improving upon the results of treatment through initial primary and secondary WWT stages alone, tertiary treatment is performed prior to waste water being discharged into the environment or re-used. According to Frost & Sullivan, the North America WWT equipment market is forecasted to grow from \$322.0 million in 2013 to \$465.5 million by 2020 at a compound annual growth rate of 5.4%. Additionally, legislative and regulatory pushes in the region, including the passage of Canada's Wastewater Systems Effluent Regulations, and the United States' (US) new regulations regarding the treatment and discharge of ballast water provide a strong market opportunity. Another particular boost to industrial opportunities in tertiary wastewater treatment is focused on algae toxins; US authorities along the West Coast and in the Northeast, as well as those surrounding the Great Lakes, increasingly seek advanced levels of WWT.

For tertiary WWT, activated carbon is currently the industry standard for filters, while ozone, ultraviolet (UV), and chlorine are alternative disinfection technologies the industry employs. While activated carbon provides a lower degree of efficacy compared to ozone, UV and chlorine, the disinfection technologies are typically cost-prohibitive. WWT projects are also capital intensive; with difficulties in securing funding, many municipalities have adopted a cautious approach towards investment. Consequently, suppliers suffer from fewer opportunities, resulting in price pressures as competition for limited contracts intensifies. Additionally, the WWT sector has historically adopted a conservative attitude towards technical change, reflecting concerns over the long-term viability of new equipment both on cost and public health grounds. Current efforts by manufacturers, consultants, and engineers to improve efficiency, lower costs, and reduce equipment size typically take time to become accepted and adopted.

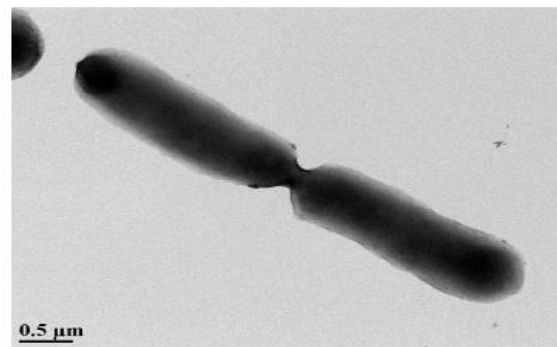
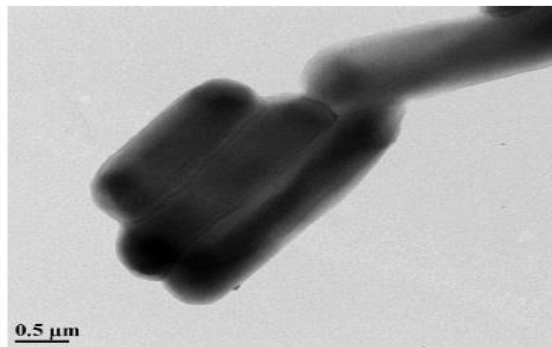
Technology Attributes and Future Business Value

BioLargo Water, Inc. has developed a low-cost, sustainable, and advanced WWT solution utilizing the mechanics of the earth's natural iodine cycle. Developing a platform based on three distinct iodine-based technologies, BioLargo Water's award-winning and patented technology destroys bacteria and dismantles soluble organic contaminants. A wholly-owned Canadian subsidiary of BioLargo, Inc., BioLargo Water, Inc.'s office and laboratories are located within Canada's University of Alberta research center, where it is a founding member of a research chair focused on evaluating technologies to help solve contaminated water issues in oil sands. BioLargo, Inc. holds 15 US patents with more than 3 additional patent applications pending. With the development of its revolutionary Advanced Oxidation System (AOS) Filter that combines iodine, water filter materials, and electrolysis within a water filter device, the AOS Filter is able to provide significant cost-benefit and efficacy improvements over existing WWT technologies.

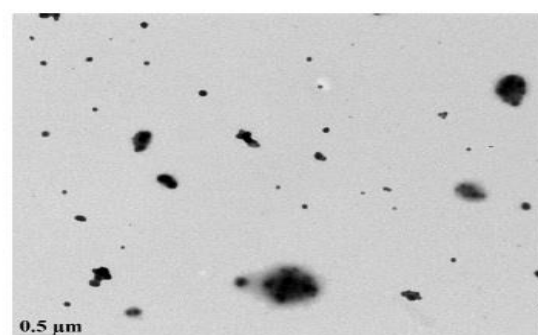
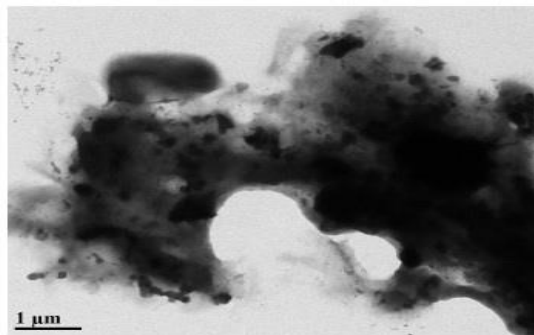
Revolutionizing Water Treatment: The AOS Filter

Differing from existing WWT technologies on the market, the AOS Filter is unique in its efficiency in generating a high oxidation potential to eliminate soluble organic contaminants commonly found in wastewater. This gives the AOS Filter the ability to achieve unusually high rates of disinfection, eliminating infectious biological pathogens like *Salmonella*, *Listeria* and *E.coli* in water. It is also highly effective in removing soluble organics like naphthenic acids, dioxane, sulfur compounds, ammonia and other aromatics like benzene, in addition to fungi and spores. The AOS Filter has no disposal of concentrates or solids when compared with adsorption or membrane filtration technologies, enabling a high level of performance regardless of salinity.

Salmonella rods intact before passing through the AOS



Debris field left after passing through the AOS using 50 ppm KI (25 ppm I₂) with 12 volts 0.006 m amps



Source: BioLargo Water, Inc.

The success of the early *Salmonella* trials propelled the company to explore treatment for other toxins and chemicals impacting water treatment. According to Kenneth R. Code, the company's Chief Science Officer, the company is accumulating similarly startling results with respect to efficacy.

Transforming a Standard Filter into a Electrochemical Reactor

The AOS Filter is able to generate high levels of oxidation potential across surfaces within the device by employing a patented configuration to convert a typical carbon matrix filter into an electrochemical reactor. This amplification and multiplication of the oxidation potential of iodine, a key natural disinfectant, creates different and powerful forms of

iodine, greatly enhancing its efficacy. Furthermore, while providing a disinfection task similar to UV or ozone—a benefit traditional activated carbon filters lacks—the AOS Filter does so at a price point at a fraction of the cost of these technologies. Citing research from Tallinn University of Technology, the company estimates that energy costs to operate UV and ozone technologies at varying pH levels to promote advanced oxidation range from \$100 per acre foot to as high as several thousand dollars per acre per foot. In contrast, energy cost for the AOS Filter in a high saline environment is less than 1/20th the energy cost of the nearest competing technology.

Independent Efficacy Verification

According to Dr. Jennifer Jay, a professor at the University of California Los Angeles' Department of Civil and Environmental Engineering, BioLargo's iodine delivery technology provides "a complete disinfection...and this was with an 80 parts per million (ppm) solution of the BioLargo technology. Highlighting the increase in performance efficacy on a dose-for-dose basis of iodine as compared to chlorine, Jay explained "It was more powerful than a 250 ppm solution of chlorine...we were impressed."

The company's AOS Filter further amplifies the oxidation potential of ordinary iodine and focuses its utility within the filter as water passes through the device. Offering the flexibility to conserve and regenerate the iodine within the device, it allows for all iodine to be removed or, where appropriate, to be delivered as a residual treatment for diverse applications including the treatment of livestock drinking water or in cooling towers where disinfection is desired. Scientists at the University of Alberta's Department of Agricultural, Food and Nutritional Science and the Department of Engineering have also tested and validated the AOS Filter for use in eliminating soluble organic contaminants like those found in oil sands tailings ponds, industrial waste streams as well as in food and agriculture. In a recent study to validate the AOS Filter's ability to eradicate *Salmonella*, the AOS Filter eliminated 10 million cells within a two-minute time point. The performance of the industry standard, chlorine dioxide, only eliminates 100,000 cells within a 60 minute time point.

According to Dr. Lynn McMullen, a professor at the University of Alberta's Department of Agricultural, Food and Nutritional Science, "The levels of disinfection achieved by the AOS filter are unprecedented, and the data supports (AOS filters') potential to accomplish high-level disinfection that can be useful in multiple markets including food processing and agriculture production. Extremely high levels of performance were achieved during testing and we are excited to expand the work with BioLargo to other applications targeting food safety concerns."

Positioning for Market Success

BioLargo Water, Inc. is positioning the AOS Filter as the prime product in its already-impressive portfolio. According to company CEO and President Dennis Calvert, the technology represents a scientific and technical breakthrough and is currently in the

process of being piloted in the Canadian poultry processing industry. A commercial technology demonstration that highlights the significant disinfection capability of the AOS filter, the pilot involves processing the chill tank water to reduce the bioburden in a recirculating system, and is projected to achieve 100 times the efficacy of any competing technology. Currently, the company's Isan System, another iodine-based platform technology, licensed by Clarion Water, and is in the early stages of commercialization.

The company intends to expand its focus to include commercial opportunities within the agriculture, industrial produced water, algae toxins and food processing industry, specifically by increasing the AOS Filter scalability to tackle larger industrial, municipal, and commercial challenges. The company is evaluating a wide array of licensing/strategic alliance opportunities. According to Calvert, the AOS Filter's current proven flow rate capacity is sufficient to meet poultry industry standards, but at present is insufficient to meet tests for major industrial volumes including frack fluid or municipal water. BioLargo Water, Inc. is actively working at bridging the gap from proof of claim to commercial adoption for these larger industries. Enhancing scalability is the next phase of development; in the meantime, the company has a modular design in which the kinetic reaction can be managed at the current configuration. BioLargo Water, Inc. is also in the process of automating the technology, creating a smart filter that can offer real-time monitoring data, and other enhanced functionality.

Funding Commercialization Efforts

BioLargo Water, Inc. is in the early stages of commercialization, with current revenue under \$1 million a year. Currently negotiating with potential strategic partners and customers, including the Canadian pilot poultry processor, the company anticipates the first commercialization of the AOS Filter to occur in 2016.

Rather than seeking traditional venture capital funding to take its next steps, BioLargo Water, Inc. is capitalizing on emerging investor interest in sustainability and water decontamination by family offices, sovereign wealth funds, and corporate strategic investors including Walter Schindler, managing partner and founder of Sail Capital Partners, a clean technology venture capital firm. In 2015, the company announced it had completed a \$1 million capital drive from individual investors as part of a \$5.5 million offering. As of October 2015, it has raised approximately half of the total offering.

Introducing a New Industry Standard

BioLargo Water, Inc., under the sponsorship of the provincial government of Alberta, Canada, recently attended the EUREKA ACQUEAU Conference in Paris, France. A publicly funded, intergovernmental network of companies and funding agencies from over 40 countries across Europe and beyond, EUREKA is a leading international water cluster whose stated goal is to promote transnational collaboration for developing innovative projects in water technologies. Within days of the showcase, BioLargo Water, Inc. received additional grant funding and investor interest.

Current grants include research funding from the Natural Sciences and Engineering Research Council of Canada to further gather data around the company's AOS Filter technology and its electrochemical inactivation of pathogens. Specifically, the funds will provide additional data that can be translated to further applications in the food and agricultural industries. Additionally, the company received financial contributions from the National Research Council of Canada Industrial Research Assistance Program. Grants and financial awards to advance the AOS Filter to commercialization have exceeded US \$1,000,000 and are projected to top the \$3,000,000 mark in 2016. The company is deploying a highly collaborative research/public funding supported business model to expand its intellectual property while aligning itself with key industry experts and leaders to help facilitate market adoption.

While commercialization efforts are nascent, BioLargo Water, Inc. is confident the AOS Filter technology will become the industry standard. "It is a technological advance that needs a global footprint of identity," Calvert said. "The science is patented, validated and fully defensible at the highest level, setting the stage for successful commercialization. Additionally, our CTO, Kenneth R. Code, has carefully guided our company through a lengthy and painstaking journey to build a solid technical foundation beyond reproach."

Focused on identifying and recruiting licensing partners for commercialization purposes, BioLargo Water, Inc. is also targeting strategic segments, e.g., the ballast water treatment industry, for its WWT applications to address the issue of slow industry adoption. By targeting subsets of industry and focusing on discrete problems where technology is lacking, leading to either ineffective or expensive alternatives, or both, BioLargo Water, Inc. seeks to position itself as an important emerging technology and significant value proposition.

Conclusion

BioLargo Water, Inc.'s Advanced Oxidation System Filter is a low-cost, high-impact, sustainable clean water technology capturing the attention of leaders in academia, governments, and the industry worldwide. With applications ranging from food and agriculture to ballast water treatment, the AOS Filter demonstrates industry-leading decontamination and disinfection capabilities and is well-poised for further scale-up and successful commercialization in the tertiary and advanced waste water treatment market. With its innovative technology and commitment to research, BioLargo Water, Inc. earns Frost & Sullivan's 2015 North America Technology Innovation Award in the water treatment market.

Significance of Technology Innovation

Ultimately, growth in any organization depends upon finding new ways to excite the market, and upon maintaining a long-term commitment to innovation. At its core, technology innovation or any other type of innovation can only be sustained with leadership in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.



Understanding Technology Innovation

Technology innovation begins with a spark of creativity that is systematically pursued, developed, and commercialized. That spark can result from a successful partnership, a productive in-house innovation group, or the mind of a singular individual. Regardless of the source, the success of any new technology is ultimately determined by its innovativeness and its impact on the business as a whole.

Key Benchmarking Criteria

For the Technology Innovation Award, Frost & Sullivan analysts independently evaluated two key factors—Technology Attributes and Future Business Value—according to the criteria identified below.

Technology Attributes

- Criterion 1: Industry Impact
- Criterion 2: Product Impact
- Criterion 3: Scalability
- Criterion 4: Visionary Innovation
- Criterion 5: Application Diversity

Future Business Value

- Criterion 1: Financial Performance
- Criterion 2: Customer Acquisition
- Criterion 3: Technology Licensing
- Criterion 4: Brand Loyalty
- Criterion 5: Human Capital

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of our research process. It offers a 360-degree-view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often, companies make important growth decisions based on a narrow understanding of their environment, leading to errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry players and for identifying those performing at best-in-class levels.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS



Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan Awards follow a 10-step process to evaluate award candidates and assess their fit with select best practice criteria. The reputation and integrity of the Awards are based on close adherence to this process.

STEP	OBJECTIVE	KEY ACTIVITIES	OUTPUT
1 Monitor, target, and screen	Identify award recipient candidates from around the globe	<ul style="list-style-type: none"> Conduct in-depth industry research Identify emerging sectors Scan multiple geographies 	Pipeline of candidates who potentially meet all best-practice criteria
2 Perform 360-degree research	Perform comprehensive, 360-degree research on all candidates in the pipeline	<ul style="list-style-type: none"> Interview thought leaders and industry practitioners Assess candidates' fit with best-practice criteria Rank all candidates 	Matrix positioning all candidates' performance relative to one another
3 Invite thought leadership in best practices	Perform in-depth examination of all candidates	<ul style="list-style-type: none"> Confirm best-practice criteria Examine eligibility of all candidates Identify any information gaps 	Detailed profiles of all ranked candidates
4 Initiate research director review	Conduct an unbiased evaluation of all candidate profiles	<ul style="list-style-type: none"> Brainstorm ranking options Invite multiple perspectives on candidates' performance Update candidate profiles 	Final prioritization of all eligible candidates and companion best-practice positioning paper
5 Assemble panel of industry experts	Present findings to an expert panel of industry thought leaders	<ul style="list-style-type: none"> Share findings Strengthen cases for candidate eligibility Prioritize candidates 	Refined list of prioritized award candidates
6 Conduct global industry review	Build consensus on award candidates' eligibility	<ul style="list-style-type: none"> Hold global team meeting to review all candidates Pressure-test fit with criteria Confirm inclusion of all eligible candidates 	Final list of eligible award candidates, representing success stories worldwide
7 Perform quality check	Develop official award consideration materials	<ul style="list-style-type: none"> Perform final performance benchmarking activities Write nominations Perform quality review 	High-quality, accurate, and creative presentation of nominees' successes
8 Reconnect with panel of industry experts	Finalize the selection of the best-practice award recipient	<ul style="list-style-type: none"> Review analysis with panel Build consensus Select winner 	Decision on which company performs best against all best-practice criteria
9 Communicate recognition	Inform award recipient of award recognition	<ul style="list-style-type: none"> Present award to the CEO Inspire the organization for continued success Celebrate the recipient's performance 	Announcement of award and plan for how recipient can use the award to enhance the brand
10 Take strategic action	Upon licensing, company may share award news with stakeholders and customers	<ul style="list-style-type: none"> Coordinate media outreach Design a marketing plan Assess award's role in future strategic planning 	Widespread awareness of recipient's award status among investors, media personnel, and employees

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, enables clients to accelerate growth and achieve best in class positions in growth, innovation and leadership. The company's Growth Partnership Service provides the CEO and the CEO's Growth Team with disciplined research and best practice models to drive the generation, evaluation and implementation of powerful growth strategies. Frost & Sullivan leverages almost 50 years of experience in partnering with Global 1000 companies, emerging businesses and the investment community from 31 offices on six continents. To join our Growth Partnership, please visit <http://www.frost.com>.