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INSIDE

Precast Tanks Paired with Advanced Filtration a Win for Homeowners

A precaster in Ontario provided a complete residential onsite wastewater solution that installs quickly, reduces the overall footprint and provides the homeowners with peace of mind for many decades to come.

By Kirk Stelsel, CAE
National Precast Association

Concrete's primary components are coarse and fine aggregates, cement and water. While there are other elements added to modern mix designs such as admixtures, fibers and sometimes even color, the four primary ingredients can be found in every batch of concrete. It's only fitting, then, that an engineer and homebuilder are using precast concrete tanks with advanced filtration systems to meet stringent effluent requirements for a new subdivision being built around a lake that was once an aggregate mine.

From mine to mansions

Driving through Heritage Lake Estates in Puslinch, Ontario, it's hard to imagine it was previously home to a steady stream of heavy equipment and dump trucks. Today, well-manicured lawns, picturesque greenspaces and homes torn straight from the pages of magazines dot the shoreline and area surrounding a lake that is now ready for fishing, boating and swimming.

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Application of Electroflotation Technology for Microbrewery Wastewater Treatment

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Problem Statement

Breweries are becoming an increasingly integral component of the Ontario economy with the number of breweries increasing by **17.6%** from 2017 (695) to 2018 (817) (Swain, 2019). Much of this growth can be attributed to craft beers. They remain the LCBO's fastest growing sector with sales growth averaging **20-30% per year** (Ontario Ministry of Food Agriculture and Rural Affairs, 2018).

Despite their recent economic success, microbreweries are becoming increasingly at risk from rising Overstrength Disposal Fees (ODFs). Sewer Use Bylaws introduced ODFs as a mechanism for regulating contaminant concentration limits while providing municipalities a means to recover the cost of treating overstrength wastewater. ODFs were originally proposed to encourage industrial wastewater generators to build their own treatment systems. However, many producers do not have enough capital to design, construct and operate independent wastewater treatment systems (WWTS) capable of meeting municipal discharge limits. In addition, WWTS often require extensive floor space for both equipment and technical personnel for maintenance and operation. As a result, many producers choose to dispose of raw or partially treated wastewater into the municipal sewers while paying the corresponding ODFs (Stantec, 2012). ODFs are constantly increasing and therefore, presenting a long-term economic challenge for businesses discharging high strength industrial wastewater.

In Ontario, **24%** of industrial wastewater treatment plants fail to meet environmental guidelines placing both human health and surface water ecosystems at risk (Kapitain, 1995). Consequently, there exists an urgent need to develop and introduce more sustainable decentralized systems.

Case Study: Guelph Microbrewery

Guelph is home to a considerable number of successful independent microbreweries. However, as the industry continues to expand, the Municipality of Guelph has begun applying pressure to industries discharging overstrength wastewater. Limited floor space and smaller operating budgets are commonplace among decentralized brewers with the majority opting to discharge raw or only partially treated wastewater while paying the corresponding ODFs. As a result, many microbreweries only maintain simple primary wastewater treatment systems such as a sedimentation tank prior to discharging.

Recognizing this problem, the research team has been collaborating with one of Guelph's microbreweries to identify a cost-effective and space-efficient decentralized treatment process. Unlike large scale brewers, who brew consistently year-round, the composition of the wastewater at microbreweries is extremely variable with day-to-day concentrations capable of changing significantly. **Table 1** outlines this heightened contaminant variability in microbrewery effluent compared with typical industry effluent:

Parameter	Guelph Microbrewery (2018-19)	Industry Typical
Total Phosphorus (mg/L)	30-233.5	10-50
COD (mg/L)	3,700-30,000	2,000-6,000
TSS (mg/L)	10-28,367	200-3,000
Total Nitrogen (mg/l)	78.3-80.9	25-80
pH	4.99-7.62	4.5-12

Table 1: Characteristics of the Microbrewery Effluent

Table 1 highlights the significantly higher concentrations of organics and Total Suspended Solids (TSS) in craft beer compared to more conventional brands. In 2018, the Ontario Craft Brewers Conference and Suppliers Marketplace emphasized the need to encourage the development of decentralized wastewater treatment options, particularly in rural regions (Horne, 2018). This prompted the research team to identify an on-site treatment system capable of meeting the constraints and criteria of a decentralized producer.

Electroflotation Wastewater Treatment

Conventional wastewater flotation typically falls within two categories: (1) dispersed air flotation and (2) dissolved-air flotation. These two methods are only capable of capturing particles between 50-200µm. Removal of particles smaller than 50µm through flotation can only be achieved through a lesser known and unconventional flotation method of Electroflotation (EF).

Electroflotation treatment begins when a DC current is passed between an electrode pairing submerged in a conductive medium producing an electric field resulting in electrolysis. The EF process is facilitated by the production of hydrogen and oxygen bubbles generated during electrolysis. EF reactors are designed to utilize the adhesive properties of oxygen and hydrogen micro-bubbles that are produced at the electrode surfaces during the electrolysis of water to capture pollutants as they rise to the surface. This fine cloud of microbubbles is very low in turbulence and when accompanied with an appropriately sized electrode grid, EF can ensure an effective and uniform clarification by flotation. Due to the reduction in buoyancy forces accompanying smaller bubbles, increased current density will lead to greater removal by flotation due to the extended detention time of the smaller micro-bubbles. Furthermore, smaller bubbles offer reduced contact angles between the gas-solid-liquid interface that reduces the shear forces of the bubbles on the surrounding flocs significantly improving the clarification of the wastewater (Holt, 2002).

Prototype Electroflotation Unit/Reactor

The prototype EF treatment unit **(Figure 1)** consists of four chambers with a total working volume of 18L. The sequential functions of the four chambers are a primary settling tank for large flocs and solids, two consecutive EF reactors, and a final polishing tank.

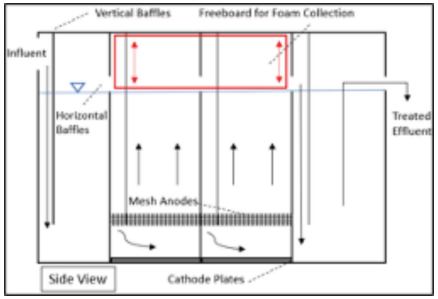


Figure 1: Flow pathway for prototype EF unit

The two primary operating variables are the system flow rate and the applied current. The flow rate can be optimized to encourage settling in the primary chamber while minimizing the cost of EF treatment per unit volume of wastewater. Increasing the applied current results in greater bubble density in the EF columns improving pollutant removal.

Objectives of Product Development

The primary objective of this research was to develop and evaluate a space-efficient electrokinetic based design as a standalone treatment unit or integrated alongside existing treatment systems. The resulting design should be capable of treating high-strength industrial effluent from a decentralized wastewater producer. The results generated by the prototype reactor will provide the framework for developing a pilot-scale design.

Performance of the EF Reactor

The performance of the reactor was assessed based on its capabilities of removing both suspended solids and organic contaminants from the wastewater. **Table 2** summarizes the performance of the EF unit relative to the removal of RP, TP, COD and TSS. The results show that the EF unit can remove a large percentage of TSS with minimal applied current. It is also evident that a linear relationship exists between applied current and organics removal, implying that an equilibrium condition exists between energy consumption and pollutant removal.

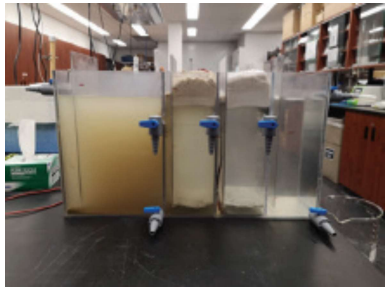
Parameter	High Strength		
	Raw (Avg)	% Removal (0.1A)	% Removal (0.8A)
RP- Reactive Phosphorus (mg/L)	178.0	12.7	89.8
TP - Total Phosphorus (mg/L)	210.3	16.5	83.3
COD (mg/L)	10,840	27.73	46.2
TSS (mg/L)	3,050	85.75	97.6

Table 2: EF Reactor Performance

Figure 2 shown below provides a steady-state snapshot of the EF reactor in operation. It is important to note the following observations:

- Chamber 1 (left) homogenizes the influent wastewater allowing for the settling of the largest solids.
- The floated scum layers in Chambers 2 & 3 (centre) highlight the removal pathway for organics and colloids alongside the smaller suspended solids (Arambarri, Abbassi, & Zytner, 2019).
- The clarification of the EF unit is evident in Chamber 4 (right) due to the reduction in colour and turbidity.

Figure 2: Steady state continuous EF treatment of high strength microbrewery wastewater



Conclusion & Future Plans

The successful treatment of high strength microbrewery wastewater has confirmed the research team's concept that Electroflotation can be integrated alongside existing treatment systems or operate as an independent treatment system. Future tests will focus on identifying other decentralized wastewater sources suitable for EF treatment.

The research team is seeking to collaborate with an industry partner to commence development of a pilot scale system (1-2m3) to assess the scalability of electroflotation technology. The pilot project will also allow the research team to integrate more sophisticated mechanisms into the existing system. These include recycled flow, scum removal, and advanced continuous EF treatment regimes such as pulsed power and electrode polarity reversal.

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OOWA'S REGISTERED PROFESSIONAL PROGRAM (RPP)

What is it?
The RPP is OOWA's skills and professional development program available exclusively to our members. The RPP provides special designations that cover all job descriptions in the onsite and decentralized industry. Depending on your experience and aptitudes acquired through formal study and course completion, members can apply directly to get any one of these designations. Another pathway way to an RPP designation is by registering in the In-Development Program. This program gets you on our exclusive on-line 'Find an Expert' directory and gives you three years to take the courses you need to meet your chosen designation requirements.

What's in it for me?
We know that onsite system owners want to hire only the best people. Your RPP designation tells potential clients that you are a qualified professional, that your skills and knowledge are current and that you are engaged with and care about your industry.

An OOWA RPP designation also sets you apart from your competition and can serve as an effective marketing tool. Pursuing this designation also builds your career by positioning you as a desired individual for new opportunities.

What designations are available?
Below are the designations available through the RPP:

- Designer
- Installer
- Private Installer
- Project & Administrative Professional
- Regulatory Inspector
- Residuals Transporter
- Technical Sales Consultant
- Wastewater Service Technician

How do I enroll?
Go to OOWA's website and then find the 'Training' tab at the top of the home page. For the documents mentioned below, scroll down to the 'RPP Documents and Resources' page where you can download them for your reference.

1. Review the RPP How to Apply document.
2. Review the RPP Background document.
3. Select one or more RPP designations that apply to you and review the Aptitudes by Designation document to see what courses/aptitudes you still need of if you can apply directly to your chosen designation.
4. Check out the FAQ document to help with some specific program requirements.
5. Download the In-Development Registration Form if you need to acquire more skills or courses to secure your desired designation.
6. Download the full RPP Application Package
7. Contact us with any questions at 1-855-905-6692 ext. 101 or via email at outreach@oowa.org.
8. Begin the process today!

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Where the Public Goes to find Dedicated Septic Professionals

One of the big benefits of being a participant in OOWA's 'In-Development Stream' of the Registered Professional Program is being featured on our website's interactive "Find an Expert" directory. This listing is separate and apart from our Membership Directory. All of our RPP graduates and 'In-Development'participants are highlighted here so that members of the public can find the onsite professionals who are committed to ongoing professional and skills development. Get more information about the 'In-Development Stream' of the RPP on our website under the 'Training' tab and set yourself apart from your competition!