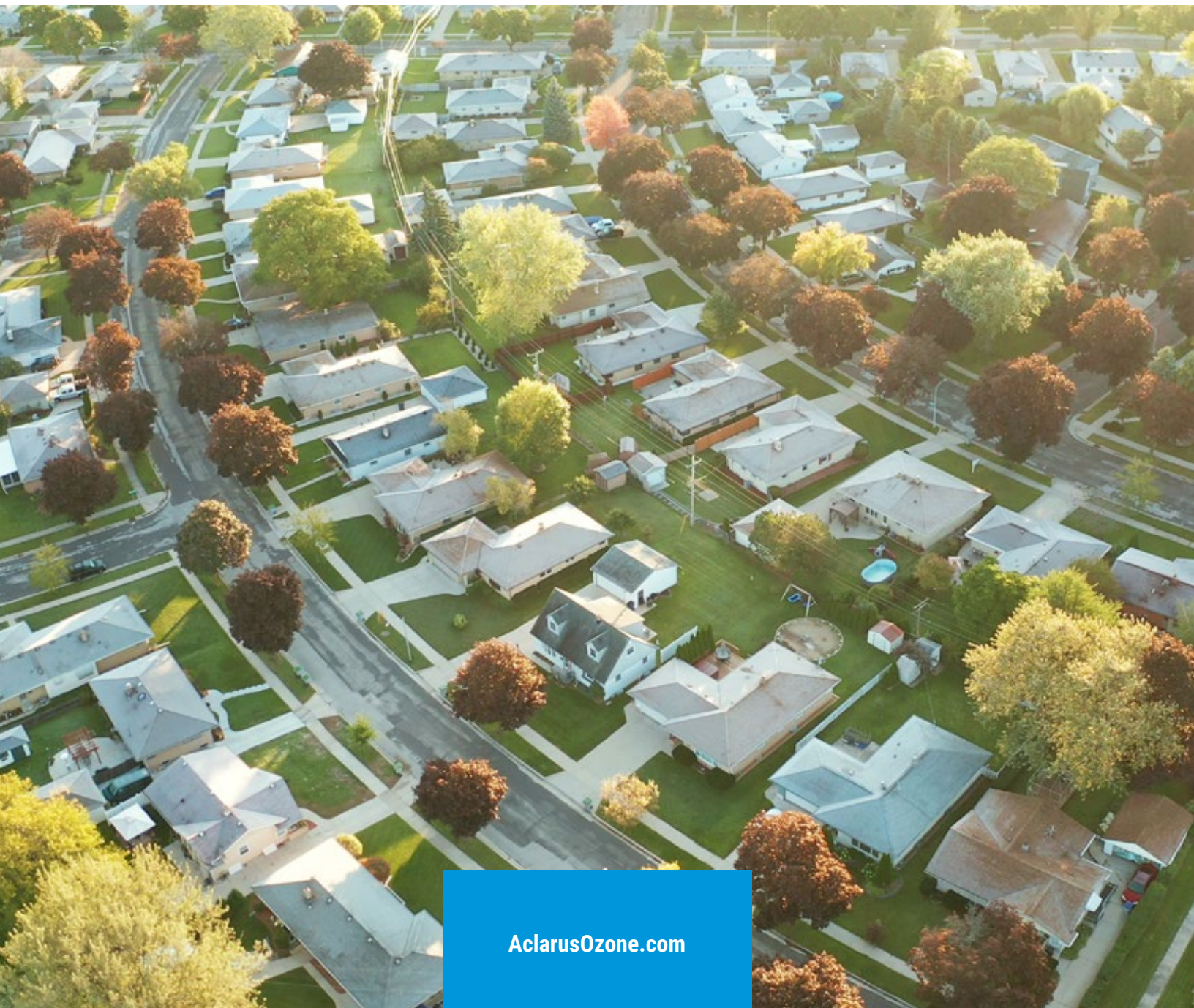


ACLARUS™
OZONE

Municipal

WASTEWATER AND WATER

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AclarusOzone.com

MUNICIPAL

Ozone is a sustainable and environmentally safe treatment for water that is chemical-free, energy-efficient and cost-effective. It has been used for over 100 years for municipal drinking water and wastewater treatment, particularly in Europe.

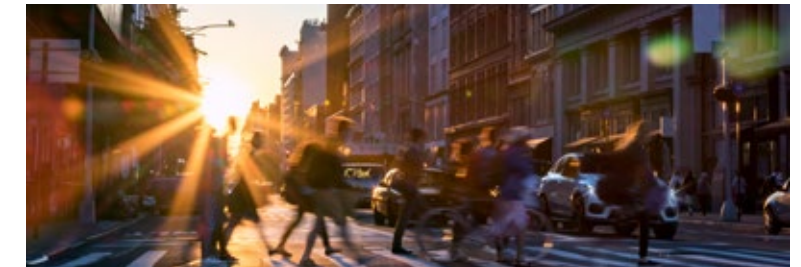
For small-to-mid sized municipalities, with populations up to 100,000, Aclarus Ozone provides water treatment solutions for the following operational challenges:

- ≡ **Drinking Water**
- ≡ **Wastewater**
- ≡ **Ground, Storm and Rain Water**

OZONE ADVANTAGES FOR MUNICIPALITIES

Ozone is an approved disinfection method for municipal drinking water and wastewater. Ozone water treatment technology currently in use in larger cities has not been affordable or practical for small-to-mid sized areas.

However, Aclarus Ozone Systems are designed and engineered specifically for small-to-mid sized municipalities – including First Nations communities – with populations of approximately 100,000 or less. They are cost-effective and can be installed on a small footprint, typically within existing infrastructure.



Ozone is increasingly used in the municipal sector because it has the following advantages over traditional disinfection methods for municipal operations:

- ≡ **Fully automated**; minimal operator requirements;
- ≡ **Environmentally Friendly**; no harmful residual left in the water;
- ≡ **Disinfects and sanitizes** quickly and strongly, **without chemicals**;
- ≡ **Neutralizes metals** in the water, like iron, sulphur and manganese;
- ≡ **Removes** any **colour, taste or smell** with no pre-treatment required,
- ≡ **Removes contaminants**, such as pesticides, organic mater, various microbes, pharmaceuticals and microplastics; and,
- ≡ **Produced onsite**, removing the need to purchase, store and physically handle chemicals;
- ≡ **Lowest Lifetime Operation Cost (LOC)**; and,
- ≡ **Quick Return on Investment (ROI)**.

ACLARUS WATER TREATMENT SOLUTIONS

Drinking Water

Effective treatment of incoming water is an important step for municipalities to ensure the quality of their drinking water. Different sources of water will require different treatment methods and levels of treatment.

Ozone solves multiple treatment issues safely and efficiently. It works to very quickly disinfect and treat water without chemicals, and the treated water is of premium quality, with no chemical residual or by-products.

Regardless of the source of the water, ozone and post-filtration will remove bacteria, chlorine and other chemicals, metals, and even many micro-pollutants such as hormones, pharmaceuticals, microplastics and petrochemicals from municipal water. It also removes colour, taste and smell from the water, an important benefit for municipalities.

Ozone has no impact on pH levels in the water and leaves no residual, as it breaks down to oxygen before use.

Aclarus Ozone offers NSF-61 Certified Systems

NSF-61 is a certification given by NSF International, an independent public health and safety organization that sets stringent health and safety standards for products available to consumers around the world. To receive this certification, Aclarus Ozone Systems must meet or exceed strict standards that ensure that the chemicals and materials used in the production of drinking water are safe. It certifies that all components in the production process have been thoroughly tested to industry standards and will not add contaminants that could pose health risks.

Achieving NSF-61 certification requires a multi-step process that includes performance testing and a comprehensive product literature review. Once a product is certified, end users and regulators have confidence that the product has met the requirements of this rigorous industry standard.

Much of the U.S., as well as countries around the world – including Canada – rely on this certification standard. NSF-61 certification is often mandatory for equipment used in water-treatment facilities.



Wastewater

Most municipalities have regulations to ensure that wastewater leaving treatment plants has acceptable levels of pathogenic bacteria (e.g. E. coli), and they typically use primary and secondary treatment before final disinfection.

Chlorine was long used to disinfect wastewater, but impacts from this stage of treatment has led to changes in regulations. To avoid the harmful effects of chlorine, regulations now require municipalities to have less than 0.02mg/L of chlorine entering the environment.

This restriction often requires the use of more chemicals – such as sulphur dioxide – to remove excess chlorine from the treated wastewater. However, the addition of sulphur dioxide to neutralize chlorine has two effects on the water. First, it reduces the amount of dissolved oxygen in the water, and second, it increases the water's acidity because hydrogen chloride and sulfuric acid are by-products of the process. As a result, chlorine as a treatment solution is an inefficient use of municipal funds and needlessly adds chemicals and by-products to our waterways.

Ozonation of wastewater from municipal treatment plants is an alternative to costly and dangerous chlorination/de-chlorination systems. Ozone can also enhance existing ultraviolet light (UV) waste treatment systems used by municipalities. UV requires clear water to work properly, and ozone can be added as a pre-treatment to clear the water and remove CECs. In addition, when ozone is used after UV disinfection, it has a strong, very quick reaction that is beneficial to treating the wastewater.

Ozone:

- Eliminates chemical by-products:** Converting to ozone will eliminate residual chlorine, sulphur dioxide, and chlorine-containing organic by-products (e.g. trihalomethanes), preventing them from entering local waterways;
- Destroys Pathogens:** E. coli is reduced by 99.9% within seconds of contact with ozone. Lowering pathogen levels in the local waterways will assist municipalities in keeping beaches open during the summer;
- Protects Aquatic Life:** Pilot studies have shown that ozone residual drops to 0.0 mg/L by the midpoint of a contact chamber. As the ozone levels increase, they convert back to oxygen. The oxygen dissolved in the effluent increases, and fish populations benefit from the increased oxygen content in waterways; it also removes colour and odor for truly clean discharge quality;
- Removes Contaminants of Emerging Concern (CECs):** Studies have shown that CECs such as microplastics are entering the environment at unacceptable levels. Studies have also shown that ozone technology out-performs other treatment technologies and can significantly degrade or completely destroy microplastics in the treatment process. (See study references below). Ozone also effectively eliminates other CECs, such as pharmaceuticals and petrochemicals.
- Easily retrofitted with existing equipment, and adaptable:** Ozone can replace or enhance existing chemical systems while using existing infrastructure to minimize capital costs and enhanced integration. The modular equipment, with automated controls, allows for easy expansion and redundancy.

ACLARUS WATER TREATMENT SOLUTIONS

Ground, Storm, Rainwater & Re-Use

With growing concern about water shortages, governments are introducing more regulations that require industry and buildings to re-use water for non-potable use. However, ground, storm and rainwater can be affected by surface influences and therefore require treatment before being discharged into waterways – a process that can strain municipal treatment plants.

Re-using water has significant environmental, economic and social benefits:

- Less storm water for city to treat and discharge;
- Lower costs for building and business owners (lower fees for incoming water and discharge, and no ongoing chemical purchase, storage or safety).
- Less demand from municipalities for potable water treatment used in non-potable sources (e.g. toilets), which leads to lower GHG emissions (from treatment); and,

However, there are challenges in achieving these benefits. Few treatment solutions exist that match the ability of ozone to disinfect and remove colour, metals and other contaminants without the use of chemicals; manage high flow rates; deal with varying water quality from building to building; and, are fully automated and low-maintenance.



With an increase in demand for sustainable solutions to solve re-use and building water issues, ozone is increasingly being employed because of its numerous advantages over traditional treatment methods. Supplementing or replacing an existing system with an ozone system has the potential to reduce costs and lessen environmental impacts.

Ozone:

- Is chemical-free and a sustainable solution;
- Reduces or eliminates fees on discharge and incoming water;
- Is fully automated with remote access, for ease of use and integration;
- Has low life-cycle costs with a quick ROI
- Completely disinfects and removes contaminants, including colour, for assured re-use quality;

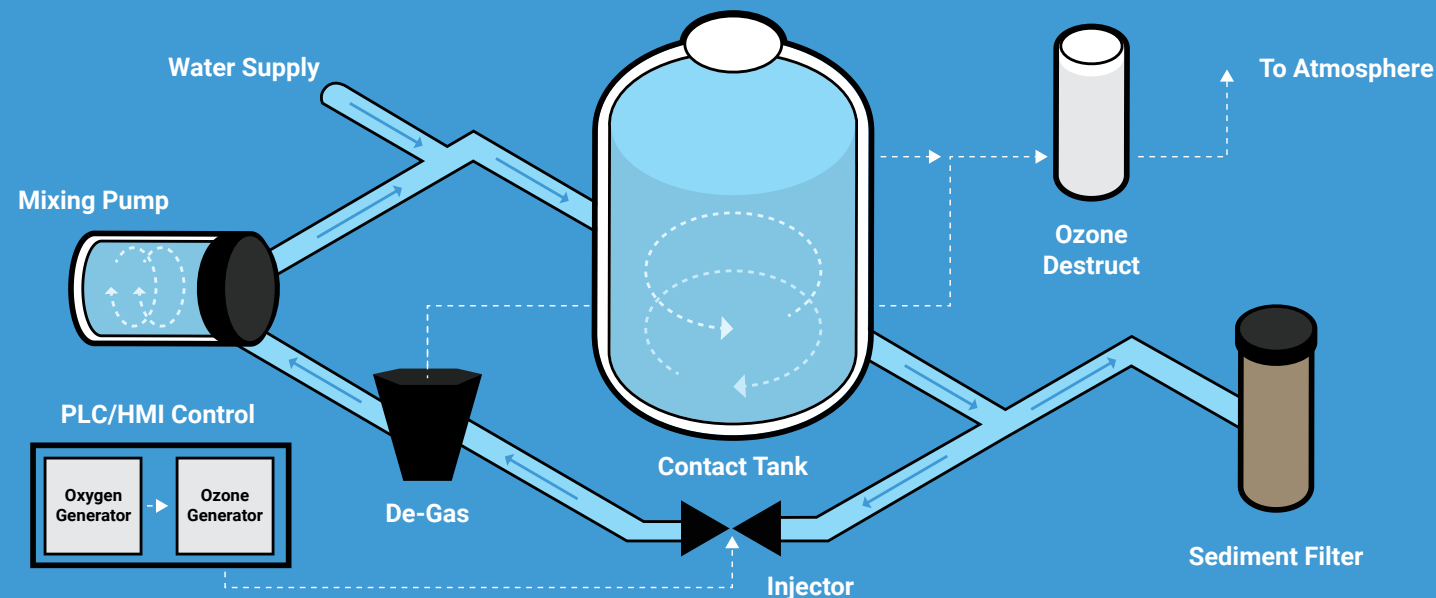
ACLARUS OZONE SYSTEMS OVERVIEW

Aclarus Ozone systems generate ozone on-site, with an ozone level calibrated for each application and flow rate. The systems are scalable and offer advanced ozone generation, mixing and control systems for reliable and accurate treatment. They can range from simple on/off systems to fully programmable control systems with remote monitoring, alarm integration, ozone dose control and more.

Aclarus' advanced saturation systems maximize ozone transfer into water at an average of over 90% compared with traditional transfer rates of approximately 10%. Using inline monitors, the water is measured for automated control to either increase or decrease the ozone level to remain at a set point for optimal function.

Aclarus Ozone systems also remove excess ozone from the water and destroy it, limiting potential off-gassing by using integrated air monitors for safe workspaces.

Following ozonation, the water is filtered and then ozone is either removed for incoming use or not removed and sent for use in sanitation. System controls integrate with other control systems and allow for remote monitoring.



SAFETY

Municipal wastewater plants need safe and reliable technologies to provide final disinfection to remove pathogens from wastewater prior to discharging it into the environment. Operators need safe and reliable systems that are practical and easy to use.

Ozone is generated at the time of use. This eliminates the need for bulk chemical storage, as is the case for chlorine. In the event of an ozone leak, an ozone sensor will shut down the system, activate a flashing red warning light, and turn on an exhaust fan. The flashing red light will deactivate once ambient conditions are safe for human entry. Even without the ventilation fan, the ozone would break down spontaneously within minutes of its release.

A chlorine leak, on the other hand, requires operators take extreme safety precautions prior to entering the room. They must wear protective suits to prevent skin contact and use self-contained breathing apparatus (SCBA) to prevent inhalation. Ventilation of chlorine to the outside, without prior neutralization, presents a safety concern for bystanders.

Studies have also shown that chlorine can react with organic components of the wastewater effluent to form carcinogens such as trihalomethane. By contrast, ozone does not react with organic components; rather, it breaks down into organic compounds.

And, as mentioned above, when sulphur dioxide is added to neutralize chlorine, it reduces the amount of dissolved oxygen in the water, and increases the water's acidity because hydrogen chloride and sulfuric acid are produced.



COST COMPARISON

There is a common perception that ozone is an unaffordable approach to water treatment. In fact, the average operational cost of the Aclarus Ozone System is approximately 5-10 cents per 1,000 litres of treated water, offering the lowest Lifetime Operating Cost (LOC) compared to other technology and a quick Return on Investment.

Aclarus Ozone systems are found in a wide range of applications – including municipal operations – precisely because they are a cost-effective and reliable treatment. There is significant independent research demonstrating the savings for municipalities when switching to ozone.

The savings are found in four categories:

- Less Monitoring of Equipment:** Unlike the conventional chlorination systems, the Aclarus Ozone System requires very little operator intervention. A local programmable logic controller (PLC) continuously monitors oxidation readings and adjusts the ozone generator to maintain the pre-determined setting. If the oxidation goes out of range, equipment fails, or an ozone leak occurs, an automated alarm system alerts the operator. A single Accuvac Ozone Test is performed once per day to confirm that the oxidation-reduction potential (ORP) is reading accurately.
- Easier Regulatory Compliance:** Due to government regulations on chlorine discharges into waterways, significant operator time is spent monitoring and controlling the chlorine and sulphur dioxide feeds. Incomplete disinfection is a regulatory violation, and the operator time required to ensure compliance with regulatory bodies is significant. Conversely, ozone control is completely automated, and since the ozone rapidly degrades to oxygen, it is unnecessary to remove the ozone post-disinfection. Operator time to control the ozone is therefore minimal.
- Lower Peripheral Costs:** Producing ozone requires more electricity than running a chlorination system. However, ozone does not have the same peripheral costs as chlorine, including the purchase of the chemical and the costs associated with its safe handling and storage. UV systems can be more costly than ozone because they require a UV chamber that increases an organization's CAPEX costs, use more electricity, and require the regular replacement of bulbs.
- Reduced Maintenance:** Chlorine is extremely corrosive and damaging to nearly every component with which it comes into contact. The chlorine transfer lines and regulators must be cleaned/replaced annually. The ozone system uses 316 stainless steel for all its transfer lines, so maintenance cost is negligible. UV systems, meanwhile, require regular monitoring of UV bulbs and their periodic replacement. The bulbs also end up in landfill.

Example of 10% Cost Savings from Municipal Wastewater Treatment Plant

| Expense Item Units (\$/yr) | Ozone | Chlorine / Sulphur Dioxide |
|-----------------------------------|-----------------|----------------------------|
| Chemical Costs | - | \$19,000 |
| Electricity Costs | \$35,000 | - |
| Container Deposit | - | \$6,000 |
| Annual Maintenance | \$600 | \$8,000 |
| Alarm / Calibration Testing Costs | \$1,000 | \$1,000 |
| Safety Equipment | \$100 | \$5,000 |
| Annual Labour Costs | \$60 | \$1,200 |
| Lab Testing | \$1,500 | \$1,200 |
| Total Annual Cost | \$38,260 | \$41,400 |

Engineered for a Wide Range of Applications



Modular Design, Easily Expandable



Compact Design, Small Footprint, Retro-fit ready

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GET IN TOUCH

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