

Monitoring total residual oxidants in power plant discharge water

Government regulations for total residual oxidants

The U.S. Clean Water Act requires all facilities that discharge cooling water blowdown to follow guidelines set by the Environmental Protection Agency (EPA) for National Pollutant Discharge Elimination System (NPDES), which set the discharge limit for total residual oxidants (TRO) in the water and related monitoring and reporting requirement. A few examples of Individual NPDES Permits include*:

Wisconsin:

Current permit limits set at 0.038 mg/L TRO

North Carolina:

Current standards are 0.017 mg/L TRO for trout waters

- 0.017 mg/L TRO as an action level for non-trout waters.

Pennsylvania:

Current permit limits set at 0.011 mg/L TRO

Free chlorine in disinfection

Free chlorine refers to both hypochlorous acid (HOCl) and the hypochlorite (OCl⁻) ion or bleach, and is commonly added to water systems for disinfection. When ammonia or organic nitrogen is also present in the water with free chlorine, they will react to form chloramines, such as monochloramine, dichloramine, and trichloramine. Chloramines are also known as combined chlorine. Total chlorine is the sum of free chlorine and combined chlorine.



The Thermo Scientific™ Orion™ 7070iX TRO Analyzer is able to monitor most common oxidants, and can help ensure your plant meets pollution control guidelines.

Monitoring TRO in effluent water

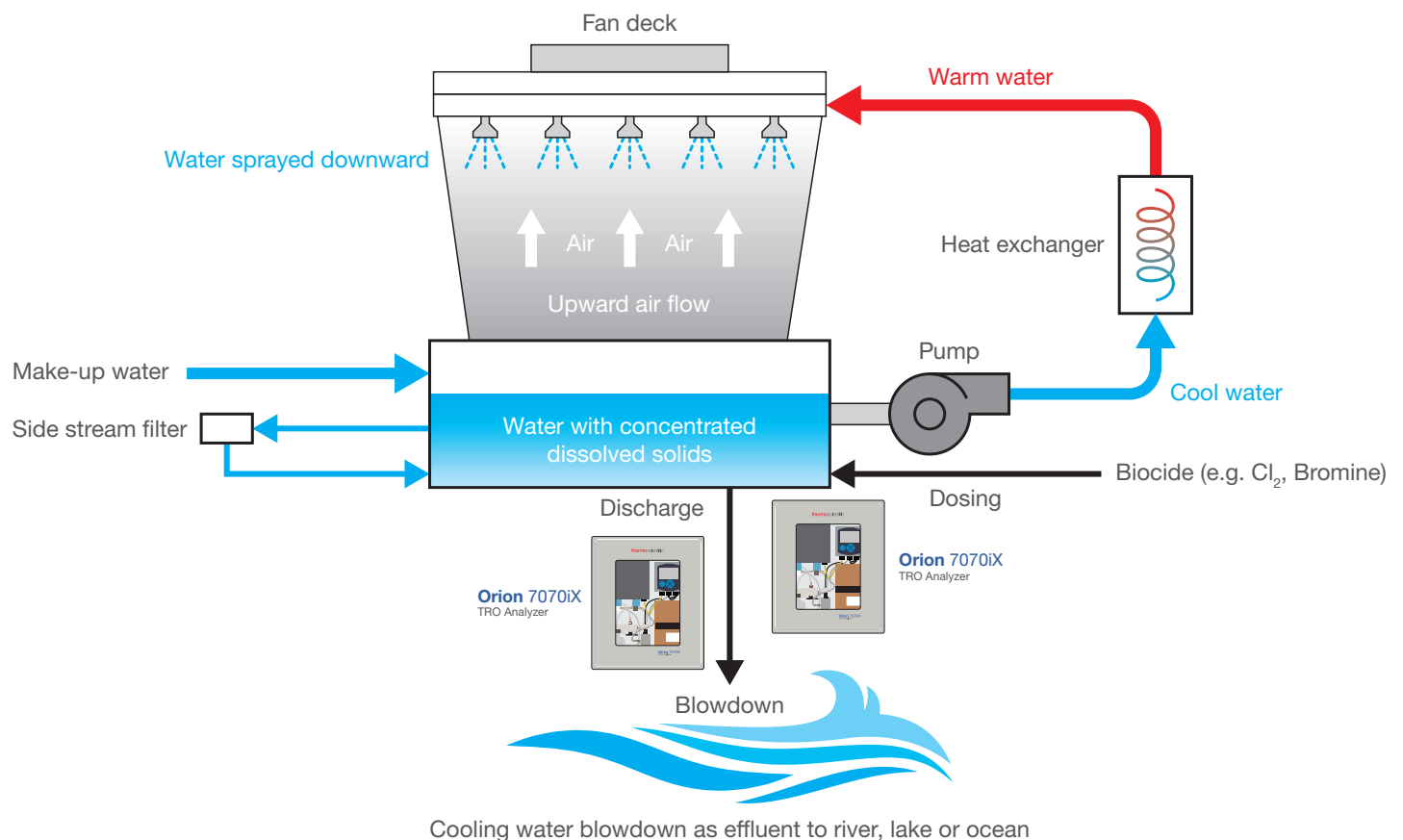
The Thermo Scientific™ Orion™ 7070ix TRO Analyzer measures all common oxidants including, chlorine, chloramines, bromine, chlorine dioxide, and ozone, in water used for disinfection, and not dissolved oxygen (DO). The primary monitoring parameter is TRO, and it can measure in a range from 15 ppm to 1 ppb, helping ensure that you are able to meet parameters set by regulators.

The secondary monitoring parameter is total chlorine. The direct measurement reading of the TRO analyzer is often equal to total chlorine (when no bromine or ozone is used). For customers that have a consistent water source, the ratio of total chlorine to free chlorine is constant, so free chlorine can be calculated based on the ratio derived from total and free chlorine testing of sample water onsite. This was validated and explained in a case

study of TRO application at a power plant that use river water for cooling water makeup, which can be found at thermofisher.com/troanalyzer.

How can the Orion 7070iX TRO Analyzer help a plant meet regulations?

Anywhere water with disinfectant is discharged as effluent to surface water, which in the United States is regulated by the NPDES permit program and enforced by EPA. The Orion 7070iX TRO Analyzer can be used to monitor TRO online to help ensure compliance with your plant discharge NPDES permit. The analyzer is able to monitor and report TRO in real time, allowing users to tune or control their oxygen scavenger dosage to quench excess TRO and potentially avoid violation of their NPDES permit.



The above image shows the Orion 7070iX TRO Analyzer installation recommendations for cooling tower application in power plants.

Also, anywhere biocide, e.g. Chlorine, bromine, chloramine, and ozone, is dosed into water for disinfection. If your plant has a consistent water source, the ratio of total chlorine to free chlorine is constant, so free chlorine can be calculated based on the ratio derived from total and free chlorine testing of sample water onsite. Customers can use free chlorine calculated to tune or control biocide dosing.

Finally, anywhere de-chlorination is needed. Plants that have an RO membrane for pretreatment or production of ultrapure water, need to dechlorinate the water to prevent RO membrane damage. A TRO analyzer can be used to monitor total residual oxidant for tune or control oxygen scavenger dosage before it reaches the RO membrane to reduce RO membrane replacement frequency.

Where are the recommended installation locations in a plant for the Orion 7070iX TRO Analyzer?

- **Cooling towers:** Cooling towers use chlorine and bromine based biocides for disinfection and a TRO analyzer is appropriate here for monitoring and dosing control of disinfection or biocides. The discharge regulation often requires fewer than 100 ppb, or 0.1 mg/L of TRO.
- **In what conditions with the Orion 7070iX TRO Analyzer perform best?** It's best to place the TRO analyzer in an indoor location where no freezing condition is present, to avoid the reagents freezing. As delivered, it is not suitable for hazardous locations either.

The product specifications that include installation and sample requirements are below. The quick start guide, which provides instructions for installation can be found at thermofisher.com/troanalyzer.

Will the Orion 7070iX TRO Analyzer work if it comes in contact with debris or particles larger than 130 micron?

If your plant treats water that has particles larger than 130 micron, you will need to make simple adjustments to the TRO analyzer using accessory parts for optimal performance. This can be done by installing the 130 nm pore size Y-strainer, which is provided, prior to analyzer inlet. The sample inlet and sample return overflow fittings on the bottom of analyzer require 1/4-inch OD (6 mm OD) flexible tubing. Then, connect the inlet sample Y-strainer to the 1/4-inch tube through an adaptor, which is also provided. Next, connect the inlet sample Y-strainer with a 1/2-inch NPT pipe thread. Finally, the waste drain fitting at the bottom of the analyzer needs to be adjusted. This requires 3/8-inch OD (9.6 mm OD) flexible tubing.



Y-strainer (1/2" NPT)



Adaptor



1/4" Tube

Product Specifications

Orion TRO Analyzer	
Measurement Performance	
Measuring Range	0.001–15 ppm
Accuracy	Less than 5% of reading or 10 ppb, whichever is greater from 0.001–15 ppm
Resolution	0.001 ppm in all ranges
Response Time	95% within three minutes
Precision	±2% of reading or ±10 ppb, whichever is greater from 0.001–15 ppm
Limit of Detection	0.001 ppm
Method	Based on electrode 9770 ISE EPA approved standard method
Environmental	
Ambient Operating Temperature	5 to 45 °C (41 to 113 °F)
Maximum Humidity	85% at 40 °C (104 °F)
Sample Requirements	
Sample Flow	40 mL/min
Sample Pressure	5–50 psig
Sample Supply	Continuous
Sample Temperature	5 to 45 °C (41 to 113 °F)
Max TSS	1000 ppm
Max particle size	130 microns
Max Turbidity	500 NTUs
Chlorine	up to 20 ppm
Sample Inlet/Outlet Connections	1/4" LLDPE Tubing — length 2 ft min
Drain Tubing	1/8" LLDPE Tubing — length 2 ft min
Sample Streams	One
Construction	
Enclosure Integrity	IP54
Enclosure Dimensions	27.9 inches x 18.8 inches x 12.4 inches
Shipping Weight	20 kg (45 lbs) without reagent
Electrical	
Power Requirements	100–240 VAC, 50/60 Hz, 40 watts

*<https://dnr.wi.gov/regulations/labcert/documents/training/CL2SimpleTRC.pdf>, Accessed May 14, 2019.

Find out more at thermofisher.com/troanalyzer

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