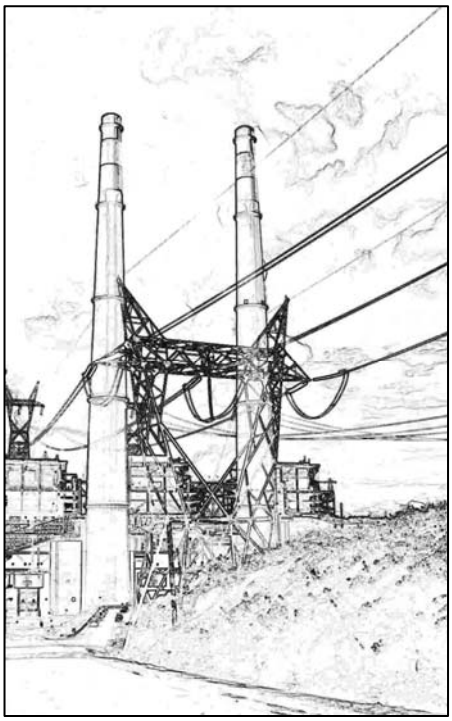
THORNTON

Leading Pure Water Analytics

Application Bulletin

The Problem of Organics in Power Plant Waters

While most efforts at producing pure water are aimed at removing minerals, these processes do not necessarily remove organic compounds. There is an increasing awareness of the kinds of trouble that organics can cause and this can drive changes in water treatment methods. Key to confirming and trouble-shooting organics removal processes is a reliable TOC measurement.



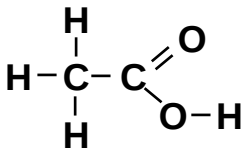
Effects of Organics

Organic contamination of pure power plant waters can cause a number of costly problems: It can foul resins in make-up and condensate deionizers and require more frequent resin cleaning and replacement. It can break down to organic acids that lower the pH of early condensate and cause turbine corrosion. It can deposit along with other contaminants onto heat exchange surfaces and significantly reduce efficiency. It can cause foaming in the boiler and increase carryover of other contaminants into the steam. Organics are a major concern in plants where any of these problems occur.

Sources

The major source of organics is make-up water. Surface waters have higher levels of naturally occurring organics than ground waters. But ground water sources are being depleted in many areas. As a result, there is greater reliance on surface water, reclaimed water and even municipal wastewater as the raw source for high purity make-up water for the water/steam cycle. A further complication is that surface water sources typically have significant seasonal variations in concentration and types of organics. A treatment system that produces water with low organics during one season may be seriously challenged in another season. Even greater changes in source water composition hit a treatment system if it must alternate between surface water high in organics during wet seasons and ground water high in minerals in dry periods. There are a number of unit operations that can reduce organics in make-up water including improved flocculation, membrane processes, final oxidation, and others. Treatment must be tailored for the specific water composition and site conditions.

The second most important source of organics is from ion exchange resins in the treatment system. They are, after all, organic polymer beads. Resin fines from physical breakdown can find their way into the steam cycle if they are not trapped. Chemical breakdown of resins can produce trace contaminants: sulfonic acids from cation resins and amines from anion resins. In addition, traces of processing solvents may also be released. These contaminants may include inorganic constituents in their structure such as chloride and sulfate that are released in the steam cycle through thermal degradation and become even more corrosive.



Additional sources of organic contamination are directly in the steam cycle, including pump lubricants, condenser leaks, condensate polishing resins, and any condensate return from cogeneration processes such as refineries, pulp & paper, and sugar mills. Of course organic cycle chemistry additives, where used, represent high levels of organics that must be compatible with the overall cycle.

Detection

Conductivity is the common and economical measurement for detection of ionic contaminants—usually minerals. Conductivity will detect organic acids and bases but is insensitive to the majority of organic contaminants. For this reason, total organic carbon (TOC) analyzers oxidize organics to an ionic form as carbonic acid in order to detect them by conductivity. The increase in conductivity after oxidation gives a measure of the amount of carbonic acid produced. With proper calibration, it can provide readout as ppb TOC.

Monitoring TOC in the make-up water treatment system after the last deionization stage is the most important checkpoint for organics to prevent them from entering the cycle. Additional measurements upstream can help diagnose where the organics are getting through, e.g. whether it is a membrane failure or ion-exchange resin deterioration.

For these points in the make-up water treatment system, the Thornton 5000TOC Sensor with 770MAX Multiparameter Analyzer/Transmitter provides an ideal and economical analytical detector. The 770MAX can accept 2 TOC sensor and a total of 4 analytical sensors, including conductivity, cation conductivity, pH, ORP or dissolved oxygen, plus two flow sensors. See Thornton data sheets ML0067 for more information on the 770MAX Instrument and ML0103 for more information on the 5000TOC Sensor.

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