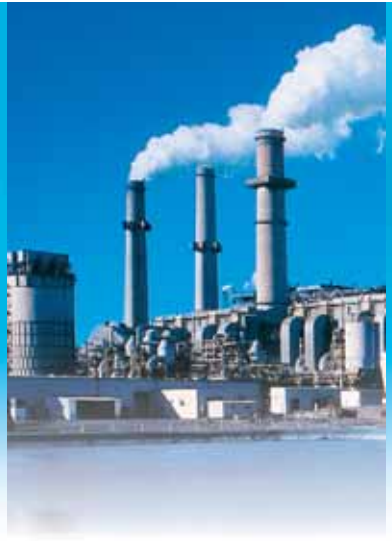
Power Generation

Perspectives in Pure Water Analytics



8 News

THORNTON

Leading Pure Water Analytics

TOC Measurement Protects
High Pressure Cogeneration Assets

Cogeneration plants receiving steam condensate return from organic chemical processes are concerned with contaminants entering their boilers. TOC measurements on condensate return are essential to warn of organics intrusion.

Coal Creek, one of the first high pressure cogen plants

With the increasing demands for efficient production of biofuels and fuel additives, more cogeneration opportunities are being developed. One such development is the construction of the Blue Flint ethanol-from-corn plant next to the Coal Creek Station of Great River Energy in Bismarck, North Dakota. Operational since 1980, Coal Creek has been a top performer in several national rankings of power plants as one of the most reliable and cost-efficient in the country. It is now one of the first high pressure plants to enter into a cogeneration contract in the U.S., with plans to produce 50 million gallons per year of ethanol as a fuel additive. Coal Creek has two lignite-fired 2800 psi (195 bar) boilers producing a total of almost 1200 MW. Its 450 GPM (1700 LPM) of condensate runs about 9.2 pH, specific conductivity near 1.0 µS/cm and cation (acid) conductivity near 0.15 µS/cm.

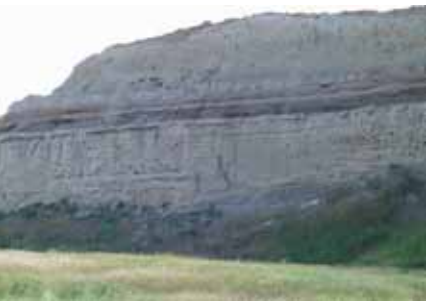
THORNTON solution for Coal Creek Station's concern

To preserve its excellent track record with this major change in operation, Lab supervisor Ken Norton and his Lab team recognized the need to have fast detection of ethanol leakage into the condensate. The plan is to have two TOC systems to be used at the ethanol plant and one at the hotwell effluent of each unit. Several types of TOC analyzers plus the THORNTON 5000TOC Sensor with 770MAX Multiparameter Analyzer/Transmitter were evaluated.

METTLER TOLEDO

Implementation of the measuring systems

To maximize sensitivity using the 5000TOC, the condensate sample was first run through a cation exchange column, the same as used for cation (acid) conductivity measurement. This removes the ammonia and lowers the sample pH to a range where the TOC measurement is more sensitive. The background TOC was found to be near 10 ppb. The evaluation was performed by spiking the condensate just ahead of the cation exchange column to produce known ppb levels of methanol, ethanol and sucrose. Response correlated well with the concentration calculation based on flowrate and organic injection quantities.



Coal deposit in North Dakota.

Fast response time – an important criterion

Response time is also critical to catch any organics before they enter the hotwell. It was found necessary to use a smaller diameter cation exchange cartridge and higher sample flowrate to achieve the desired fast response. The resulting higher flow velocity also provides the benefit of more complete exchange as the turbulence within the resin reduces the boundary layer around the beads, assuring intimate contact and less chance of channeling.

Customer benefits

After evaluation of several TOC measuring systems, Ken Norton favored the Thornton 5000TOC with 770MAX because of its simplicity, easy maintenance, consistent response and moderate cost.

Key benefits of the THORNTON 5000TOC sensor

- Continuous flow design provides rapid TOC response with complete oxidation
- No gases or reagents to handle, store or replace and no moving parts minimize routine maintenance and service intervals
- Smart sensor design reduces installation and setup time
- Real-time continuous monitoring for precise data trending and better process control
- Wide dynamic operating range meets the needs of pure and ultrapure water applications
- Two TOC measurement points with one 770MAX instrument for cost-effective installation
- Compact NEMA 4X rated enclosure for demanding industrial environments
- Meets ASTM D5173 standard test method for on-line TOC monitoring
- Conductivity sensor and measurements traceable to NIST and ASTM

Key features of THORNTON 770MAX Multiparameter transmitter

- Extensive measurement capabilities: six channels and display with 16 measurements on 4 line screen with auto or manual scrolling
- Alarm/control and 8 analog outputs
- Compact size
- Cost effective: one instrument and one panel cutout for 6 sensors
- Minimal wiring with plug-in sensors

The THORNTON 770MAX and 5000TOC system provided lower maintenance and lower costs than alternative instruments. Its response to known injections of various organic contaminants confirmed that it met the detection requirements for the application.

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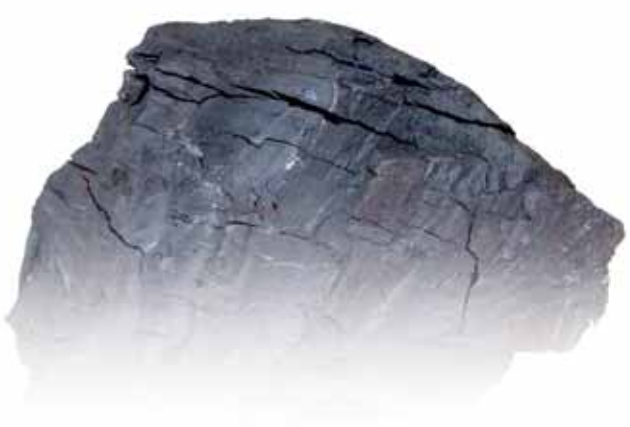
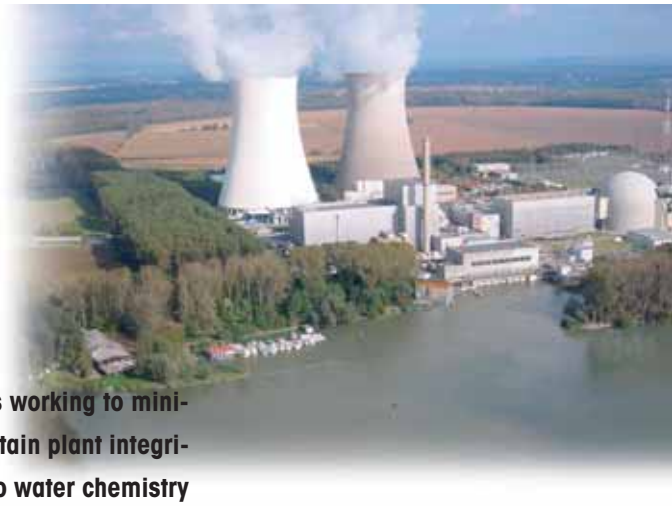




Nuclear Plant Utilizes
THORNTON TOC Analyzer

Boiling Water Reactor nuclear power plants are always working to minimize corrosion, minimize radiation exposure and maintain plant integrity. To meet these goals simultaneously, adjustments to water chemistry must be carefully chosen not to produce unwanted side effects.

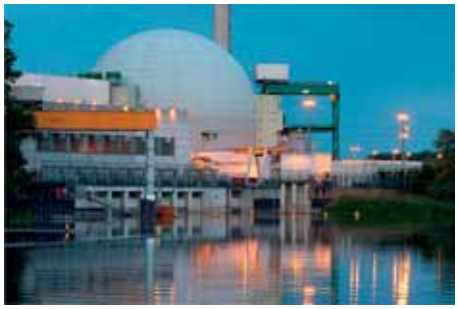
Successful evaluation

In some plants methanol has been evaluated for its ability to reduce radiolysis-induced corrosion. To implement this kind of evaluation, the concentration of methanol has to be carefully monitored and controlled. Continuous and fast responding measurements are also important to achieving the correct balance.

Philippsburg Nuclear Power Plant in southwestern Germany purchased a Thornton TOC analyzer for evaluation of the methanol injection technique. It provided rapid, continuous analysis of the methanol without reagents, membranes or moving parts. Its light weight, compact size and user-friendly operation made it particularly convenient for that purpose.

Further application

After completion of the methanol evaluation, Philippsburg later found the Thornton TOC analyzer to be useful during a plant shutdown for an outage. Ascorbic acid was dosed into the reactor water to reduce volatility of radioactive iodine species. The TOC analyzer provided ascorbic acid concentration measurements that assured proper lay up.



Simplicity of operation

The TOC analysis is made by oxidizing the organics in a continuously flowing sample to carbon dioxide using high intensity ultraviolet light. The carbon dioxide forms carbonic acid and bicarbonate ion which raise the conductivity of the sample. Continuous conductivity measurements before and after the UV exposure are compared. From the difference between these two values, the organic content is determined. The simplicity of this technology yields a low-maintenance, rapid and continuous measurement.

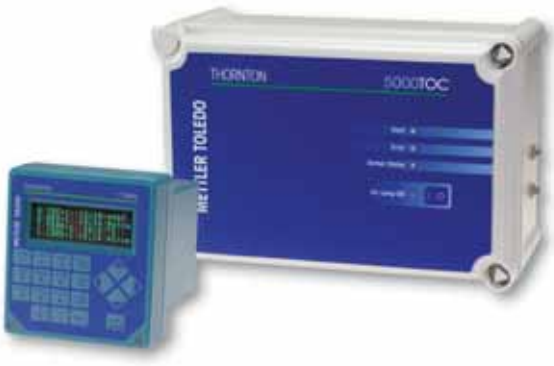
Reliable contamination detection

The same measurement technology can be applied to detection of contaminating organics in any steam power plant. These can come from various sources, the most significant of which are the makeup water and deteriorating or poorly rinsed ion exchange resins.

The worst contaminants are organic compounds that include halides or sulfur. In unionized organic compounds, these materials will not be detected by conductivity alone. However, they typically break down into highly corrosive chlorides and sulfates in the steam generator or boiler when it is too late to remove them. Detection earlier in makeup water treatment is key to preventing them from entering the cycle. Again, the simple, continuous and fast responding analysis from Thornton TOC instrumentation provides excellent means of protecting the power generation components.

The new Thornton 5000TOC sensor with 770MAX Multiparameter Analyzer/Transmitter operates with the same technology as the predecessor TOC analyzer used at Philippsburg and provides even more convenience of operation.

770MAX with 5000TOC Sensor detects inorganics (conductivity) as well as organics (TOC).



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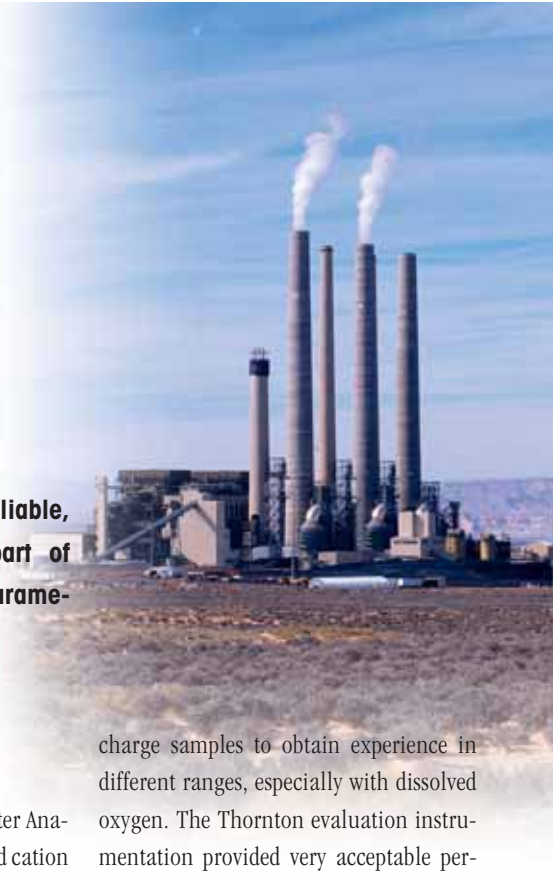

770MAX Found Ideal
for Cycle Chemistry Upgrade

Many power plants have gone through life extension projects. Reliable, up-to-date process analytical instrumentation is a critical part of extending that life and the increasing capabilities of new multiparameter instruments can make it very worthwhile.

Wider perspective on instrument upgrades

Aging process analytical instrumentation can be costly, both from the parts and labor needed to keep it running and from the loss of valuable measurement information after failure, often when it is most needed. Aging instruments have had issues with reliability, requirements to replace backup batteries for memory, and parts obsolescence. When looking at a new generation of instrumentation it is worthwhile to consider the wider capability of multiparameter designs.

Need for upgrade recognized

For example, a mid-western U.S. power plant planned to upgrade the cycle chemistry monitoring instrumentation as well as adding ORP measurement on one of their 350 MW coal-fired units built in the 1950s. Their 10-year old installed instrumentation was beginning to fail at an unacceptable rate. The head chemist learned about the advantages of the Mettler-Toledo Thornton multiparameter instrument platform from a presentation at a recent EPRI conference. He was especially intrigued with the pH calculation from specific and cation conductivity at no additional cost. The calculation provides high accuracy backup to the traditional pH electrode measurement. The benefits of commonality of sensor interface and instrument operation were also evident. He requested more information and an opportunity to evaluate the equipment himself.

Demonstration equipment installed easily

A Thornton 770MAX Multiparameter Analyzer/Transmitter with specific and cation conductivity, pH and dissolved oxygen sensors were placed on evaluation on that unit and compared with the existing equipment. Installation was exceptionally easy. With a pre-piped evaluation panel, connecting sample and drain tubing for the sensors and adding output signal wiring for all measurements from the 770MAX to the plant data acquisition system were completed in just a couple of hours. A short presentation was provided to brief the chemist on the operation and capabilities of this platform.

Successful evaluation

After acclimating to sample conditions and calibration, the sensors delivered consistent signals. Over the evaluation period, measurements were made on both deaerator outlet and condensate pump discharge samples to obtain experience in different ranges, especially with dissolved oxygen. The Thornton evaluation instrumentation provided very acceptable performance for all parameters and was found to be "much better" than existing equipment for dissolved oxygen.

As a result, the chemist approved replacement of 27 points of conductivity, pH and dissolved oxygen plus 6 new points of ORP using the 770MAX Multiparameter Analyzer/Transmitter platform. The equipment will fit easily into the existing panel space, using only 9 of the 770MAX Transmitters and leaving 3 additional channels of measurement available for future requirements. It is anticipated that upgrades in other company plants will benefit from these same capabilities.

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THORNTON 770MAX portable sample panel used for evaluation.

Conductivity Standards

Conveniently Available from THORNTON

THORNTON conductivity standard solutions provide a way to verify or calibrate the conductivity sensor cell constant after the period of initial calibration has expired. Similar to pH buffer solutions, conductivity standard solutions can be used periodically to confirm the accuracy of readings.

Stability of cell constant

A conductivity cell constant is generally quite stable. THORNTON conductivity sensors are factory calibrated with traceability to ASTM and NIST and are certified for a period of one year from installation under normal operating conditions. Long-term evaluations of our sensors in clean makeup water systems have shown changes of less than a percent over several years of operation. However, in cycle chemistry monitoring with temperature excursions or corrosion product deposition and the resulting cleaning can result in changes.

Accuracy verification

The cell constant has direct impact on the critical specific and cation conductivity measurement accuracies. For this reason, a 1 to 12 month verification period for conductivity sensors is commonly practiced, depending on the application.

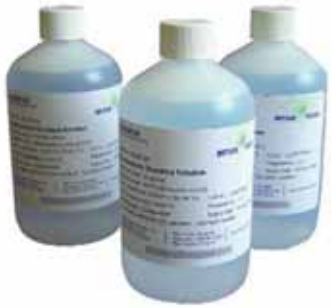
For this verification, there are three options:

1. Return the sensor to the factory for recalibration.
2. Compare measurements with a recently calibrated plant standard system such as the THORNTON 1885 Portable Conductivity / Resistivity Calibration System.
3. Verify and / or calibrate in a conductivity standard solution.

Use of conductivity standards

THORNTON conductivity standard solutions are provided for this third option with values from 25 to 100,000 µS/cm. Although many conductivity measurements are made below 25 µS/cm the use of very low conductivity standards is not recommended. Low conductivity standards are much more vulnerable than pH buffer solutions to contamination by variable amounts of CO_2 from the air and from other sources. The buffering capacity of pH standards tends to resist pH change and makes them much more forgiving of contamination. Conductivity standards on the other hand are directly affected by dilution or contamination and their values will change readily, especially at low values.

The wide rangeability and consistent linearity of THORNTON measuring systems between 100 µS/cm and pure water has been shown to provide much better accuracy in practice than is typically obtained using standards below 100 µS/cm. You can use conductivity standards with confidence and know that your THORNTON instruments are reading accurately right down to ultrapure water.



THORNTON conductivity standards.

THORNTON 1875 Portable Calibration System.

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Training and Technical Services

On-site instrument operation and calibration training workshops

THORNTON's Operator Training Courses are tailored to each customer's requirements. The course is conducted in a classroom setting where interaction between instructor and participants is encouraged. Each attendee is supplied with material detailing the course content. Instruments are provided for hands-on participation. The areas covered in this training program focus on THORNTON instrumentation, calibration, and maintenance specific to your facility. Additional technical topics may be added or substituted as requested.

Traceable instrument calibration

THORNTON offers instrument calibration and validation services traceable to national standards, industry guidelines and/or regulatory requirements. Services using factory-trained technicians are available at our facilities in Bedford, Massachusetts or on-site at your location. Each calibrated/validated instrument is supplied with the appropriate calibration documents.

Specialized conductivity calibrations

Choose one of seven unique conductivity calibrations to fit your application needs, from standard calibrations to customer-specified temperature and ASTM verification points. System calibrations are also available where the instrument and sensors are calibrated together optimizing system accuracy.

Tradeshows Semiconductor	Location	Dates 2007
SPWCC - 25th Anniv.	Santa Clara, CA USA	Febr 12-14
SEMI - China	Shanghai, China	March 21-23
UPW - PA	Philadelphia, PA USA	April 17-18
SEMICON West	San Francisco, CA USA	July 17-19
SEMI - Taiwan	Taipei, Taiwan	Sept 12-14

Tradeshows Power Generation	Location	Dates 2007
UPW - PA	Philadelphia, PA USA	April 17-18
Champaign Utility Chem.	Champaign, IL USA	May 15-17

Tradeshows Pharma UPW	Location	Dates 2007
Interphex PR	San Juan, Puerto Rico	Febr 1-2
Interphex East	New York, NY USA	April 23-25
UPW - PA	Philadelphia, PA USA	April 17-18
ISPE - Boston	Foxboro, MA USA	Sept 10-13

Service and calibration contracts

A THORNTON representative will provide on-site service for items covered under the agreement. These services include, but are not limited to:

- Calibration/validation of instrument and sensor system
- Issuance of appropriate documentation
- Identification and verification of all software revisions
- Minor repairs or adjustment of instruments
- Installation and validation support services
- TOC test services
- On-Site System Suitability Testing

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