Power Generation
Perspectives in Pure Water Analytics

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News

THORNTON
Leading Pure Water Analytics

Faster Startups and Less Corrosion
Thanks to Degassed Cation Conductivity

With accurate and reliable conductivity measurements using UniCond® sensors, the new DCC 1000 System confirms water purity to minimize corrosion and can reduce startup time by up to 40 %.

Selecting the right conductivity measurement

The importance of monitoring conductivity in order to confirm feedwater or steam condensate purity is well recognized. What is less well acknowledged is that the chosen method of conductivity measurement may be providing a false picture of cycle chemistry conditions.

An increase in conductivity occurs with an increase in corrosive contaminants such as chlorides and sulfates, but that is almost negligible compared to the background conductivity of non-corrosive treatment compounds such as ammonia or amines. Such chemicals and their conductivity effects can be removed using a cation resin column. However, the cation column will not remove carbon dioxide, and a significant amount of the conductivity measured after a cation exchanger can be caused by CO_2 as bicarbonate ion. Although it is not a significant cause of corrosion, its presence obscures the actual conductivity from key corrosion-causing contaminants such as chlorides and sulfates.

CO_2 removal gives far greater accuracy

The answer is a degassed cation conductivity system. This eliminates carbon dioxide interference and therefore provides a clear picture of what the actual level of corrosive contaminants is.

The degassing is accomplished by raising the sample water temperature to near the boiling point which releases the carbon dioxide from the water. The sample is then

METTLER TOLEDO

cooled and a conductivity measurement determines the actual level of chlorides and sulfates.

New solution, new level of performance

The DCC 1000 System uses the latest technology in conductivity measurement to accurately and reliably measure conductivity at various stages of sample conditioning to give a more precise view of plant cycle chemistry.

UniCond sensors used in the DCC 1000 are the best available probes for the measurement of conductivity in ultrapure water, giving the greatest accuracy at the lowest levels of detection. The DCC 1000 System measures the conductivity after the cation resin column as well as after degassing to provide comprehensive information on the various contaminants in the water.

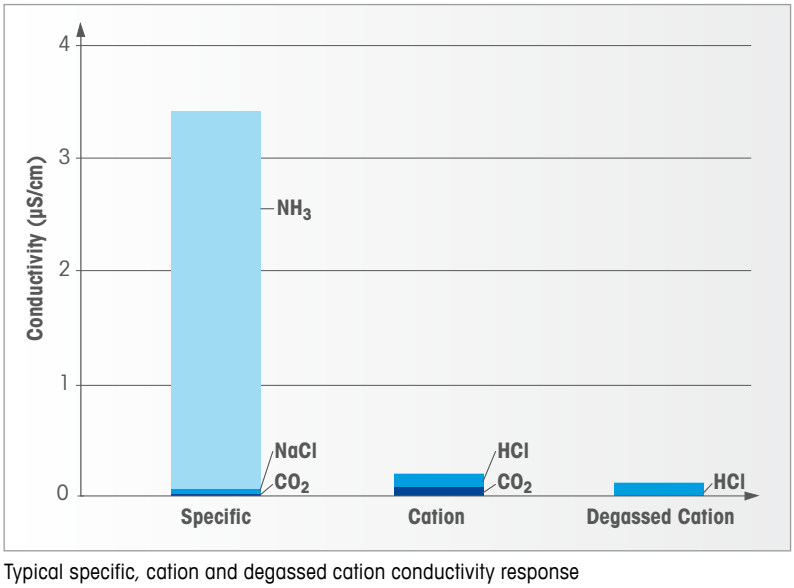
Faster plant startups

It can take many hours during plant startup for water chemistry to reach required levels. This is often due to CO_2 interference in cation conductivity monitoring. The DCC 1000 System can reduce startup time by as much as 40 %, helping you maximize production uptime.

Features and benefits

- All components are mounted on the front of the system, with no tubing or wires on the back. This allows the system to be attached to any flat surface or rack in the water sample room.
- The DCC 1000 requires no external source of cooling water which results in simpler, faster, and cheaper installation and offers more mounting location options.
- The M800 Transmitter in the system offers calculated pH and calculated ppm CO_2 measurements, for better process control.
- A single screen on the M800 can display all parameters and measurements, allowing easy monitoring of cycle chemistry.
- Individual alarms and analog outputs are available for all measurements.
- There are no moving parts in the system, for more reliable operation and minimizing maintenance requirements.
- For safety, a sensor shuts down the system's heater in the event that sample water flow stops.

► **www.mt.com/DCC1000**



Typical specific, cation and degassed cation conductivity response

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Confidence in Ultrapure Water Systems
with a Pure Water Optical DO Sensor

Minimizing corrosion is vitally important in power plant cycle chemistry monitoring and generator stator cooling. The Pure Water Optical Dissolved Oxygen Sensor with Intelligent Sensor Management (ISM®) technology provides fast response, high accuracy, and increased stability in demanding, low ppb-level ultrapure water applications.

Traditionally, dissolved oxygen (DO) measurement has been achieved using amperometric sensors. Although these measure accurately they often respond slowly to changes in DO and require frequent, time consuming maintenance.

The Pure Water Optical DO Sensor provides outstanding measurement performance with low detection limit, the fastest response available and minimal drift, and therefore significantly improves oxygen monitoring.

METTLER TOLEDO's proprietary OptoCap sensing element provides very accurate oxygen determination and easy maintenance without electrolyte handling. Additionally, the OptoCap eliminates the need for polarization, making the measurement system quickly available and reducing downtime.

ISM simplifies sensor handling and provides diagnostic tools that predict the need for sensor maintenance before measurements are affected.

Your benefits include:

Fastest response
METTLER TOLEDO's proprietary Optical DO technology delivers the fastest response available providing confidence in the integrity of your ultrapure water system and equipment.

Reduced servicing
No electrolyte or polarization eliminates the need for frequent, time consuming service.

Intelligent Sensor Management
ISM provides simple sensor handling, and predictive diagnostics for proactive maintenance.

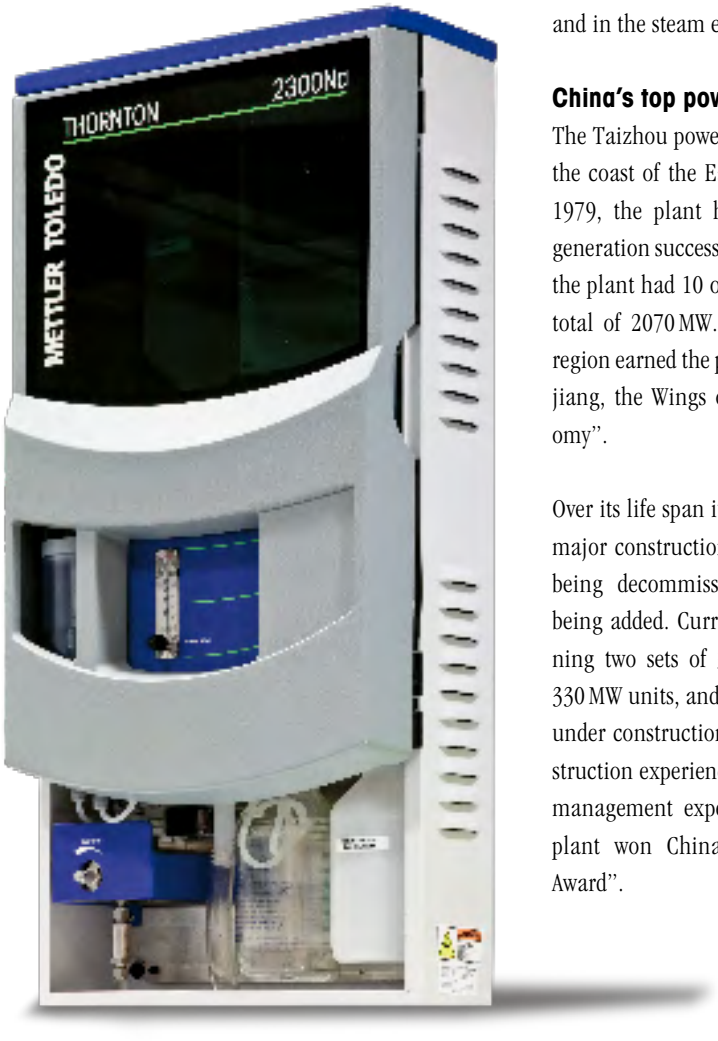
▶ **www.mt.com/opticalDO**

More Stable and More Reliable
Low Maintenance Sodium Analyzer

Higher boiler pressures result in greater efficiency, but also mean sodium analysis is more critical. Old measurement technology requires regular, time-consuming maintenance. With the latest in high sensitivity analyzers, the addition of additional alkalizing agents is needed only four times a year.

Growing workload for instrumentation engineers

In China, with its rapidly developing power industry and ever increasing power plant generation capacity, more and more attention is being placed on quality supervision and control of critical parameters required in plant water chemistry analysis.



Along with this power generation and industry growth, power plant instrumentation engineers have seen their workload escalate in respect of the number of units, measurement points, and parameters to be monitored. In particular, with a trend towards higher boiler pressures, there is increased need to accurately measure sodium contamination in the feedwater process and in the steam entering turbines.

China's top power plant

The Taizhou power plant is located along the coast of the East China Sea. Built in 1979, the plant has 35 years of power generation success. At its peak production, the plant had 10 operational units with a total of 2070 MW. Its importance to the region earned the plant the name of "Zhejiang, the Wings of the Southeast Economy".

Over its life span it has gone through five major construction phases of older units being decommissioned and new units being added. Currently, the plant is running two sets of 300 MW units and two 330 MW units, and two 1000 MW units are under construction. Due to the rich construction experience, plant operation and management expertise at this site, this plant won China's "Top Power Plant Award".

Old sodium technology demands a lot of maintenance

Plant policy has long insisted on use of the most advanced and reliable analytical instrumentation and systems for steam quality monitoring and control. Yet, one parameter that has particularly frustrated this site is sodium measurement. Most sodium analyzers available today employ a technology that is several decades old. Staff at Taizhou realized that to meet the requirements of today's modern turbines, this old technology could not be depended on.

The failures of the design of longstanding sodium analyzers are easy for staff at the plant to identify because they have encountered many problems in the past, including:

- High sensor maintenance involving regular etching, activation and calibration
- Frequent replacement of the reference electrode, alkaline reagents, calibration standard reagents and other chemicals required for consistent operation
- Poor stability and accuracy at low level measurements of sodium
- Measurement signal compromised due to electrical interference in the surrounding environment.

The Zhejiang Taizhou plant had been looking for a new generation of analyzer to come on the market and became aware of the METTLER TOLEDO 2300 NA Sodium Analyzer. This unit offers a path to reduced maintenance, greater reliability, and more accurate sodium measurements.

After purchasing and installing a 2300 Na, staff at the plant identified the following features as critical technology improvements:

- Advanced, non-contact diffusion tubing for alkalizing reagent dosing and control reduces overall reagent consumption while providing stable and reliable measurements.
- Unique sodium ion sensor used in common with a highly accurate pH electrode, forms a reference system with no need for reference chemical reagent consumption.
- Ability to measure extremely low pH samples as produced by ion beds, without having to purchase any additional accessories or expensive options.
- Industry leading measurement range from 0 to 100,000 ppb with a detection limit of 0.001 ppb.
- Large display screen provides ongoing measurement data on sodium levels, pH and temperature of the water.
- Periodic automatic calibration process gives the user the option of single, dual, or three-point calibration.

"More stable and reliable results"

The Taizhou site's lead Field Instrumentation Engineer commented: "Compared to other sodium analyzers we have had in the past, the METTLER TOLEDO unit produces more stable and reliable results, even detecting small sodium changes in the sodium in the steam. The maintenance associated with the analyzer is very small, only requiring the addition of additional alkalizing agents every three months and replacement of the alkali diffusion tubes every eight months."

The METTLER TOLEDO 2300 Na has eliminated the burdensome maintenance of the plant's previous sodium analyzers. As a result, the staff now have more confidence in their sodium measurements, allowing more time for them to work on other critical maintenance tasks.

Based on this very positive experience, the Taizhou facility plans to replace all their sodium analyzers with the 2300 Na.

► www.mt.com/Thornton-sodium

New Trends in Process Analytics
for the Power Industry

Kirk Buecher at METTLER TOLEDO Thornton is an expert in the deployment and use of process analytical measurement systems in the power industry. He travels around the globe advising power plants on how to minimize corrosion and deposition through monitoring their cycle chemistry. Power News spoke to him about process analytics.

Process analytics is playing an increasingly larger role in the power industry. How do you explain this?

I believe it's the convergence of several influences.

The first, and perhaps the most important, is the realization that one of the leading causes of unplanned downtime in power plants today can be traced back to water chemistry problems. This is reflected by the increased number of recommendations/standards from leading power industry bodies around minimum required analytics, recommended sample locations, standards around which parameters should be measured and the falling levels of acceptable contamination in the water. Boiler and turbine manufacturers' warranties are also increasingly specifying water quality for use with their equipment.

Second, there is the growing number of power plants going from "base loaded" to "cycling", especially across the US and parts of Europe. With each cycle, more stress, wear and risks are incurred by the power plant. To minimize these, and to have greater confidence in the water quality before going back to full load, power plant chemists and operators need to rely on the accuracy, reliability and the fast response of their analytics.

Third, is the reality of decreasing staffing in the ranks of the power plant chemists, instrumentation and control and laboratory departments, often driven by pressure to reduce operating costs. This increases the need to move away from lab to on-line measurements, and increases the need to have process analytics that require lower maintenance, frequency of repair and in the case of analyzers, that consume less reagents.

These three powerful influences are all driving up the importance of the use of high quality process analytics in the power industry.

What do you see as being the current trends in power plant cycle chemistry?

At a higher level, there's an encouraging trend where operators, plant chemists, and instrumentation and control engineers are finding their voice on new builds and major refurbishments. They're asking panel fabricators and system integrators for quality analytics that allow them to better manage their plants, rather than living for years with the equipment supplied by the lowest bidder for the project.

How about parameter specific trends?

One common problem I have seen in hundreds of power plants is the lack of faith in their pure water pH measurements, and the trend towards trying to find better tools for the job.

Accurate, reliable and fast responding pH sensors are required to manage the chemical dosing of phosphates, ammonia and/or amines to condition the boiler water. Power plants that try to tolerate the use of poor quality pH sensors end up falling into an overdosing or underdosing trap with their chemicals.

Underdosing puts their boilers and potentially their turbines at risk of increased damage and premature failure. Overdosing is just throwing money down the drain and raises the operational cost of plants while encouraging secondary problems like phosphate hideout.

I'm also seeing an increased recognition of the importance of an accurate, low level of detection, on-line sodium analyzer, especially in international markets that were slow to make the transition from lab measurements to on-line.

I've also noticed more interest and more demand for on-line real-time measurement of organics in traditional power plants, rather than just in cogeneration plants: especially in locations where the source/raw water has high levels of organics to begin with. The risks and consequences of having high levels of TOC break-down into organic acid in your boiler is so serious, that continuous on-line monitoring now provides peace of mind to a growing number of power plants.

What challenges does process analytics face in cycle chemistry monitoring?

Well, keeping up with the industry's demand for greater accuracy, lower levels of detection, greater stability, reliability and lower maintenance and operating costs in all of their analytics would make the headlines.

Add to these the almost generational change from old analog transmitters and sensors, (often with a single transmitter connected to a single sensor), to the newer, digital, multi-channel, multi-parameter technology. Power plants that have already made that move are enjoying analytical systems that are lower in cost to build and deploy, easier and more flexible to calibrate, and lower in maintenance costs due to built-in sensor diagnostics.

The more our customers get a taste of this new technology the more they offer us suggestions on other parameters they want this technology applied to and even better ways to improve their water chemistry management.

Keeping up and keeping ahead of their needs is what motivates us to bring new products and technologies to the market.

For further information, or if you have any questions, please contact Kirk Buecher:
kirk.buecher@mt.com

Protecting Turbines
with a Self-Calibrating Silica Analyzer

Silica in return condensate can damage turbines and cause unplanned shutdowns. A major cogeneration operation in Russia chose the 2800 Si Analyzer to monitor silica levels in the condensate. Its accurate and reliable measurements provide critical data for making decisions on water quality and for controlling its treatment.

The enemy of turbine blades

Silica in purified water can cause significant damage to turbines. Increased temperature and pressure in boilers leads to silica volatilizing with the steam. Subsequent decreases in temperature and pressure during the steam's passage through the turbine results in the formation of silica deposits on turbine blades, erosion of turbine blades, imbalance, and potential unplanned and costly shutdowns.

For cogeneration applications, where the plant produces steam for production processes, the returning condensate may contain contaminants, such as silica, that originate outside the water-steam cycle. Timely detection of excess concentration of these contaminants is key to taking corrective action and ensuring reliable operation of the equipment.

Return condensate must be closely monitored

In May 2014, a major cogeneration power plant in Russia initiated a project to monitor the return condensate collected from the adjacent fertilizer plant it supplies power to. Based on the process requirements, pH, total dissolved solids, and silica were monitored. For silica monitoring a 2800 Si Analyzer was used.

The data collected over two weeks is shown in the graph below.

As can be seen, even though the values of pH and TDS content (as ppb NaCl) did not change, the concentration of silica varied significantly. This shows that:

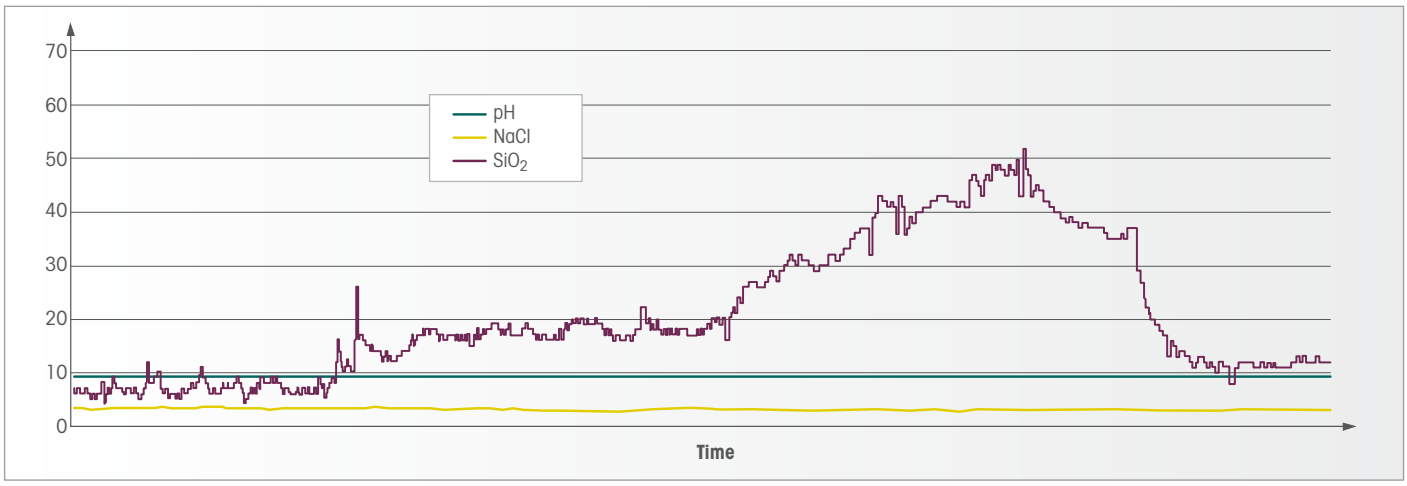
- Partial monitoring (pH and TDS) and laboratory testing do not give a complete and timely picture of fluctuations in key indicators of water quality.
- The use of on-line analyzers allows dynamic monitoring of changes in a timely manner, leading to quick response to any deviation in key parameters.

Reliable and accurate silica analyzer

The 2800 Si Analyzer offers easy installation, exceptional reliability and has minimal maintenance requirements. With automated calibration and operation, the analyzer ensures consistently accurate measurements to help detect any deviations in silica levels. Large reagent bottles enable long-term operation before refilling becomes necessary.

Continuous and dependable measurements

Chemists at the power plant noted that the analyzer provided stable and accurate



Changes in return condensate pH, TDS, and silica levels over two week period.

measurements continuously, even when the water sample temperature and pressure changed. The precision of the on-line measurements was much higher than the laboratory analyses they previously relied on, leading to far greater confidence in their water treatment decisions.

2800 Si Silica Analyzer

Reduced chance of operator error

The analyzer's design and safety features, such as a lockable enclosure, help prevent accidental damage to the unit. The supervisory staff appreciated the automatic unattended calibration and operation of the analyzer, which reduce operator error and ensure reliability of measurements at all times. Moreover, specialists from METTLER TOLEDO were available to train plant personnel and assist in start-up and maintenance of the analyzer, thus providing local support whenever needed.

▶ **www.mt.com/Thornton-silica**

Exceptional Measurement Accuracy
pH Electrode for Low Conductivity Waters

Ensuring the purity of boiler feedwater demands the use of highly capable pH electrodes. pHure Sensor™ LE provides the most accurate pH measurement available for low conductivity waters.

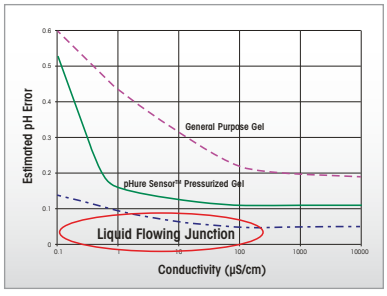
The higher the water purity, the lower is its conductivity. As pH electrodes require some conductance to make measurements, establishing precise pH levels in pure waters requires the use of specialized sensors.

Thornton's pHure Sensor LE has been designed to provide reliable, continuous, on-line pH monitoring in power plant cycle chemistry. The sensor conforms to the requirements of ASTM Standard D5128, Test Method for On-Line pH Measurement of Water of Low Conductivity.

pHure Sensor LE is available with Intelligent Sensor Management (ISM®). This technology offers a number of valuable features including Plug and Measure for fast error-free startup, embedded measurement circuitry for greater signal integrity, and on-board storing of factory and user calibration data.

Find out more at:
▶ **www.mt.com/pHure**

Your benefits



Highest accuracy
Liquid electrolyte provides exceptional measurement precision by maintaining a steady electrolyte flow through the diaphragm.

Fast response – always
Uses a very low volume housing to prevent corrosion product particles from accumulating and slowing response.

Intelligent Sensor Management
ISM provides simple sensor handling, and predictive diagnostics for proactive maintenance.

pHure Sensor LE pH electrode
and housing

Get in-line with METTLER TOLEDO

Get the Most
from Your Sensors and Analyzers

METTLER TOLEDO Service ensures you receive maximum performance and accuracy from your process analytical instruments. From Setup & Configuration, to Calibration, to Preventive Maintenance Services, you can expect a professional response by well trained and well equipped Service Technicians to meet accuracy and international regulation requirements.

Maximize product performance with METTLER TOLEDO Services for:

- Conductivity Sensors
- Ozone Sensors
- Silica Analyzers
- Sodium Analyzers
- TOC Sensors

► **www.mt.com/pro-service**

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