White Paper

THORNTON
Leading Pure Water Analytics

Trust Your Measurements

to Detect Cycle Chemistry Deviations

In many cases, power plant downtime starts with a change in an instrument reading. A change that is often ignored. Power plant technicians do not always assume that an unforeseen alteration in measurement is genuine, because instrumentation is not always dependable. Therefore, the key to minimizing plant downtime is to ensure measurement reliability. This white paper explains how Intelligent Sensor Management technology achieves exactly this.

Introduction

Power industry conferences, workshops and events around the world provide excellent venues for chemistry professionals to share best practices, successes and occasionally, negative experience stories. The latter are cautionary reviews, shared with some hesitation among power plants with the hope that divulging bad experiences can help friends and colleagues in the industry avoid similar catastrophes. These woeful tales can involve major process or equipment failures that result in unplanned shutdowns, extended outages for expensive repairs or even severe injuries.

Such stories sometimes include the costs of the failure and recognition of the risk to personnel and the loss of revenue associated with an unplanned outage. They also describe the headaches that come with major unbudgeted turbine, boiler or condenser cleaning or repairs.

In most of these narratives, an underlying theme becomes evident. Often, regardless of the root cause of the problem, there comes a point in the story where someone first sees unusual instrument readings. If it involves water chemistry, it might be an alarm from a sensor or a jump in readings from a sodium or silica analyzer. Perhaps a pH problem or odd changes in dissolved oxygen or conductivity levels are seen.

This becomes the tipping point in the story. Even though the measurements are saying something has changed and something

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is likely wrong, personnel don't believe it. Time elapses waiting for readings to go back to normal, waiting for lab results to arrive or waiting for remote personnel to weigh in on the situation. This allows a slowly developing problem to go from the need for minor corrective action to long-term out-of-spec operation resulting in significant downtime, or for a rapidly escalating problem to go from a recoverable situation to a major failure!

What causes this delayed action to become the secondary contributing factor to the failure? It comes down to judgment. Something unusual was seen but the analytical measurements were not believed. There may have been a number of reasons that were used to justify non-belief. I&C or maintenance was behind on the service and calibration schedule; that sensor had become contaminated, failed, or needed more electrolyte; those analyzers had run out of reagents; or maybe that pH sensor or silica analyzer just never was accurate or worked right.

Whatever the reason given, the opportunity was missed to prevent a small problem from becoming a major one, that chance to take immediate corrective action instead of delaying until something further went wrong. In any case, one very critical thing was evident: they didn't trust the measurements!

Fundamental sensor and measurement technology

The integrity of measurements is taken very seriously by METTLER TOLEDO Thornton. Over a half century of experience with on-line analytical sensing coupled with innovations in microelectronics and firmware techniques have enabled the leap forward in dependability of measurement described here.

Advanced digital measurement

These complementary areas of expertise have led to an exceptional opportunity to improve the reliability of analytical measurements to make them more trustworthy. The result of this synergistic R&D work is advanced digital sensors that go well beyond basic measurement and digital signal conversion within the sensor.

Such sensors fully exploit the opportunities available when measurements are made right next to the sensor element. They don't compromise the measuring circuit design in order to accommodate the resistance and capacitance of long analog signal cables, especially for conductivity measurement. They don't incur uncertainty when different measuring circuits are used to calibrate the sensor than are used in the final installation because the measuring circuit is inseparable from the sensor elements. In addition, they always utilize correct calibration data for their measurements because on-board memory retains it.

The measuring circuits of these digital conductivity sensors are designed to maximize their performance with negligible analog cabling. A UniCond® conductivity sensor of this new design can measure ultrapure water with higher accuracy than its analog counterpart and the same sensor can measure up to the range of seawater. That means the same model sensor can be used throughout a makeup water treatment system as well as for all cycle chemistry monitoring points. This interchangeability makes any mix-up of replacement sensors and spare parts impossible. In addition, this standardization improves the long-term dependability of all of the measurements and simplifies the maintenance of spare parts.

If desired, digital sensors, particularly pH, can be calibrated in the laboratory under controlled conditions. Their calibration data, stored in on-board memory, goes with them back to the installation sites with no opportunity for operator error. This ability to calibrate under lab conditions can make the measurements more reliable as well as being a convenience for the technician.

Predictive diagnostics

Beyond the above improvements, advanced digital sensors include real-time predictive diagnostics. These take the sensor's cumulative operating exposure into account to forecast in real time when calibration, maintenance and replacement will be needed. Taken together, the sum of these advanced sensor capabilities are designated Intelligent Sensor Management or ISM®. ISM sensors are able to warn of the need for service before loss of accuracy or failure, making the measurements more

Figure 1 - iMonitor screen showing predictive diagnostics for a pH electrode

Table 1 - Summary of reliability advances with ISM digital sensors by parameter

Parameter	Improvement
Conductivity	• Higher accuracy with inherent loop calibration • Wider rangeability enables sensor standardization and long-term dependability
pH & ORP	• More efficient service with predictive maintenance • Higher reliability with self-contained high-impedance measurement and no analog signal connections
Dissolved oxygen	• More efficient service with predictive maintenance • Higher reliability with self-contained low-level measuring signal
Temperature (used in above measurements)	• Higher accuracy with inherent loop calibration and fixed wiring resistance • Higher accuracy temperature compensation eliminates false alarms from sample temperature excursions

reliable and increasing the efficiency of maintenance scheduling. They can also eliminate unnecessary servicing.

Internal algorithms integrate sensor exposure to measurement range and operating temperature plus sensor characteristics (diaphragm and membrane resistances in the case of pH) to determine the sensor's condition and trend. The resulting ISM predictive maintenance capability comprises three functions:

1. Adaptive Calibration Timer – identifies the amount of time before a calibration is recommended
2. Time To Maintenance – displays the amount of time until servicing will be needed
3. Dynamic Lifetime Indicator – forecasts when the sensor will need to be replaced

The transmitter can display all of these predictive maintenance functions on an "iMonitor" screen for each sensor as shown in Figure 1. Any of these functions can also be displayed like other parameters and be assigned to output signals for remote monitoring. With this information, maintenance of sensors can be managed in an orderly and efficient way. Advance notification of the need for sensor calibration or service is always available. This enables more effective use of technician time and more reliable measurements—the basis for confidence in reporting upset conditions in the plant.

Conclusion

This brief description of ISM functionality shows how it enables a predictive maintenance program that can make measurements more reliable and boost confidence in operating personnel to trust them. With the installation of this more advanced analytical instrumentation it is anticipated that more conference experience presentations will be success stories where personnel "trusted their measurements" and quickly responded to deviations before major damage occurred.

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