

More Efficiency with Intelligent Sensors



Although the chemical industry is characterized by a large variety of processes, few of which are exactly alike, typical unit operations share many commonalities. One of these is the requirement for accurate process analytics in order to help maximize product quality and yield, and to minimize costs. Measurement of pH, ORP, conductivity, DO or turbidity may seem like small parts of a total industrial process, but these parameters can be the cause of frustration, downtime and substantial expenditure unless they are properly understood and adequately controlled.

How can plant managers and engineers ensure measuring parameters will help processes run smoothly and efficiently, and exploit the availability of process machinery? Fortunately, advanced process analytics solutions exist that not only are accurate and reliable -- even in the harshest of process conditions -- but that also minimize the maintenance burden by actually predicting when maintenance of a measuring point is required.

This white paper reviews issues that can occur in chemical plants when some of the above mentioned parameters are not held within desired ranges, and how cutting-edge process analytics can help avoid the problems and achieve greater plant efficiency.

Water Preparation

Boiler tube failures continue to be the single largest source of forced outages in

industrial-type steam generators. In most cases, corrosion occurs under deposits and scale which builds up on the boiler tubes. In addition to contributing to the corrosion process, the buildup of scale on the tubes by itself reduces heat transfer and therefore increases the overall fuel costs required to produce a given quantity of steam. Corrosion and scale buildup can be controlled by maintaining proper water chemistry.

Accurate pH control of the inlet water of the reverse osmosis unit protects membranes from damage. In the operation of ion exchangers, pH monitoring is required to ensure that no excess regeneration acids or bases contaminate the boiler water. In boiler feedwater, pH measurement is a significant challenge but essential for corrosion prevention. Continuous in-line measurement of pH, DO and conductivity is of paramount importance for the control of corrosion and scaling and in maximizing energy efficiency.

Main Processes

The quality and yield of products are the two most important aspects in individual processes. For companies to remain globally competitive therefore, individual processes must be monitored and analyzed through a specialized approach. Both quality and yield can improve significantly through in-line analysis during each individual process step. For example, pH is a critical process parameter in various synthesis steps, such as esterification, polymerization and in the formation of certain salts. Apart from reducing chemical consumption, pH control improves the purity of the product and contributes significantly to overall cost savings. Accurate pH control can play an important role in initiating the crystallization process and in determining the crystal structure. Dissolved in-process or wastewater substances like H₂S, CO₂ and NH₃ are potentially corrosive or harmful. Accurate pH control in the stripper ensures that these components are present in their gaseous form and so can be efficiently removed from the water. In gas scrubbers, maintaining the correct concentration of the scrubbing agent is an absolute necessity. Depending on what agent is used, control of pH is very effective in optimizing scrubber performance.

Cooling Water

Cooling water systems are vulnerable to corrosion, scaling and biological contamination, and the concentration of impurities increases over time with evaporation. Corrosion inhibitors in cooling water are effective within a certain pH range. Accurate pH control is important in the cooling tower and at various locations in the circulation. Also, typical scaling impurities tend to precipitate at high pH which is another reason for keeping tight pH control. Biological impurities grow at warm temperatures and relatively high oxygen levels. Controlled additions of biocides such as chlorine and hypochlorite compounds are possible providing reliable oxidation potential (ORP) measurements are made.

Petrochemical Processes

Sour water is poisonous to petrochemical plant equipment. It is responsible for most

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of the corrosion processes in metallic pipes, heaters, coolers and columns, and must be treated and neutralized. Regulating pH is used to control the sour water and the neutralization treatment, and to protect the pipelines and equipment from corrosion. However, the presence of gasoline in the media damages pH electrodes, making in-line analysis difficult.

Advanced Process Analytics

High quality analytics equipment can help plant managers minimize the above issues by providing constant data on process parameters. Utilizing suitable sensors and transmitters provides invaluable information that can assist achieving maximum process yield while helping to minimize the maintenance burden for the process equipment, as well as for the measuring points themselves. Mettler-Toledo has a worldwide reputation for producing highly efficient and reliable analytics measuring points. A wide range of sensors, transmitters and housings ensures that there is a solution for even the most extreme measurement challenges. However, Mettler-Toledo realized that accurate measurement of processes was not the only requirement for the chemical industry. The time taken to maintain measuring points and the time lost in process downtime due to sensor failure can eliminate much of the benefit from using analytical equipment in the first place. What the chemical industry needed was a way of predicting when a measuring point required maintenance, and even when a sensor was about to fail. And that is just what Mettler-Toledo developed.

Intelligent Sensor Management

Intelligent sensor management (ISM) is a revolutionary platform based on electrodes with embedded digital technology. In the head of the sensors an integrated chip stores all relevant parameters, and algorithms that provide enhanced sensor diagnostics. By making this data available directly into a PROFIBUS® or FOUNDATION fieldbus™ network, integrated predictive maintenance of measurement points on a process control system level has become a reality. This simplifies diagnostics in the event of measurement problems, while also providing information about the timing of the next required calibration or adjustment, and the remaining lifetime of the sensor. Calibration and maintenance operations take place when needed, and where needed. As a result, processes can be run with less unscheduled downtimes, leading to higher efficiency and more efficient use of resources.

iSense® — Asset Management Software

Developed alongside ISM, Mettler-Toledo's iSense software suite facilitates quick and easy ISM sensor configuration at commissioning and enables predictive maintenance by providing access to diagnostic information, calibration routines, and automating documentation.

The key features of ISM technology are:

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1. Offers true predictive maintenance functionality by recognizing any sensor maintenance requirement at an early stage, hence reducing downtimes and minimizing plant operational costs.
2. Reference system is of critical importance in pH monitoring and ISM has an in-built mechanism to monitor its behavior.
3. Eliminates difficult configuration procedures by automatically transferring the status from the sensor to the transmitter during startup.
4. Solution Ground ISM electrodes in combination with the transmitters offer a unique lifetime indicator using a proprietary, intelligent algorithm for dynamic and predictive maintenance information.
5. Minimizes unexpected process shutdowns due to sensor failure.
6. With iSense software, ISM offers calibration and maintenance protocol management for all installed sensors within a plant.
7. Allows unique maintenance management of the installed sensor base by extensive diagnostics and key performance indicator monitoring, in combination with convenient export functionalities.
8. Enables pre-calibration of sensors in laboratory environments by even untrained personnel.
9. Critical electrode information stored within the electrode itself.
10. Reliable digital output signal from the sensors.

ISM in Water Preparation

Mettler-Toledo's ISM solution includes highly versatile transmitters, such as the M700 and long-life electrodes, e.g., InPro 3250 i, InPro 7000 and 7001. Conductivity sensors and DO electrode InPro 6900 i provide a low-cost predictive maintenance program.

ISM in Main Processes

Electrodes with ISM technology offer a highly reliable and long-life pH solution, with optimally tailored versions to solve almost any demanding process application. The digital pH sensors eliminate the problems of moisture ingress, leakage and corrosion, and they store calibration data as well as other important operation values that can be used as a basis for predictive maintenance.

ISM in Cooling Water

With ISM, water chemistry can be continuously monitored and compared to the normal chemistry conditions. The InPro 3250 i/3250 SG electrodes with platinum solution ground can be used for both pH and ORP measurement applications. ISM makes it possible to spot potentially damaging trends and take appropriate corrective actions. The total number of measurement points in cooling water systems can be extensive; ISM significantly reduces the maintenance effort and costs.

ISM in Petrochemical Processes

The ISM solution includes a double measuring system -- pH combined with

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conductivity --which allows controlling sour water in-line without damaging the pH electrodes. The InPro 7250 conductivity sensor verifies whether water or gasoline is passing through a pipe. When the conductivity is very low, it

indicates gasoline is present and the pH electrode must be retracted (which can be done automatically using a Mettler-Toledo retractable housing) so that it is not damaged. The In- Pro 4260i ISM pH electrode provides easy maintenance by allowing pre-calibration of the electrodes and in-line diagnostics. The M700 transmitter accepts both the conductivity and pH signals. By conducting an in-line measurement with the pH electrode being protected by a conductivity electrode, it is possible to respond to pH variation automatically and just in time, making ISM a powerful predictive maintenance platform.

Conclusion

The chemical industry is frequently a challenging environment for process analytics measurement. Yet, these obstacles must be overcome if plant efficiency is to be maximized. Mettler-Toledo supplies a wide range of sensors, transmitters and housings that are suitable for in-line measurement, regardless of how harsh the process conditions might be. Further, Mettler-Toledo's proprietary ISM technology provides extremely useful information for achieving predictive maintenance. ISM is a truly integrative platform that can offer higher productivity, less downtime, lower operational costs and better profit margins. Maximized plant efficiency is now a significant step closer.

For more information, please visit www.mt.com [1].

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