



INGOLD

Leading Process Analytics

Improvement of Yield and Quality With pH Control in Sweetener Production

Return on investment for the pH electrode InPro 4250 was reached in less than a week due to better process control, increased accuracy and reduced process time.

Company Background

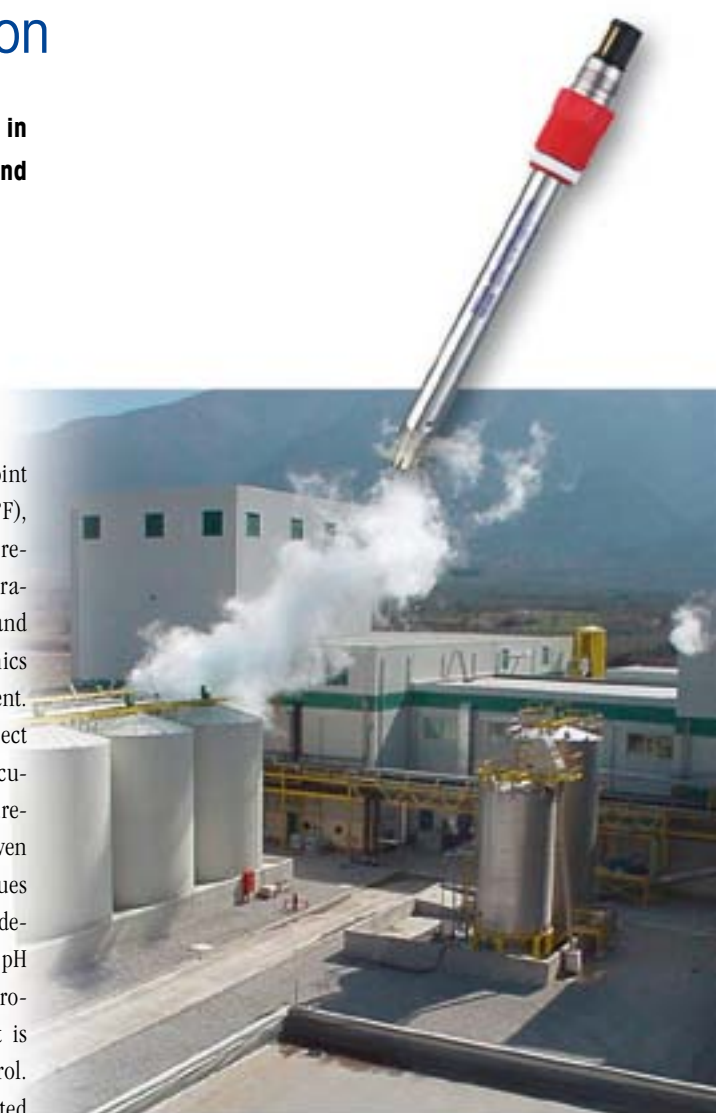
A US customer is a leading worldwide producer of corn derived sweeteners. The plant consists of several production lines containing multiple unit operations. These operations are complex and require tight control of operating parameters to ensure safety, quality, and yield. One of the important control parameters is pH.

Description of application

pH is critical to the proper operation of much of the plant and several unit operations have additional challenges that make pH control difficult. As a result redundancy is a requirement in these operations, to ensure both accuracy and reliability of the measurement.

Problems in pH control to be solved

One particularly difficult control point in the process operates at 54 °C (130 °F), 5 bar (75 psi), and in turbulent flow regime. The process fluid is fouling, abrasive, contains a high salt content, and also contains high levels of organics which interfere with the pH measurement. This measurement point has been subject to high maintenance costs and the accuracy and repeatability of the measurement has not always been reliable. Given the problems and maintenance issues they had been having, the customer decided to investigate replacing their pH control technology on the sweetener production lines. The yield of the plant is dependent on the degree of pH control. The production profile is directly related



to the pH profile during each batch. Additionally, chemical addition volumes and rinse times are controlled by the pH in the process. Having reliable and accurate control of the pH is critical to the safety and production yield of the plant.

Customer's expectations

The customer expected to install a measurement loop that would provide him accuracy of the measurement point as confirmed by redundant measurement points and verified by off-line devices. He also required a loop-powered unit to meet, FM Certification for Class I, Div 1. The processes contain organics, salt, and also corrosive components, so Hastelloy C-22 wetted parts and Kalrez elastomers were required to withstand chemical attack during processing. Additionally, due to the tenacious fouling tendency of the solutions, retractable housings were desired to provide safe access to the process during operation without interruption of the process.

METTLER TOLEDO solution

■ InPro 4250

METTLER TOLEDO presented a solution using an InPro 4250 solid polymer pH reference system in combination with an InTrac 777e retractable housing and a 2100 e2XH loop-powered transmitter with HART® communication. In the InPro 4250 pH electrode, the gel interior of the reference system is solidified. This unique design allows METTLER TOLEDO to eliminate the need for a reference diaphragm. Because their process is fouling, plugging of a reference diaphragm is inevitable. By eliminating the diaphragm, METTLER TOLEDO was able to provide a better pH solution with a longer life because a mode of failure for the pH electrode could be eliminated.

■ InTrac 777 e

The use of a pneumatically operated retractable housing was also a key parameter to having the best solution in place. METTLER TOLEDO retractable housings have a triple seal against the process which allows the customer to safely and easily remove the electrode from the process without interruption of operation. The pneumatic operation of the housing allowed the customer to automate the system and to minimize employee exposure to the process and process conditions.

■ pH 2100 e2XH transmitter

The 2100 e2XH transmitter was selected

to provide a user-friendly, loop-powered transmitter to meet the customer's requirements for a FM certified Class I, Div.1 transmitter. This transmitter also offered HART communication as well as advanced diagnostics to track the performance of the pH sensor.

Pleased customer orders several loops

There are several operation lines within this facility. This particular process utilizes 3 pH loops and operates under very difficult pH control conditions. There are several other processes in the plant that have less strenuous pH control parameters and the METTLER TOLEDO pH loops are working successfully in those other 20 applications, as well.

Success and payback go hand in hand

The INGOLD pH process solution was installed, with some skepticism that it would outperform the existing technology. At the time of the installation, the pH was the only parameter to change in the process. After the first batch, the production manager, noted a marked improvement in pH control.

- The parameter was much tighter than the former technology and the plant was able to see a much more accurate control of the pH.
- The increased accuracy and reliability

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Retractable housing
InTrac 777e.

pH electrode
InPro 4250.

pH transmitter
2100e.

of the measurement point allowed the plant profile to be more tightly maintained.

- One of the critical additives is expensive and tighter pH control meant a significant reduction in its usage resulting in substantial savings.
- Also, the processing time was reduced, the rinse times were minimized, and the yield was increased.
- All of these improvements resulted in significant cost savings to the user.

The price of the installation of the pH loops was paid for in less than one week of operation.

Current operation

The systems are installed since the end of 2006 and continue functioning well in the process. The lifetime of the electrodes is more than quadruple that of the former technology. The pneumatically retractable housings cut the maintenance time in half. Also, the installations of the

pneumatically retractable housings are a gateway of automation for potential future cleaning and calibration systems. The customer is pleased with the operation, performance, accuracy and reliability of the INGOLD solution of METTLER TOLEDO.

► www.mt.com/pro-pH

pH and Conductivity Measurements Help to Protect Reverse Osmosis Membranes

The METTLER TOLEDO InPro 4800 pH electrode and InPro 7001 conductivity sensor can be efficiently used in upstream monitoring and pretreatment for reverse osmosis applications.

Pretreatment

Filtration, softening, and chlorine removal are important in pretreatment for reverse osmosis (R.O.) applications for water purification, for reasons of membrane protection as well as immediate performance of the R.O. Effective pretreatment reduces process costs because the performance per step and per unit membrane area is improved and the service life of the R.O. membrane is increased.

Monitoring of oxidants such as chlorine

The ORP and the pH are important determinants of the performance and service life of the R.O. membrane. R.O. membranes are susceptible to attack by oxidants such as chlorine, bromine, ozone and hydrogen peroxide. Depending on the selected R.O. membrane type, acceptable pH values may range from 4 to 6. Typical R.O. membranes are comprised of cellu-

lose acetate or of polyamide; thus the possible optimum pretreatment pH may vary substantially. Polyamide membranes in particular are vulnerable to oxidation, even at low levels of chlorine in upstream water. Therefore, dechlorination is considered an essential part of pretreatment. Two different means are used simultaneously to monitor the chlorine concentration – ORP measurement and pH measurement. If ORP measurements are done indirectly it is necessary to keep the pH value constant. The ORP value depends not only on the quantity of oxidants but also of their resultant activity. Problematically, low ORP does not settle the issue because it may indicate high biological activity which in itself may cause fouling of the membranes.

Monitoring of CO₂ conversion into carbonate and bicarbonate

Another important pretreatment function is the monitoring of CO₂ conversion into carbonate and bicarbonate. This conversion is initiated by adding caustic and can be monitored with a pH sensor. CO₂ levels in low pH waters can be as high as 50 – 100 ppm. Since carbon dioxide is a small dissolved gaseous molecule it passes right through the reverse osmosis membrane. Carbon dioxide is weakly ionized and tends to have high affinity for the anion-exchange sites in the downstream deionization cartridge, significantly reducing the expected service life of the cartridge. Therefore, it is desirable to remove as much CO₂ as possible from the R.O. product water, so as to preserve the normal service life of the deionization cartridge.

Electrical conductivity measurement is the most convenient means for testing re-

verse osmosis water quality and membrane performance. Pure water has very low conductivity. The amount of ionized substances (salts, acids, or bases) dissolved in water determines its conductivity. Ordinarily, most impurities found in tap water, surface water, and ground water are dissolved minerals which contribute to conductivity.

METTLER TOLEDO's solutions

A METTLER TOLEDO customer has purchased 24 pH measuring systems and 16 conductivity measuring systems for use in R.O. pretreatment stream monitoring and control.

Each pH system is comprised of the following:

- one InPro 4800 pH electrode;
- one InFit 761 stationary housing;
- one pH 2100 PA pH signal transmitter.

Each conductivity system is comprised of the following:

- one InPro 7001 conductivity sensor;
- one InFit 761 stationary housing;
- one Cond 7100 PA conductivity signal transmitter.

Additional pH systems and conductivity systems are expected to be purchased by other plants of the same group.

Characteristics of the InPro 4800 pH electrode

The InPro 4800 electrode is the top-of-the-line combined pH and temperature electrode, designed to operate well in an environment of high temperatures and pressures, and in the soiled surroundings which may be found in some chemical applications. Its strong resistance to oxidizing media, solvents, and acid and alkali solutions make it suitable for highly demanding industrial applications such as, e.g., sugar processing.



pH electrode
InPro 4800.



This electrode is now also available with “Intelligent Sensor Management” (ISM) for “Plug and Measure” and with Advanced Diagnostics.

Characteristics of the InPro 7001 conductivity sensor

The factory-determined cell constant for maximum accuracy allows the most efficient control of water quality. Temperature measurement with a built-in Pt 1000, class A is fast and accurate. The sensor is installed in the process line using a Pg 13.5 thread fitting and METTLER TOLEDO InFit 761 housings.

Customer's benefits

The R.O. customer was able to meet all its pretreatment needs with the aid of METTLER TOLEDO process monitoring. The customer found the systems to be:

- efficient, reliable, and cost-effective;
- effective in protecting R.O. membranes, thus increasing membrane service life; and
- easy to integrate into existing remote control systems employing the PROFIBUS® PA network and existing communications protocols for process instrumentation.



pH transmitter 2100ePA.



Stationary housing InFit 761.



Conductivity sensor InPro 7001.

Improved Steep Water Control With Turbidity Sensor InPro 8400

Turbidity measurement in the condensate of the wet-milling process allows efficient effluent control and therefore high operational availability.

Product background

Starch and modified starch are produced from different feedstock materials such as corn, wheat or tapioca. Aggressive chemicals and tough process conditions are necessary to isolate the starch from its feedstock.

Process

In the wet-milling process, corn is softened in steeping vessels. Process water from the wet mill containing SO₂ and a population of lactic acid bacteria is used as steep water. By the end of the steeping period the corn has absorbed water to about 45% and released a certain portion of the dry substance as solubles and undissolved particles into the steep water. Then the steep water is drawn off towards a steep water evaporator.

Customer's expectations

The starch producer required an in-line turbidity system which can be installed easily in a slipstream of an evaporator. The temperature of the condensate here is around 50 °C (122 °F) at ambient pressure. A big challenge was the presence of air bubbles which disturb every turbidity measurement. Consequently the sensor must be installed after a deaeration tank or bubble trap.

Installed solution

The system consists of an InPro 8400 turbidity sensor with ½" NPT flow-through cell and the Trb 8300 F/S transmitter. The InPro 8400 sensor was designed for measurements in harsh applications. The flow-through cell is made of stainless steel and the media wetted optical windows are made of corrosive resistant sapphire.

Also all other optical components like the light source and the detectors are well protected by stainless steel enclosures. This rugged design turned out to be the key to success to solve this demanding measuring task.

Customer's benefits

During a trial period of three months the system provided reliable and reproducible measurement results. The operational availability of the steep water evaporators has significantly improved. The system performance completely fulfilled the customer requests.



Turbidity transmitter Trb 8300 F/S.



Turbidity sensor InPro 8400.

► www.mt.com/turbidity



Process Analytics Product Catalog

New Edition 08/09 Available

Get an overview of the latest INGOLD and THORNTON products available for your process application with the new product catalog 08/09.

The catalog offers comprehensive overview on product features and specifications, benefits and recommended application areas, order details and much more for process analytics measurement solutions.

The product catalog covers complete measuring solutions for the parameters:

- pH
- Dissolved oxygen and O₂ in gases
- Ozone
- Dissolved CO₂
- Conductivity
- Turbidity
- TOC
- Flow

The featured product range includes:

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- Housings
- Process connections
- Transmitters / analyzers
- Cleaning and Calibration systems
- Cables
- Accessories

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