



INGOLD

Leading Process Analytics

Reduced pH Electrode Consumption in Cane Sugar Refining

One of the most common problems in sugar refining processes, especially during carbonatation, is the continual electrode maintenance required to ensure smooth process control. METTLER TOLEDO problem-solver pH InPro 2000 electrode for harsh conditions offer longer serviceable life and needs much less attention.

Sugar industry in the UK

UK sugar production is dominated by two national sugar makers. The largest concern concentrates on the processing of the UK's entire sugar beet crop of around 9 million tons. The other company, with a more international commitment and a more diversified product portfolio, is one of the largest producers of cane sugar in Europe. Apart from white sugar manufacture traditionally covers a wide variety of cane sugars, including the dark soft types much favored for baking purposes, e.g. Demerara, Muscovado, Turbinado, as well as treacle and syrups.

Problems with high electrode consumption

During the refining process, the pH electrodes have to endure extremely hostile

environments with high temperatures of over 90 °C/194 °F as well as the presence of very abrasive solids. Our customer was experiencing instable readings and high electrode consumption due to these harsh conditions. This had in the past resulted in the electrodes lasting only 1 week before needing to be replaced.

The solution offered by METTLER TOLEDO

METTLER TOLEDO's advice to the customer was to generally use the problem-solver electrode InPro 2000 with Frisco-lyt-B liquid electrolyte, and transmitter pH 2500. For control reasons, the client is now also using transmitters M 700 with pH 2700 modules. The liquid filled sensor was selected due to the harsh operating conditions and for offering



METTLER TOLEDO

the customer flexibility to change over-pressure as well as to use different reference electrolytes such as Calcolyt. The M 700 transmitter with its excellent communication features was suggested in order to provide signal output to DCS (Distributed Control System) as well as due to the wide range of diagnostic features which help the instrument technicians with information on the electrode relative to lifetime and maintenance functions.

Control of carbonation stage

The equipment is mainly being used on the carbonation step in the process where milk of lime is added to the product to promote precipitation of impurities. This step is controlled via monitoring of the pH value, the 4-20mA signal from the transmitter being fed back into the DCS system to control lime dosing.

Improved process reliability

The electrodes now last 3–4 weeks as opposed to < 1 week with previous brands. The METTLER TOLEDO InPro 2000 also provides a more stable pH reading and consequently improves the reliability of this important control parameter. The customer has expressed confidence in the current pH measurement values. Cleaning/calibration is done on a weekly basis, which has been found to be sufficient for this application when using the InPro 2000.

Why was METTLER TOLEDO consulted?

The customer required a product that would stand up to the harsh application whilst still being price competitive. The equipment needed to be from a trusted manufacturer that would be able to provide backup and support when essential.

The international reputation of METTLER TOLEDO as a problem solver supplied the leverage.

A welcome payback

The diagnostic capability of the pH 2500 and the M 700 has been used by the customer to determine when cleaning/calibration is required, and these functions have also been used to determine to help predict the lifespan of electrodes. Such information is important for maintenance planning, accordingly with improvement in productivity. The less frequent effort now required for maintenance of each measuring point and the reduced consumption of electrodes replacement are together substantial cost-saving factors.

www.mtpro.com/pH



Transmitter M 700.



Publisher / Production

Mettler-Toledo AG
Process Analytics
Im Hackacker 15
CH-8902 Urdorf
Switzerland

Illustrations

Archive MarCom
CH-8902 Urdorf
Switzerland
Archive UNICA, Brazil
Archive Zuckerrfabrik Aarberg,
Switzerland

Subject to technical changes.
© Mettler-Toledo AG 06/06
Printed in Switzerland.

Successful pH Measurement During Carbonation Reduces Process Costs

Purification of raw sugar juice, whether from cane or beet, involves the use of lime at an elevated temperature in a process known as carbonation. Latest developments provide a viable solution to longstanding problems surrounding inline pH measurement in this high-alkaline, high-temperature process.

Problematics and solutions

Sugar production is a caustic process carried out at temperatures of up to 100 °C/ 212 °F, and requiring strict pH control at almost every stage, particularly during carbonation. The harsh process conditions placed such extreme demands on traditional measuring equipment that inline/online measurement procedures suffered from reduced electrode lifetime. Recent technological advances, particularly in respect of electrode/sensor design and dedicated ancillary equipment with a high level of automation, now allow real-time, inline pH measurement to be made directly at the measuring point which extremely extended the electrodes lifetime.

pH measurement during carbonation

Purification of raw sugar juice is widely carried out in two separate carbonation stages and normally involves the use of milk of lime, $\text{Ca}(\text{OH})_2$, and CO_2 at temperatures of between 77 °C/170 °F and 100 °C/212 °F. The pH value rises easily to 11 before dropping to about 8 in the final phase. The combination of high alkalinity, high temperature, high viscosity as well as abrasivity of the medium presents a stiff challenge for the sensors.



InPro 3250.

Developments in pH electrode technology

With the modern, resilient INGOLD sensors, it has become possible in conjunction with automatic cleaning and calibration systems to insert the pH electrode directly inline into the process to obtain unequivocal, realtime measurement values. Consequently costs for replacement electrodes are substantially reduced.

Recommended pH electrode InPro 3250

METTLER TOLEDO offers special pH electrode models which operate consistently and reliably at elevated temperatures, and which embody sensing junctions less susceptible to abrasion and coating. In the case of the carbonation process it is recommended to use the liquid-electrolyte electrode InPro 3250 in combination with the retractable housing InTrac 777 e. This pH-electrode is also compatible with the transmitter pH 2100 e. The measuring loop may be completed with an automatic cleaning and calibration system such as the METTLER TOLEDO EasyClean system. The industrial-type pH electrode InPro 3250 with its substantially prolonged operational life has been developed and manufactured in line with the latest technical standards, and is highly recommended for applications in the carbonation process in the presence of particles and aggressive chemicals at high operational temperatures. Electrode

maintenance and replacement costs are thereby significantly reduced.

Following technical features characterize this electrode:

- Prepressurized liquid electrolyte prevents ingress of process medium into the reference system.
- The permanent overpressure ensures that the diaphragm is kept open by the action of the constant outflow of small amounts of electrolyte
- Silver-ion barrier prevents formation of silver sulfide at the diaphragm
- Temperature compensation through built-in temperature sensor (RTD)
- VarioPin (VP) connector (IP68)

Rugged housing InTrac 777 e for in-line measurements

The recommended InTrac 777 e retractable housing is designed for continuous in-line measurements in industrial processes such as the sugar industry. It allows the sensor to be withdrawn from the process media for maintenance, cleaning, calibration or replacement without interrupting the actual ongoing process. It is suitable for employment in conjunction with EasyClean systems. In-line measurement but with rapid access to the sensor whenever deemed necessary without having to interrupt the process is also a prime cost-saving factor.



Automated sensor maintenance – a reasonable loop update

Coating/fouling of the sensor surface in the short or long term with lime, non-sugar substances and sticky syrup remains a constant threat. To overcome manual cleaning and calibration, METTLER TOLEDO has developed a highly efficient remedy, in the form of the automatic EasyClean system.

Through incorporation of the pneumatically operated retractable housing in conjunction with the EasyClean system, regular sensor maintenance covering fully automatic cleaning, testing and calibration of electrodes/sensors can be realized directly at the measuring point. Maintenance cycles, involving flushing of the sensor surface with water or a user-defined cleaning solution, followed by calibration, are triggered by a programmable timer. This development has led to a marked overall improvement in pH control of the carbonatation process and offers substantial cost savings in loop maintenance.

EasyClean 350 e reliable and automated cleaning and calibration

For tough challenges in the sugar industry, such as in the carbonatation process, it is recommended to use the EasyClean system 350 e. EasyClean 350 e is a robust and proven fully automated system. The extremely compact and sturdy construction guarantees the safe application of aggressive cleaning chemicals and high temperatures. Effective cleaning and calibration guarantee accurate pH measurements for optimal and precise dosage of

lime and CO₂. The cycles can be freely programmed via timers, and the interruption time of the pH signal for the electrode cleaning procedure is kept as short as possible. With the EasyClean 350 e you achieve longer lifetime of the sensor and require a minimum of replacements. Automation of the measuring point takes a great burden off personnel during campaigns when productivity is a supreme objective.

Dedicated Transmitter pH 2100 e

The transmitter pH 2100 e is a cost-effective 2 or 4-wire instrument specially designed for highly reliable and accurate measurement in heavy-duty industrial applications. It provides continuous monitoring of sensor and instrument performance with sensor diagnostics (SensioCheck®). Operation is user-prompted through pictographs. The unit is equipped with HART® communication interface for control of the EasyClean system. It is specially adapted to inline calibration routines.



Transmitter pH 2100 e.



EasyClean 350 e.

www.mtpro.com/pH

www.mtpro.com/cleaning

Higher Process Safety due to Unbreakable ISFET pH Electrode InPro 3300

The pH value of sugar juice during refining has to be monitored at each process stage to obtain highest quality relative to size and regularity crystals. To realize high process and product safety, the glass-free ISFET sensor was installed.

Background information

Brazil is the world's largest producer of sugarcane. Brazil produces some 300 Million metric tons of sugarcane annually, of which roughly 55% is turned into alcohol and 45% into sugar. The residue, bagasse, is burnt to produce electric energy. The alcohol portion is mainly intended for use as vehicle fuel, either pure or mixed with gasoline. Export of these commodities continues to grow, particularly in the case of alcohol (ethanol).

Our customer

Our large customer is the leading refined sugar vendor in the Brazilian national market for 90 years. Total turnover in 2005 amounted to approx US\$ 1,2 billion. Annual output reaches 700'000 tons, of which about 15% are exported.

Applications

After raw crystal sugar has been produced through a standard process, further process stages are involved in the preparation of refined sugar:

- Crystal sugar dissolution and purification. This is the first process stage consisting of dissolving crystal sugar in water. The resulting juice solution then undergoes a further purification stage.
- Evaporation and solidification. This juice is heated up to a given point and then moved to mixers to turn it into a warm wet sugar mass. Crystals are shapeless at this stage.

- Drying and cooling. The wet mass is passed to dryers and exposed to hot and cold air spraying in order to create crystals.
- Screening. In this final stage, agglomerates are screened out to ensure high crystal uniformity.

Application difficulties

Continuous pH measurement is carried out in the sugar juice at about 75 °C/ 167 °F. However, the medium has very low conductivity (< 1µS/cm), which in itself makes measurement difficult, particularly so for electrodes made of glass.

Customer's expectations

Our customer employed the competition's equipment at this measuring point but due to the glass electrodes involved, they were uneasy about the underlying risk of process/product contamination through electrode breakage, and of course concerned with the costly consequences. This uncertainty prompted them to search for new alternatives. They were therefore interested in the use of our ISFET, non-glass pH electrode model due to the higher process safety benefit.

Loop selection

After listening to our customer we decided to install and test a full loop based on the ISFET, non-glass pH sensor InPro 3300. Due to the particular characteristics of the medium, calling for regular maintenance of the sensor,

we proposed the retractable housing InTrac 777 P. As supervisory instrument, we selected the versatile, highly reliable transmitter pH 2100 e with its particularly wide range of diagnostic and control features.

Why did the client consult METTLER TOLEDO?

The customer chose METTLER TOLEDO due to our extensive background in the Sugar Industry. Further we have a good record of success with other applications with this customer. They have already installed and successfully use Process Analytics measurement systems following carbonatation and sulfation treatment of the sugar juice. This gave us an edge over the competition. But most important in this case was the fact that we were able to offer a pH measurement system totally free of glass.

Results and outlook

The ISFET-based loop functioned highly satisfactorily and the level of performance is well comparable with that provided by glass electrodes. The greatest benefit for the customer is the assured process safety, without breakage of glass. The use of our electrodes at up to a further seven measuring points is under evaluation.



InPro 3300.

► www.mtpro.com/pH

Process Analytics Product Catalog and SpecBook

The Process Analytics Catalog and the SpecBook of METTLER TOLEDO are proven, frequently consulted reference books either to get an overview of all products on offer or to provide plant engineers with the relevant information to design their plant architecture.

Process Analytics Catalog

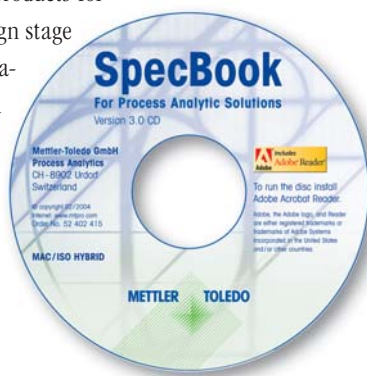
The catalog offers comprehensive overview on Process Analytics Measurement Solutions key products features, customer benefits, recommended application areas, order numbers and much more. The catalog comprises complete measuring solutions for the following parameter

- pH
- Dissolved oxygen and O₂ in gases
- CO₂
- Conductivity
- Turbidity



SpecBook

The SpecBook allows engineers to easily define and select the right products for their process during the design stage of a plant and during preparation of the relevant technical specification. The SpecBook technical CD version 3.0 also provides comfortable navigation aids, product manuals, technical data sheets, application notes, MSDS and others.



Please contact your METTLER TOLEDO representative to obtain these documents.

Mettler-Toledo AG

Process Analytics
Im Hackacker 15
CH-8902 Urdorf, Switzerland

Your METTLER TOLEDO contact:

www.mtpro.com

Visit for more information