In three critical refining processes, maintaining the correct pH level is vital. Process conditions demand the use of robust, reliable pH measuring systems. Modern process analytical technology ensures dependable measurement, long sensor life and reduced maintenance.

**Background**

The process of refining sugar from cane or beets involves the following steps: washing, grinding, juicing, liming, carbonation, filtration, sulfitation, concentration, crystallization and finally, drying (see Fig. 1). The steps in bold are the most critical to the quality of the final product and require continuous pH control. These three steps are described below.

**Process**

**Liming**

Alkaline "milk of lime" is added to the raw juice to raise the pH to 11…11.5. The purpose of adding lime (calcium oxide) is threefold:

1. To neutralize acids in the juice, thereby preventing the sucrose present from turning into inverted sugar.
2. To precipitate organic acids into salts for subsequent removal.
3. To keep foreign matter (insoluble organics, proteins, etc.) in suspension until removal by filtration.
**Carbonation**

All traces of lime must be eliminated before the concentration step to prevent scale buildup in process pipes and vessels. Carbon dioxide is added to the juice to precipitate the lime as less soluble calcium carbonate, which also captures other impurities during precipitation. CO₂ is usually added in several stages to avoid an unmanageable type of precipitate that can develop in single stage carbonation. At each stage of carbonation the pH is measured and an appropriate volume of CO₂ is injected. By the final stage the pH should be reduced to approximately 9. After carbonation the juice is filtered to eradicate all traces of solid particles before flowing to the sulfitation tower.

**Sulfitation**

Sulfur dioxide is added to the juice to lower the pH to 5…6 before it proceeds to the evaporators for concentration. The SO₂ also bleaches the juice to improve flavor, texture and color. Without this step, an alkaline juice would be produced and the sugar crystals would stick together due to moisture absorption and develop an undesirable taste.

**pH measurement systems**

METTLER TOLEDO offers a variety of solutions for pH measurement, specifically tailored for the needs of the sugar industry.

The top-of-the-line, gel-type electrode InPro 4800/InPro 4801 in combination with a retractable housing from the InTrac product family, offers excellent reliability. The InPro 4800 series of pH electrodes with their prolonged operating life, significantly reduce sensor maintenance and replacement costs. This is due to the following technical features: extremely long diffusion path in two separated electrolyte chambers; dirt-repellent annular PTFE junction in contact with the measuring media; pressure-compensated reference system to enable operation at particularly high pressures, 13 bar (188 psi); and tolerance of high temperatures, 130 °C (266 °F). The electrode has been developed and manufactured according to the latest standards, e.g. PED (Pressure Equipment Directive 97/23/EC, Art. 3, Sec. 3).

For process media in the sugar industry containing particles and aggressive chemicals, the optional flat glass membrane electrode with integrated solution ground is the optimal choice, especially if high operational temperatures are present.

**InPro 4800/InPro 4801 pH electrodes**

- Low maintenance gel electrodes with long lifetime.
- Flat membrane version (InPro 4801) for abrasive media.
- Highly resistant to acid, alkali, oxidizing media, sulfides and highly contaminated media.
- Designed for very high pressures and temperatures.
- Available with Intelligent Sensor Management (ISM) technology for reduced maintenance and calibration efforts.

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**Fig. 1 pH control in sugar refineries**
M400 transmitter
– Full ISM functionality with Plug and Measure feature and advanced diagnostics for highest operational availability.
– Mixed Mode input (digital ISM or analog sensors).
– System autonomy and maintenance-free pH measurement due to integrated PID controller.

InFit 764e stationary housing
– For accurate measurement, electrode is subjected to an over-pressure relative to the process pressure to ensure electrolyte outflow.
– Inspection glass allows monitoring of the electrolyte level.
– Rugged construction provides safe installation in industrial processes.

InFlow 761 flow-through housing
– For in-line mounting in small pipes.
– Available in a wide variety of materials and process connections.

An alternative system for overcoming the challenging measuring conditions consists of the InPro 2000 electrode with InFit 764e housing mounted in an InFlow 761 flow-through assembly. The temperature-compensated InPro 2000 pH electrode has proven to withstand the harshest process conditions. A choice of electrolyte solutions provides users with maximum chemical compatibility and the refillable chamber greatly increases electrode lifetime, reducing replacement costs. The InFit 764e housing can be pressurized to ensure electrolyte outflow, keeping the diaphragm open and free flowing to ensure accurate measurement. This system offers excellent response behavior in processes with rapid temperature fluctuations, is ruggedly constructed and easy to install. The M400 transmitter is recommended for this application.

InPro 2000 combination pH electrode
– Refillable for increased electrode lifetime and reduced maintenance.
– Liquid-filled design ensures fast response, and highest accuracy and reliability.
– Silver-ion trap minimizes electrode contamination.
– Integral temperature sensor (RTD) for higher measurement accuracy.
– Available with Intelligent Sensor Management (ISM) technology.

For more information, go to:
www.mt.com/pro
www.mt.com/ISM