

METTLER TOLEDO APPLICATION NOTE

pH Control In Sugar Refineries

BACKGROUND

Processed sugar is refined from raw sugar cane or beets. The process includes the following steps: wash, crush (or shred), extract (i.e., dissolve in warm water), *treat with lime, carbonate*, filter, *add sulfur dioxide*, concentrate, crystallize, and dry. The steps in italics are most critical to the final product and require continuous pH control. These are described below.

THE PROCESS

Liming

Alkaline “milk of lime” (whitish lime particles suspended in water) is automatically injected to raise the pH of the raw juice to 11-11.5.

The purpose of adding lime (calcium oxide) is threefold:

1. Neutralize acids in the cane or beets, thereby preventing the sucrose from turning into starch (hydrolysis) or other forms of sugar (inversion).
2. Precipitate the organic acids into salts for subsequent removal.
3. Keep foreign matter (insoluble organics, proteins, etc.) in suspension until a filtration process can remove them. (Please refer to Figure 1).

Carbonation

All traces of lime must be removed before the concentration step to prevent scale buildup. Carbon dioxide, therefore, is added to the juice to precipitate the lime as less soluble calcium carbonate (limestone), which also tends to capture other impurities during precipitation. Carbon dioxide is usually added in several

stages to avoid an unmanageable type of precipitate that can develop in single stage carbonation. At each stage, the pH is measured and carbon dioxide is automatically injected. By the last stage, the pH should be reduced to about 9. After carbonation, the juice is filtered to remove all traces of solid particles before flowing to the sulfitation tower. (Please refer to Fig. 1).

Addition of Sulfur Dioxide (Sulfitation)

Sulfur dioxide is automatically added to the juice to lower the pH to roughly 5-6 before it goes on to the evaporators. The sulfur dioxide also bleaches the juice to improve flavor and texture. Without this step, an alkaline juice would be produced, and the sugar crystals would stick together due to moisture absorption and have an undesirable taste (Figure 1).

INSTRUMENTATION

To overcome the difficult measuring conditions, the electrode of choice is the InPro® 2000 with the InFit® 764-50 housing mounted in an InFit 764-22 flow-through assembly. The temperature-compensated InPro 2000 pH electrode is durable and proven to withstand even the harshest process conditions. Choice of electrolyte solutions provides users with maximum chemical compatibility and the refillable chamber greatly increases electrode lifetime, reducing replacement costs. The InFit 764-50 housing can be pressurized to ensure electrolyte outflow, keeping the diaphragm open and free flowing for accurate measurement. This system offers good response behavior in processes with rapid temperature fluctuations, is ruggedly constructed and easy to install. The Model 2100 pH Analyzer is recommended for this application.

PRODUCTS

2100 pH Analyzer

- Detachable front panel and plug-in terminals for ease of installation
- All functions accessible through the keypad for increased ease of use
- Continuous sensor and transmitter diagnostics to monitor performance
- FM certification for Class I, Div 1 & 2 Environments and CSA General Purpose Approval
- 3 year warranty

InPro[®] 2000 Combination pH Electrode

- Refillable for increased electrode lifetime and reduced maintenance
- Liquid-fill design ensures fast response, highest accuracy and reliability
- Silver ion trap to minimize electrode contamination
- Integral RTD for higher measurement accuracy
- Rugged IP67 rated quick connect VarioPin connector

InFit[®] 764-50 Stationary Housing

- In-situ sterilizable for hygienic applications
- Electrode is subjected to an overpressure relative to the process pressure to ensure electrolyte outflow for accurate measurement
- Inspection glass allows monitoring of the electrolyte level to ensure it is never too low
- Rugged construction provides installation in industrial processes

InFlow[®] 764-22 Flow Through Housing

- For in-line mounting in small pipes
- Wetted materials prevent corrosion when used in aggressive media

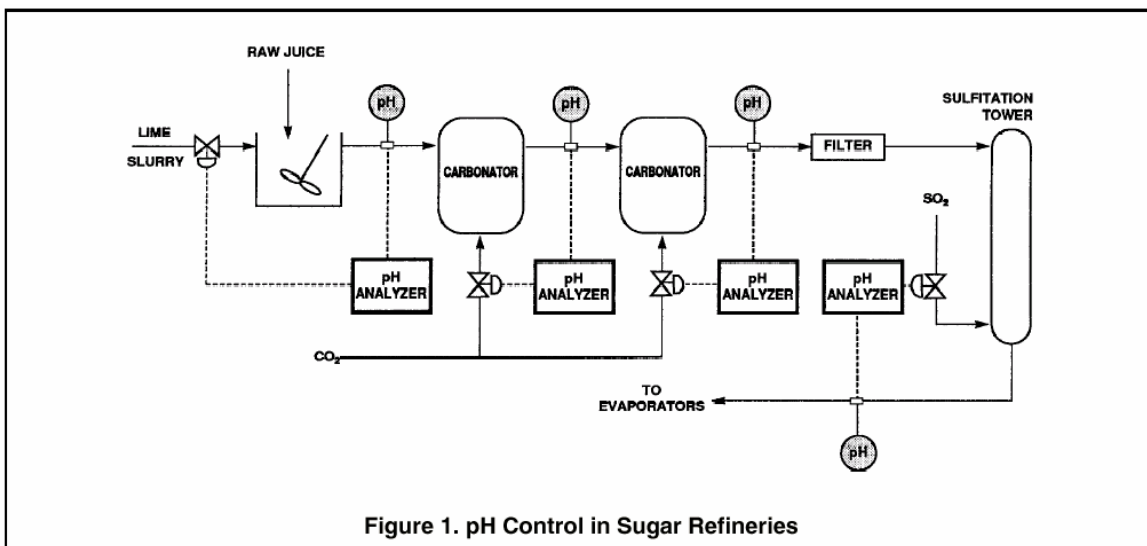


Figure 1. pH Control in Sugar Refineries

Ref: RA ADS 2001-01