

# pH Control in Sugar Refineries

## BENEFITS

- Maximize pH uptime
- Minimal maintenance
- Optimize pH control



## 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.

## PROCESS

### Liming (Figure 1)

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.

### 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 nine (9).

After carbonation, the juice is filtered to remove all traces of solid particles before flowing to the sulfitation tower.

### Addition of Sulfur Dioxide (Sulfitation)

Sulfur dioxide is automatically added to the juice to lower the pH to roughly five-six (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, the sugar crystals would stick together due to excess moisture, and the product would have an undesirable taste.

## INSTRUMENTATION

### Recommended pH Analyzers

One recommended pH analyzer for all three operations is the Rosemount Analytical Model 1056 analyzer, which features isolated current outputs and three process alarms. The 1056 analyzer and the loop-powered Model Xmt pH/ORP two-wire transmitter may also be used.

### Recommended Sensors

The insertion/submersion TUpH™<sup>1</sup> Model 396P sensor and the retractable TUpH Model 396R sensor are recommended for these applications.

The PERpH-X™<sup>2</sup> Model 3500 and the retractable Model 3400 are designed specifically for harsh, high-suspended-solids applications that tend to coat or foul the electrode surface. The double junction reference electrode excels in harsh environments. Consequently, maintenance costs and downtimes typically associated with cleaning sensors are reduced.

<sup>1</sup>TUpH is a trademark of Rosemount Analytical.

<sup>2</sup>PERpH-X is a trademark of Rosemount Analytical.

## INSTRUMENTATION

### Model 1056 Dual Input Intelligent Analyzer

- Dual configurable inputs and outputs enable cation conductivity measurement with a single analyzer
- Large, bright LCD display can be customized to show straight and cation conductivity simultaneously
- Intuitive menus with advanced diagnostics
- Four alarm relays with timers
- Optional HART<sup>®3</sup> or Profibus<sup>®4</sup> DP



### Model Xmt-P Smart Two-Wire Transmitter

- Large custom LCD display
- NEMA 4X (IP65) weatherproof, corrosion-resistant enclosure
- Comprehensive pH glass and reference diagnostics
- HART and FOUNDATION<sup>®5</sup> fieldbus options



### PERpH-X Model 3400 Retractable pH/ORP Sensor

- Highest pressure, temperature specification on market
- Longer sensor life with rebuildable design
- Retractable version for greater insertion depths
- Fast, accurate and stable measurement
- SMART enabled



### Model 3500 pH/ORP PERpH-X Sensor

- Advanced on-line sensor diagnostics for use with the Models 1056 pH/ORP Analyzer or the Xmt pH/ORP Transmitter
- Fast, accurate and stable measurement
- Optional internal preamp
- SMART enabled



<sup>3</sup> HART is a registered trademark of the Hart foundation

<sup>4</sup> Profibus is a registered trademark of Profibus & Profinet International

<sup>5</sup> FOUNDATION fieldbus is a registered trademark of the Fieldbus Foundation

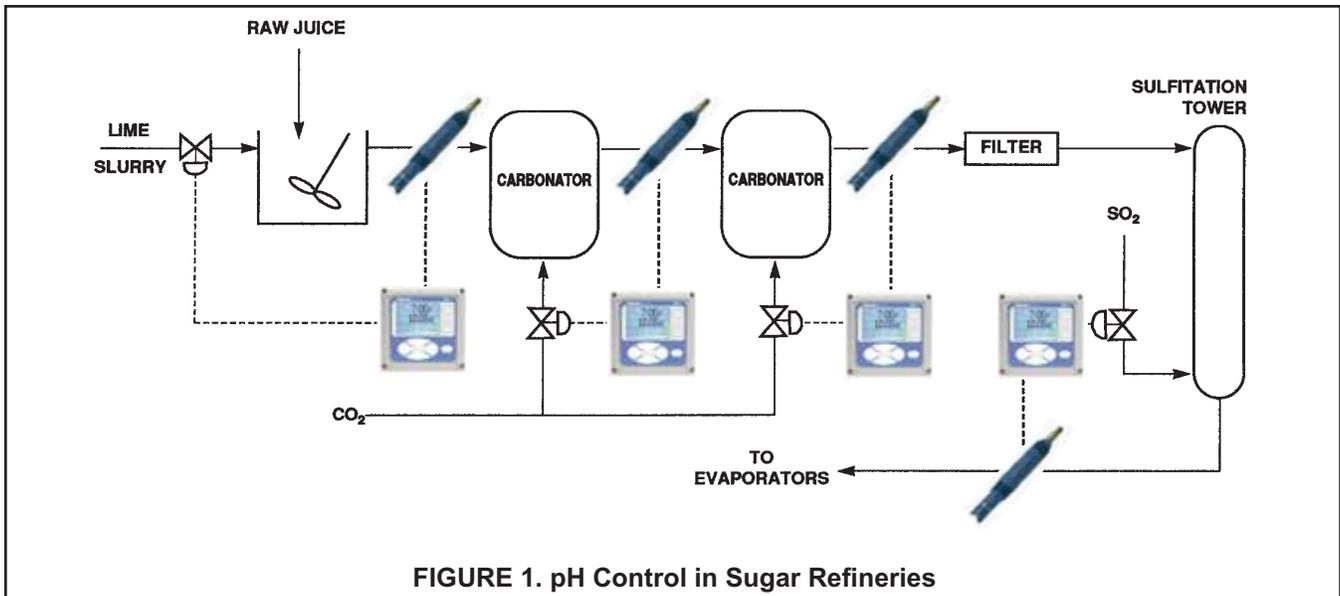


FIGURE 1. pH Control in Sugar Refineries

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