

Foxboro® pH Control System

Delivers long-lasting, accurate pH analysis in corrosive fertilizer plants

Summary

The Foxboro 875PH intelligent analyzer and 871PH rebuildable sensors are a proven system for demanding pH measurement applications and provide the right components, construction, and materials to stand up to extremely challenging applications.

Business Value

The 875PH analyzer provides ease-of-use advantages, while the fast-response 871PH rebuildable sensors include a robust and continuously reusable sensor body with a field-replaceable measuring electrode. This allows for reduced maintenance and downtime with lower equipment costs and longer sensor life.



About the Foxboro pH Control System

The 875PH intelligent analyzer and 871PH rebuildable sensors are a proven system for demanding pH measurement applications. The 875PH analyzer provides ease-of-use advantages such as two alarm relays, two 4-20 mA outputs, and an optional HART Communications Protocol for remote configuration. The fast-response 871PH rebuildable sensors include a robust and continuously reusable sensor body with a field-replaceable measuring electrode. The 871PH rebuildable sensors can withstand extended exposure to temperature cycling applications up to 250°F (121°C).

Benefits

- Accurate, reliable pH measurement in extremely demanding applications
- Improved emissions monitoring for environmental compliance
- Reduced maintenance and downtime with ease of sensor installation, replacement and calibration
- Lower equipment costs with longer sensor service life in challenging applications



“The Foxboro pH system delivers just what we hoped for: the highest reliability we could find for this very tough application.”

– A member of the company's instrumentation/electrical department

Technical Challenges

Given its extremely harsh production environment, the fertilizer industry is a fertile ground for process measurement and field instrumentation challenges. This is particularly true when producing single superphosphate (SSP) fertilizer, which involves mixing crushed phosphoric rock with a highly potent solution of 90 percent sulfuric acid.

The use of high-fluorine phosphate rocks coupled with intense process cleaning results in an extremely aggressive substance, hydrofluorosilicic acid (H_2SiF_6), in varying concentrations and at varying temperatures. One of the most powerful oxidizing agents known, this acid attacks most metals and organic compounds, and etches glass — including glass pH electrodes, which complicates accurate pH measurement.

During acidulation, this type of phosphate gives off as gas 20 to 30 percent of the fluorine in the rock, with granulation and drying stages giving off up to an additional 5 percent of the rockbound fluorine. The silicon fluoride is scrubbed with water; the resultant fluorosilicic acid is recycled to the phosphate rock/acid mixer, and the granulation drum. While very little of the fluorine recycled to the drum outgases, up to 80 percent of fluorine recycled to the mixer is emitted.

Unfortunately, this recycling reduces liquid throughput in the dense fluorine scrubbers, thereby raising fluorine concentration in the scrubbing systems. This can lead to elevated levels of fluorine in the final scrubber stages — resulting in a breach of a plant's stack discharge license. To help alleviate these difficulties, a leading international fertilizer producer employs a caustic control system that adds dilute liquid caustic (sodium hydroxide at 46 percent, diluted on-site to 30 percent) from a storage tank via a pump system to three separate scrubbers:

- Dryer area cross-flow scrubber — process temperature 122°F (50°C) with solids (dust carryover) content in liquor
- Mixing area cross-flow scrubber — at a hot 149°F (65°C) and with solids content (dust carryover and evolved silicon fluoride, SiF_4) present in liquor
- Hygiene scrubber (used for dryer and mixing areas) — at 68° to 86°F (20° to 30°C) and very high in solids (heavy dust carryover)

Control signals for the scrubbers are processed by a programmable logic controller (PLC), and then sent to a solenoid-operated caustic control valve. Precise control is critical in maintaining pH levels in each system and at pre-determined limits, keeping fluorine emissions from the plant's stack, and within government-mandated margins.

The Foxboro Solution

The Foxboro pH system proved to be the essential ingredient for achieving the required and delicate emissions control balance. The system comprises an 875PH intelligent analyzer and 871PH rebuildable sensors that provide the right components, construction, and materials to stand up to this extremely challenging application. Readings go from the 871PH sensors to the 875PH analyzer, which sends a 4-20 mA pH signal back to the PLC. There, a comparator program controls caustic opening and closing times, maintaining the pH limits designated for each scrubber station.

The 875PH analyzer provides performance and ease-of-use advantages such as two alarm relays, two 4-20 mA outputs, an optional HART Communication Protocol for remote configuration, and an optional metal field-mount enclosure rated NEMA 4X and IEC IP65. It also furnishes operators and maintenance staff with complete sensor and analyzer diagnostics, auto-buffer recognition for flawless pH calibration, and a history log.

The fast-response 871PH rebuildable sensors were selected for their outstanding ease of installation, replacement, calibration, and maintenance. The



sensors include a robust and continuously reusable sensor body with a field-replaceable measuring electrode. For this demanding application, Foxboro provided sensors with metallic antimony electrodes — specifically created for pH measuring applications containing hydrofluoric acids. The 871PH rebuildable sensors can withstand extended exposure to temperature cycling applications up to 250°F (121°C).

Results

The sensors proved that they could stand up to harsh fertilizer plant conditions, but the instrumentation team had to first deal with one minor problem. When working with a particular rock blend, byproducts produced a small amount of other unexpected acids, for which the system was not specified.

The acid proceeded to eat away the titanium retainer and clip of the electrode on the mixing den cross-flow scrubber system.

The 871PH rebuildable design allowed plant personnel to promptly install a 316 stainless steel replacement that provided the desired lifespan.

Once this minor problem was resolved, the Foxboro pH measurement system performed precisely as expected, providing accurate, reliable operation for the long term. A member of the company's instrumentation/electrical department sums it up, "The Foxboro pH system delivers just what we hoped for: the highest reliability we could find for this very tough application."

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