How to OptimizepH Measurement

Here's how one company is handling its pH analysis and achieving improved emissions monitoring, reduced maintenance and downtime, and lower equipment costs

Given its extremely harsh production environment, the fertilizer industry presents many process measurement and field instrumentation challenges. This is particularly true when producing single superphosphate 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, in varying concentrations 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 present in the rock. Granulation and drying stages give off up to another 5 percent of the rock-bound fluorine. This silicon fluoride is scrubbed with water, and 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 decided to employ a caustic control system that adds diluted liquid caustic (sodium hydroxide at 46 percent, diluted onsite to 30 percent) from a storage tank via a pump system to three separate scrubbers. These scrubbers are outlined below along with application specifics:

&#149 The dryer area cross-flow scrubber: process temperature at 122&#176F (50&#176C) with solids content (dust carryover) present in liquor.

&#149 The mixing area cross-flow scrubber: process temperature at 149&#176F (65&#176C) with solids content (dust carryover and evolved silicon fluoride) present in liquor.

&#149 The hygiene scrubber used for both dryer and mixing den areas: process temperature at 68&#176F to 86&#176F (20&#176C to 30&#176C) with very high solids content (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 to maintain pH level in each system at predetermined limits, keeping fluorine emissions from the plant's stack within government-mandated margins.

A pH control system from Foxboro achieves the delicate emissions control balance needed. The system is made up of the 875PH intelligent analyzer and 871PH rebuildable sensors. Readings go from the sensors to the analyzer, which sends a 4-20 mA pH signal back to the PLC. The PLC's comparator program controls caustic opening and closing times, maintaining the pH limits designated for each scrubber station.

The analyzer provides performance and ease-of-use advantages such as two alarm relays, two 4-20 mA outputs, and an RS232 serial port for remote configuration, plus 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 sensors were chosen for their ease of installation, replacement, calibration, and maintenance. They include a robust and continuously reusable sensor body with a field-replaceable measuring electrode. For this application, Foxboro provided sensors with metallic antimony electrodes, which were specifically created for pH measuring applications containing hydrofluoric acids. The sensors can withstand extended exposure to temperature-cycling applications up to 250&#176F (121&#176C).

The sensors soon proved that they could stand up to harsh fertilizer plant conditions, but the instrumentation team had to deal with one minor problem. With a particular rock blend, there were byproducts that produced a small amount of 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. However, the 871PH rebuildable design allowed plant personnel to promptly install a 316 stainless steel replacement that provided the desired lifespan. Once this resolution was implemented, the pH measurement system performed precisely as expected, providing accurate, reliable operation for the long term.

Additional information about pH control systems is available by contacting the Foxboro Measurements & Instruments unit of Invensys Process Systems, 33

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