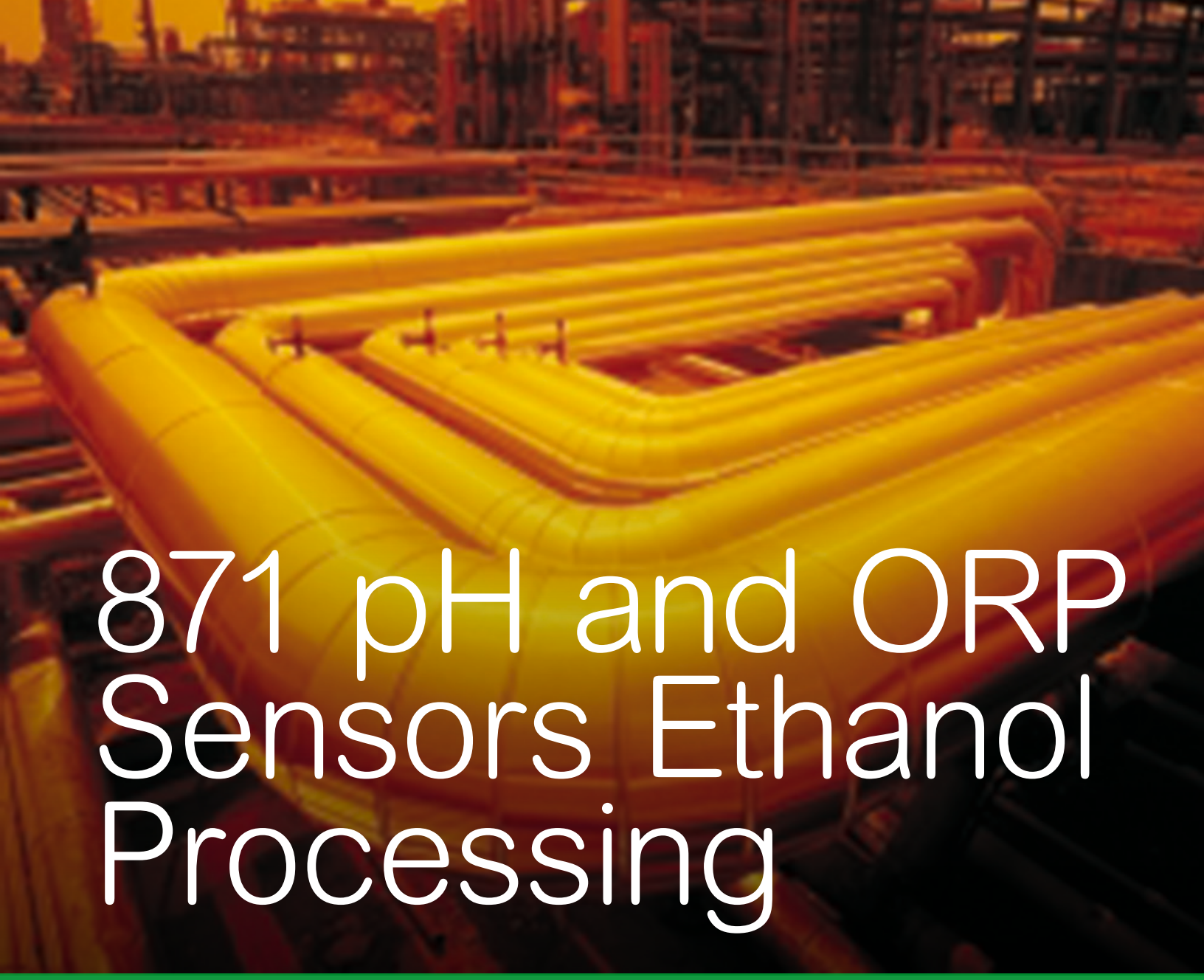

871 pH and ORP Sensors Ethanol Processing

Rebuildable Foxboro® pH sensors reduce costs while improving performance in a high temperature chemical application

Archer Daniels Midland Company (ADM)
Cedar Rapids, Iowa

www.fielddevices.foxboro.com

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Background

Cedar Rapids, Iowa

Archer Daniels Midland Company is one of the largest agricultural processors in the world producing food ingredients, animal feed ingredients, renewable fuels and naturally derived alternatives to industrial chemicals. Founded in 1902, ADM operates more than 250 processing and manufacturing facilities across the United States and worldwide. In 1971 ADM acquired Corn Sweeteners, Inc., Cedar Rapids, Iowa, and in 1981 the Cedar Rapids facility was expanded to produce ethanol.

Benefits

- Increased process efficiency by reducing downtime
- Improved stability and performance of pH sensing
- Significant cost savings in maintenance and equipment
- Heightened worker safety
- Lowered inventory and supply

Customer Challenge

Managing pH in high-temperature chemical applications is critical for consistent product quality, efficient process reaction, and compliance in environmental regulations. But because accurate measurement requires immersing pH sensors in hot, strongly acidic substances for extended time periods, companies have traditionally had to replace them every few days. ADM Cedar Rapids, however, has found a pH sensor that they can use for months without replacing, thus significantly reducing equipment and labor costs, while maintaining high process quality standards. ADM has applied the new pH monitoring solution to provide accurate, cost effective pH sensing to ethanol production at its Cedar Rapids, Iowa facility.

Ethanol is a high-alcohol, renewable fuel additive that helps gasoline producers meet environmental regulations. Maintaining accurate pH levels during ethanol production is critical to control the sulfur dioxide levels. Excessive sulfur dioxide in the ethanol corrodes the carburetor and other engine components involved in gas distribution.

Ethanol production involves fermenting and distilling starch and sugar crops. In the early stages, liquefied starch is converted to sugar (dextrose), which is then fermented. Yeast is added to the mash to convert the sugars to ethanol and carbon dioxide. The fermented mash, called "beer," contains about 11 percent alcohol, as well as all the non-fermentable solids from the corn and the yeast cells. The beer is then heated to 235˚F to evaporate alcohol content, which is collected and condensed, and run through a rectifier to eliminate the remaining water. The final product is 199-proof, almost pure alcohol, ethanol.

"We tried taking pH readings directly from the process, but the 235˚F temperature ate sensors up," says Lloyd Feickert, instrumentation supervisor at the ADM Cedar Rapids facility. "To reduce excessive sensor costs we set up a slipstream arrangement, whereby we run a sample of the ethanol offline to cool it down to 140˚F, and measure that," says Feickert.

While the slipstream arrangement significantly extended pH sensor service life, inherent process conditions still caused frequent replacement of components in the rebuildable pH sensors. "At the lower temperatures, pH sensors could last for weeks, but process conditions caused temperature fluctuations within the slipstreams. These reduced sensor life significantly. We had standardized on the Foxboro 871 rebuildable pH sensors, so we turned to them for the solution," says Feickert.

> "The folks at Foxboro studied my application and came back with a replaceable electrode that, after a cooperative testing period, increased our sensor service life from days to months."
>
> - Lloyd Feickert,
> Instrumentation Supervisor
> ADM Cedar Rapids

Foxboro Solution

To accommodate ADM's application, the Foxboro Measurements and Instruments division worked with Feickert to develop a field replaceable measuring electrode that could withstand severe temperature cycling up to 250˚F. The replaceable electrode incorporates patented technology from the award-winning Foxboro DolpHin™ pH sensor line.

"I heard about the DolpHin line of high-temperature pH sensors and asked Foxboro if they could develop a similar product for rebuildable sensors. The folks at Foxboro studied my application and came back with a replaceable electrode that, after a cooperative testing period, increased our sensor service life from days to months," says Feickert.

The newly developed measuring electrode features a unique pH glass formulation that provides superior measurement stability, accuracy, and longer service in high-temperature applications. This pH glass also increases response speed up to five times. The electrodes are available in domed, spherical, or ruggedized flat glass. The domed glass electrode is for the harshest applications: temperatures up to 250˚F and extremes of chemical concentrations.

The spherical glass electrodes are for standard process applications up to 212˚F, and the flat ruggedized glass electrodes are for applications where the process water contains solid materials with pH between 2 and 12 and temperatures up to 185˚F. All electrodes are interchangeable and their plug-in design facilitates quick and easy replacement to address changes in measurement conditions or application.

"Rebuildable sensors are definitely the most cost effective way to measure pH for our applications," says Feickert. We have standardized on the Foxboro 871 line and now, with the addition of the high-temperature domed electrode, we have all the tools to cost effectively handle pH sensing throughout our plant."

Results

"The domed 871PH electrode has increased pH sensor service life from 10 days to four months," says Feickert. "That's a 1000 percent increase! When you consider that we use the domed sensor in four beer stills, as well as other processes within the plant, that's an enormous savings."

In addition to the product cost savings, ADM has significantly reduced labor and maintenance costs. "Every time you send a person out to work on a sensor, it's at least an hour's worth of labor. I estimate that we have reduced time spent on changing electrodes over the course of a year from 36 hours per electrode to three hours per electrode," says Feickert.

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