Application Case Study: Pressure/Vacuum Protection in H2S Analyzers

Introduction

Sometimes, even experts need help from their peers. Fortunately, in industrial automation fields, most of us are driven by serving our markets and clearing complex hurdles, naturally predisposing us all to linking arms when a collective challenge arises. In early 2023, Whitman Controls was contacted by one of our instrumentation manufacturing peers to collaborate on a

unique project involving hazardous gas analyzers used in the Oil & Gas industry. Knowing that Whitman has extensive experience in hydraulic process controls and that we offer a lineup of sensors specifically designed for OEMs, our client reached out to collaborate. The goal: define an instrumentation solution that would enhance the performance and safety of our client's premier gas analytic systems, with specific consideration for hydrogen sulfide applications.

About Us

As a veteran-owned small business, Whitman Controls is dedicated to supplying premium quality, reliable, technologically advanced instrumentation for use in nearly any application. Our Bristol, CT manufacturing facility embodies over 40 years of engineering, fabrication, and customer service expertise, serving both end-user and manufacturing customers nationwide through direct and distribution channels.

Application Summary

Volatile material processing is baked into the very identity of the Oil & Gas Industry, making every application a potentially hazardous affair. Over the last century, entire engineering sub-fields have been created to evolve oil and gas processing into the highly routine, controllable, and safe industrial endeavor that it is today. One of those technical sub-fields is that of hazardous gas analytics, where advanced instrumentation is used to measure the chemistries and physical properties of process streams down to resolutions in the parts per billion. Monitoring and analyzing a gas's properties with such accuracy propels automated process control systems towards vastly enhanced efficiency, quality, and safety.

One key application of hazardous gas analyzers is in the monitoring of hydrogen sulfide, or H2S. Hydrogen sulfide is a naturally occurring organic gas that is most often encountered during crude oil and natural gas extraction. In addition, H2S can be generated by wastewater treatment, organic decomposition, underground excavation, sewage handling, and mining activities. No matter the source, H2S is extremely hazardous – in relatively low concentrations, it is both flammable and combustible, and can also cause near-instant death when inhaled. In extraction and manufacturing processes, H2S levels must be controlled and contained within tight specifications to ensure product quality, low corrosion, low emissions, efficient combustion, and personnel safety.

Challenge

Monitoring hazardous gas properties is quite similar to most other process stream monitoring, with the key exceptions being the safety hazards and sensing instruments involved. As our client explained on this project, their lineup of advanced gas instruments was designed around the concept that gas media samples would be slipstreamed out of primary process piping circuits and plumbed over to a remote instrumentation enclosure. Within these remote enclosures, instruments would measure volatile gas properties such as methane, carbon dioxide, oxygen, sulfur, moisture, humidity, and hydrogen sulfide parameters. Some of these gases required explosion-proof, Class 1 Division 1/2 electrical ratings, while others did not. Either way, all streams were treated as hazardous to personnel, equipment, or both and would benefit from additional safety provisions.

With the general hazards conveyed, our client pointed us towards their core request: we were to help assess a series of functional concerns and suggest inline instrument solutions that our client could offer as options across their entire analyzer lineup. While we were to generally consider all hazardous media types, we were to specifically focus on low-concentration hydrogen sulfide, where classified electrical ratings were not required. These concerns included:

- **Interruption of Sample Stream** – A gas analyzer only works when the sample gas stream is flowing into the analyzer. Were the incoming sample stream to be interrupted, the analyzer would report false readings.
- **Upstream Process Upset** – Incoming gas sample streams are tightly regulated for flow and pressure. Any pressure spikes, vacuum draws, or major gas density changes are good indicators of upstream process issues that will alter the analyzer's readings.
- **Operator Safety** – High pressure and vacuum induced on an analyzer can exceed the analyzer's specifications, putting operators and maintenance technicians at risk of gas leaks, blowouts, and mechanical device failures.
- **Leak Detection** – Even minor drops in normal sample stream pressure can indicate a small leak somewhere in the sample circuit, which must be addressed immediately, as even tiny volumes of hazardous gases can present significant risks.
- **Calibration Protection** – When an analyzer is subjected to pressure, vacuum, temperature, or concentration spikes, there is a risk that the analyzer could drift out of

calibration. To protect against calibration drift going undetected, spike events must be monitored and reported to operators.

- **Operator Alert / Alarm** – Across all the above risks, our client wanted a secondary alarm that would alert operators of issues even if the analyzer's internal sensors didn't catch the fault.
- **Emergency Power Shunting** – In emergency situations such as hazardous gas leaks, dangerous excess concentrations, pressure bursts, or vacuum draws, process safety control systems must receive an input signal to shunt power, mechanically disconnecting and deenergizing ignition sources in areas where flammable hazardous gases are suspected.

"Our customers have been asking for extra safety monitoring options specifically for our H2S analyzers. Between OSHA, insurance companies, fracking coverage in the news, and sales gas [natural gas] pricing, there is a lot of attention on H2S levels and leaks right now. Since we added the option for sample line pressure [monitoring], about three out of every four orders take the option." - Inside Sales Manager, Confidential Hazardous Gas Analyzer Manufacturer

Solution

Contemplating the list of our client's objectives above, it quickly became evident that each concern could be translated into discrete pressure conditions such as spikes, valleys, rapid swings, and drifting trendlines. For example, abrupt pressure losses could indicate sample stream blockage, whereas gradual pressure drifts over time could indicate small leaks or upstream process upsets. With a new pressure sensor mounted on the incoming sample line, all concerns could be monitored and reacted to immediately. We reviewed our conclusions with the client and together agreed that a single pressure sensor would do the trick.

Because the client was looking to offer this solution as a low-cost, high-value option across their entire catalog of analyzers, we narrowed our selection set down to our OEM series of sensors. Whitman's OEM sensor models are specifically designed for OEM and routine maintenance applications, where economical cost, lower complexity, extreme reliability, and fast shipping are paramount. We also confirmed that our OEM series' austenitic stainless steel materials were fully compatible with hydrogen sulfide and the other expected gas types. With these factors in

mind, we recommended the Whitman P117 OEM Pressure Switch to address all of our client's objectives based on the following features:

- Standardized, Miniature, Ultra-Dependable Instrument
- Always In-Stock Model, Intended for Same-Day Shipping
- Setpoint Range 0.80 to 500 PSIg
- Max System Pressure up to 150% of Sensor Capacity
- Wide Temperature Range -65°F to 225°F
- SPDT / SPST, 5 Amp Max Switch
- Low Weight of 3.0 oz (varies slightly with electrical interface selection)
- 17-7 PH Stainless Steel Capsule
- 303 Stainless Steel Body and Fitting
- Loctite #271 Seal
- Standard Fitting 1/8-27 MNPT

Results

Since this project concluded, our client has delivered dozens of H2S analyzers to both new and existing end users, nearly all of which were ordered with the P117 pressure switch option. The feedback we've received is that for hydrogen sulfide and similar low-concentration, non-classified gas applications, this pressure switch is a clearly beneficial investment towards personnel and system safety that end users are treating as a default requirement, not an option. We're happy to see that such a simple, economical addition can so greatly bolster end users' confidence in our client's already world-class gas analyzers.

Data Bullets

- **20%** decrease in analyzer calibration frequency due to newly detected over-pressure conditions
- **1** day's lead time on in-stock OEM sensor models
- **5%** increase in analyzer sensing consumables' lifespan by pausing detection during process upsets
- **88%** of new hydrogen sulfide analyzers ordered with the P117 pressure switch option

Here at Whitman Controls, our values drive us to provide the highest level of servant partnership that you can find. To discuss your applications or to learn more about our

capabilities, please contact us at (800) 233-4401, via email at info@whitmancontrols.com, or online at www.whitmancontrols.com.