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## AMMONIA MAKER SOLVES SUPERHEATED STEAM FLOW-MEASUREMENT ISSUES

Replacing existing system with novel meter design improves performance and eliminates costly maintenance | By Michael Machuca, Emerson

**A MAJOR** manufacturer of agricultural chemicals located in Louisiana uses superheated steam with methane to create ammonia in a reforming process. About 300,000 lb/h of superheated steam at 750°F and 545 psig goes to the reformer. Efficient plant operation depends on maintaining the correct steam-to-methane ratio in this process. Insufficient steam increases unreacted methane and reduces hydrogen output. It also raises the carbon deposition rate on the reformer tubes, necessitating more frequent cleaning. Any excursions from the proper value of steam flow demand correction in a timely fashion. Otherwise, there's a high risk of reformer tube cracking that can cause a safety issue requiring the reformer to shut down. Applying excess steam to the reformer also has negative consequences — wasting energy, reducing ammonia production and decreasing the thermal efficiency of the plant.

Because this measurement is so critical, the plant used devices with a specific safety integrity level (SIL). It relied on four SIL-2-rated differential pressure (DP) transmitters with an orifice plate on the superheated steam measurement. One transmitter served to control the ratio of steam feed to the reformer. The other three transmitters comprised the safety system and operated in a two-out-

of-three (2oo3) voting configuration. Detection of low steam flow cuts off gas to the reformer, shutting it down to prevent any reformer tube damage.

One of the byproducts of the operation was the formation of carbamate salts. These salts would drop out of solution in the liquid-filled impulse lines and often plug the high side of the differential pressure leg. Even after application of heat tracing, the plugging persisted. The plant had to devote an excessive level of maintenance to the measurement point. Transmitters would become damaged, requiring repair or replacement. Moreover, technicians had to blow down the impulse lines to keep them clear, increasing the safety risk to these personnel. Overall, the maintenance program markedly boosted operating costs and technician overtime.

Failure of this loop can lead to millions of dollars in production losses from a reformer tube failure, which can take over 30 days of downtime to repair. In one instance, the transmitters failed to read below the trip point, causing major reformer tube damage during a process upset.

### A TELLING COMPARISON

Due to the high maintenance, risk for damage and safety concerns, the plant sought a more-reliable solution that

would still meet its SIL-rating requirements. It considered several different flow technologies but none had the desired capabilities.

Ultimately, the plant decided to conduct a two-month pilot test and installed an Emerson Rosemont 10-in. quad vortex flowmeter upstream of the DP orifice system. This uniquely designed vortex flowmeter has four independent transmitters with four corresponding independent sensors mounted to two independent shedder bars — all contained in one meter body. With this configuration, the plant could achieve the SIL rating required. Just like with the DP orifice-based system, one vortex transmitter handled control while the other three transmitters operated in a 2oo3 voting configuration for the safety system. In addition, the plant chose the quad vortex meter because its body design has no moving parts and, more importantly, no ports or crevices that can clog with carbamate salts.

As part of the pilot test, the plant monitored both the quad vortex flowmeter and DP flowmeter system for several months. The quad vortex meter proved far superior in reliability and accuracy in this application. So, the plant switched automatic and trip control over to the quad vortex.

The quad vortex flowmeter, which has been installed since November 2017, has required no maintenance, completely avoiding the maintenance cost associated with the DP flowmeter system's plugged impulse lines. Eliminating impulse line cleaning has kept instrument technicians out of harm's way, thus reducing safety risks. No unscheduled shutdowns due to superheated steam flow-measurement issues have taken place.

Testifying to its happiness with the quad vortex meter's performance and immunity to carbamate salt buildup, the plant purchased a second meter and removed the original quad vortex meter in May 2019 for inspection and a calibration check. The original meter was returned to the factory where it went through the calibration facility. The meter passed all calibration checks and was still within specification after the pilot test. ●

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