Improving Gas Analysis

Improving Measurement Confidence

Reproducing Plant Failure

The ability to warn against problems prior to catastrophic failure can be crucial, reducing down-time and wastage. The ingress of moisture into a dry gas system can cause serious process problems - high moisture can write-off catalyst, pressure reduction stations can be blocked with hydrate, ice or condensate, and valve failure can cause long down- times.

In addition, pressure fluctuations can cause dehydrators and dryers to become less efficient. The full effect of these fluctuations may not be known unless a fast response system is fitted.

Prior to a catastrophic failure, valves will often begin to show signs of leaking as they are operated, causing a brief leak between systems. It is well known that, with zero flow, static dry gas in a system will soon wet-up when there is a small leak or porisity on some components. The following tests were designed to reproduce a worst case scenario, where wet air from a section of pipe is briefly introduced to a dry gas system by a leaking valve.

Fig. 1 LPDT

Aluminium oxide transmitter using HTF technology enables faster speed of response than other aluminium oxide sensors

Advances in laser technology enabled tunable diode laser systems to be commercially available, offering a dramatic improvement in speed of response. A test rig was designed to simulate short term failure of a valve. The performance of a fast responding aluminium oxide transmitter, model LPDT from Xentaur (*Fig. 1*), was compared with the SS2100 tunable diode laser system from SpectraSensors (*Fig. 2*). Both systems are available from IMA.

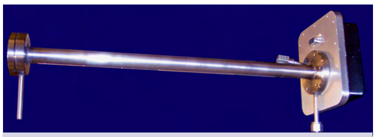


Fig. 2 SS2100 Laser system

Tunable diode laser system uses NIR light at a specific wavelength to determine moisture content.

Comparing Instrument Performance

Test Set-up

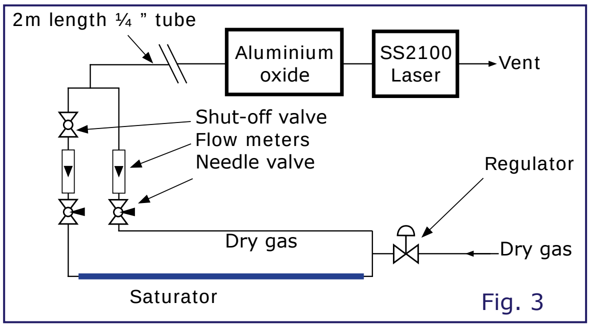


Fig. 3

A test rig was designed to reproduce a short term plant failure. All tubing was stainless steel ¼ ″ OD with double ferrule stainless steel fittings. A flow of dry gas is established and regulated to atmospheric pressure. The flow was split into a dry flow and a wet flow. The dry flow is connected with ¼ ″ flexible PTFE. The wet side was polythene tubing with a few drops of water to simulate a scenario where pipework that is normally not in operation is leaking into a dry gas supply. A shut-off valve is installed after the saturator to isolate the wet side during the dry-down phase. A flow rate of 2.5 litres a minute is established representing a normal flow rate for an instrumentation system. A 2 metre length of ¼ ″ stainless steel tube is installed after the wet and dry flows are re-combined to simulate the volume of a typical sample system for a moisture analyser. After some testing, it was decided to install the analysers in series to avoid the issue of preferential flow when the instruments were installed in parallel. The gas flow enters the flow cell for the aluminium oxide system, and then the laser system. Checks were made with the analysers the other way round: while it made no discernable difference to the laser, the aluminium oxide system performed marginally better when placed in front of the laser. The results are therefore presented where the aluminium oxide was installed ahead of the laser system.

Comparing Instrument Performance

Test Procedure

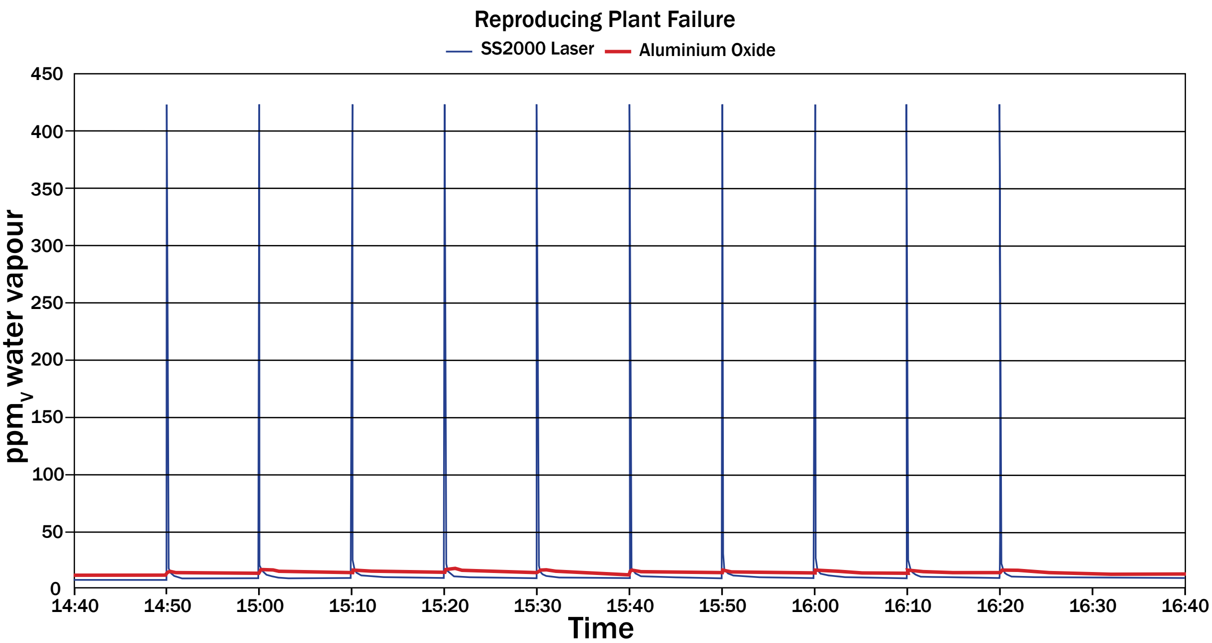
To simulate an incipient fault on a valve system, the wet flow shut-off valve was opened for a short period on a representative process cycle. It was decided that a time period of 0.5 sec would simulate the time taken for a typical valve to operate, and 10 minutes would represent a short "worst case" cycle time for a typical process.

A dry flow was established and both instruments were allowed to settle to their final reading. The analysers were challenged with 10 "shots" of wet flow each separated by 10minutes. The results were data logged with a 1 second interval.

Results

The initial dry-down of both the 2 metre tube and the analysers was performed with a flow rate of 2.5 litres/min with dry air at 9 ppm$_V$. Both systems had a good speed of response: the LPDT reaching 90 % of step change in 5 minutes and the laser reached 90 % of step change in 38 seconds.

As can be seen from the graph below, despite the aluminium oxide probe being one of the fastest on the market, it is not able to detect brief "slugs" of moisture achieving a maximum value throughout the test of only 18.2 ppm$_V$. The laser system responded to all moisture challenges by reaching its full scale value of 422 ppm$_V$ (20 lbs/MMSCF).



Conclusion

Things CAN happen quickly with moisture - both to wet and to dry but, until recently, technology has not enabled the full picture to be seen. Clearly, if this was a real process and the only data available was the aluminium oxide probe, no action would be taken to rectify the failing valve until it was too late. The laser technique is able to respond significantly better in both wet-up and dry-down challenges, and allows greater visibility of real process conditions, improving indications of transient conditions within process systems.

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