Relative Response Time of SilcoNert®-Coated Tubing (TrueTube™ EPS) when Measuring Moisture Content in a Sample Stream

Technical Insight

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Background

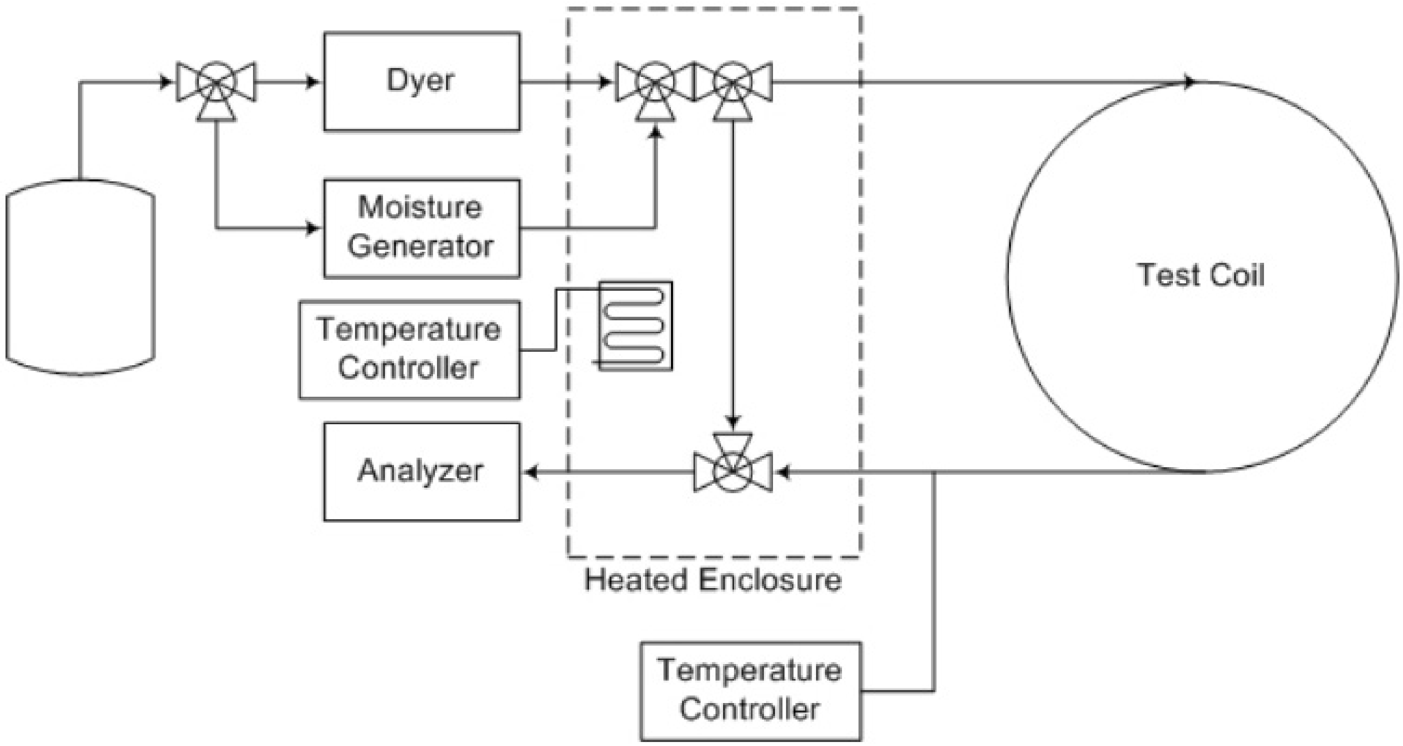
Field observations reveal delayed analyzer detection for low level moisture analysis below 30 - 50 ppm. The difference in time from when a stream composition is thought to have changed to the time it is detected by the moisture analyzer can be delayed from one to three hours. Field reports have stated that for a given installation, the delay appears to be relatively consistent for both increasing and decreasing changes in moisture concentration.

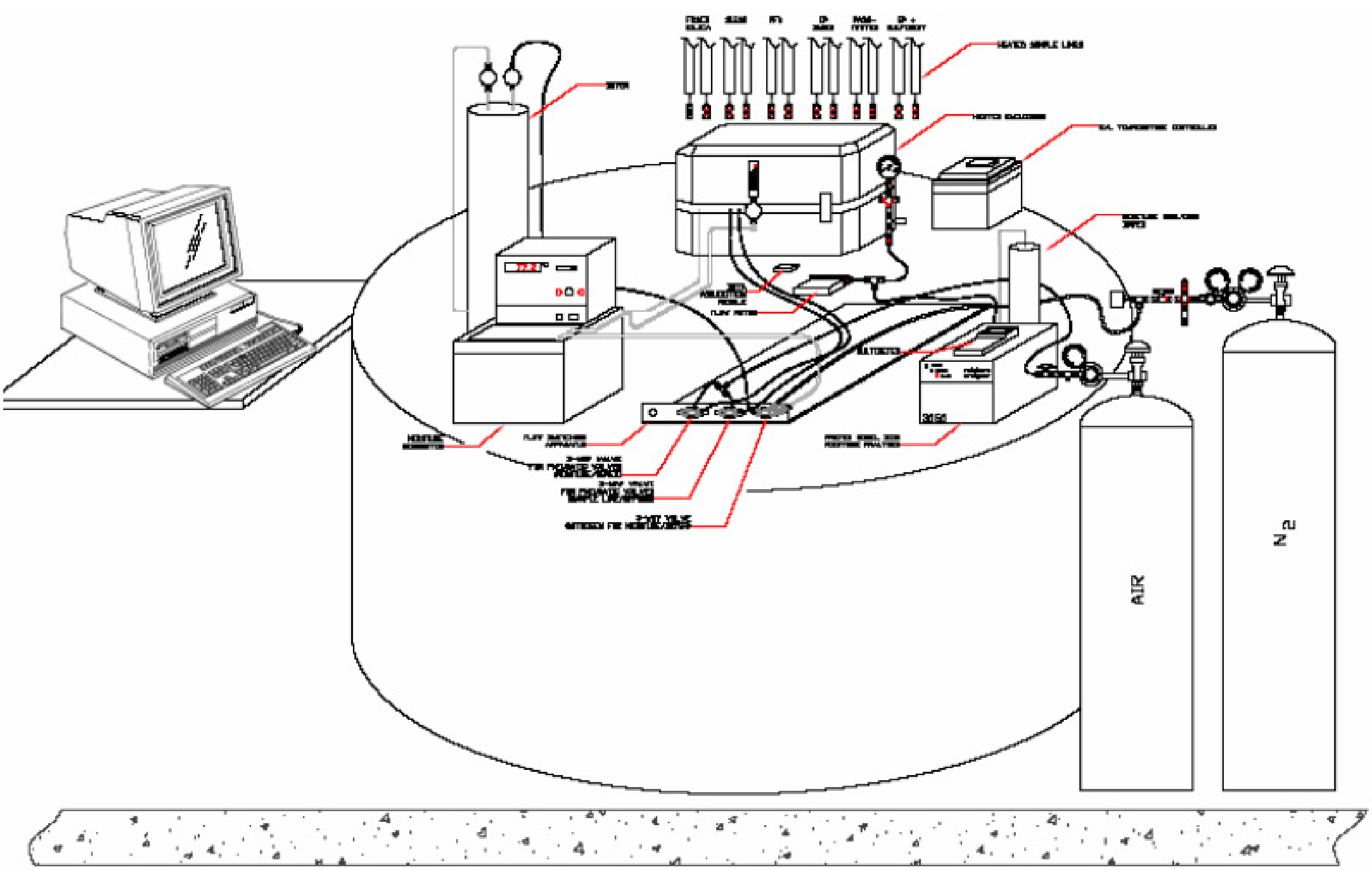
This report will determine relative response times of commercial 316L SS tubing, TrueTube™ EP (electropolished 316L SS tubing), and TrueTube™ EPS (SilcoNert®-coated electropolished 316L SS tubing) for the transmission of sample streams containing low concentrations of moisture.

Test Configuration

A moisture generator was constructed using 1/4" polyethylene permeation tubing and a Haake recalculating constant temperature water bath. The water temperature was controlled within 0.1° C and flow was controlled by a calibrated mass flow meter. Testing was then conducted to determine the ppm of water vapor produced at given selected temperatures and flow rates.

High purity valves and electropolished tubing were used to construct all common elements of the test stand. Stream switching valves and interconnects were housed in an insulated and temperature controlled enclosure.

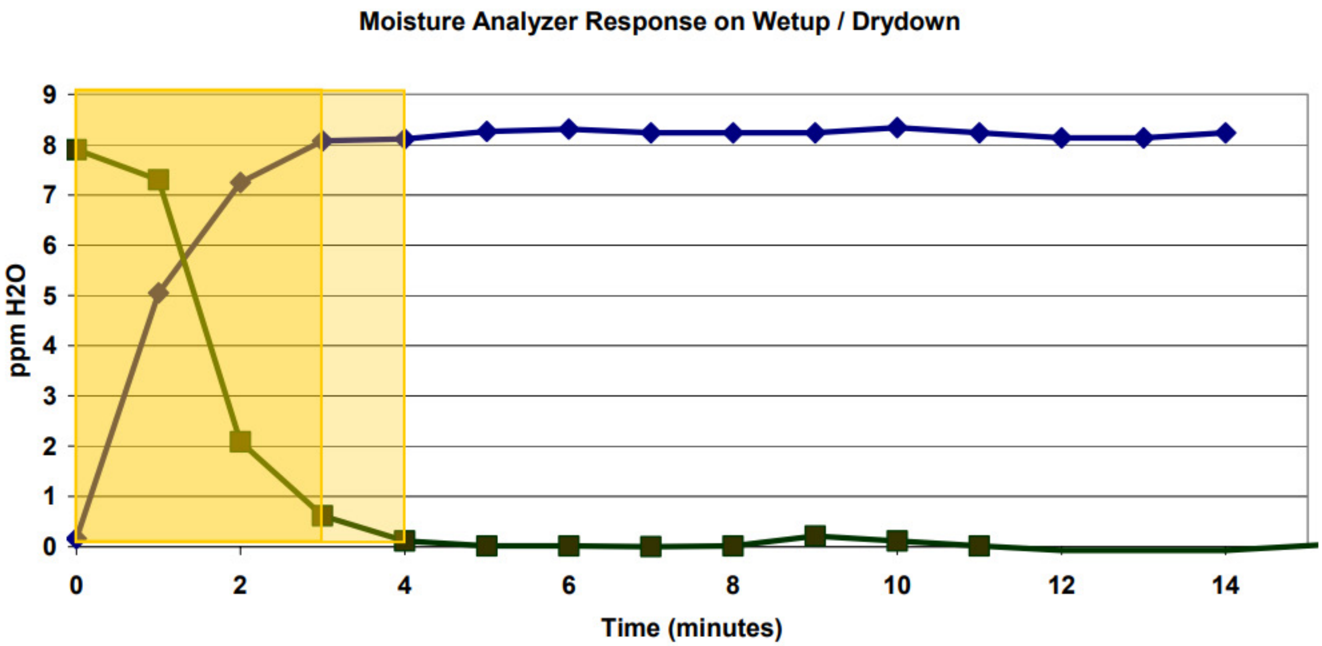

Dyer
Moisture Generator
Temperature Controller
Test Coil
Analyzer
Heated Enclosure
Temperature Controller


AIR
N2

The carrier gas was high purity dry nitrogen. For dry down tests the stream was diverted through a molecular sieve dryer to insure a moisture content of less than 10 ppb.

Each sample tube was provided in a Tracepak tubing bundle. An O'Brien HC10 controller was used to maintain a constant temperature for each test bundle. One hundred feet was used as the length of the test tube and the bundles were routed similarly from the test bench to the analyzer so installation configuration was not a variable.

The AMETEK Model 3050-AM response time was found to be 3 minutes for wet up and 4 minutes for dry down changes. The base response time has been negated in the presentation of the tube test results.



Test Procedure

Tests were conducted at gas flow rates of 0.35 slpm with ±0.02 slpm variation. Target moisture concentration was 1 ppm.

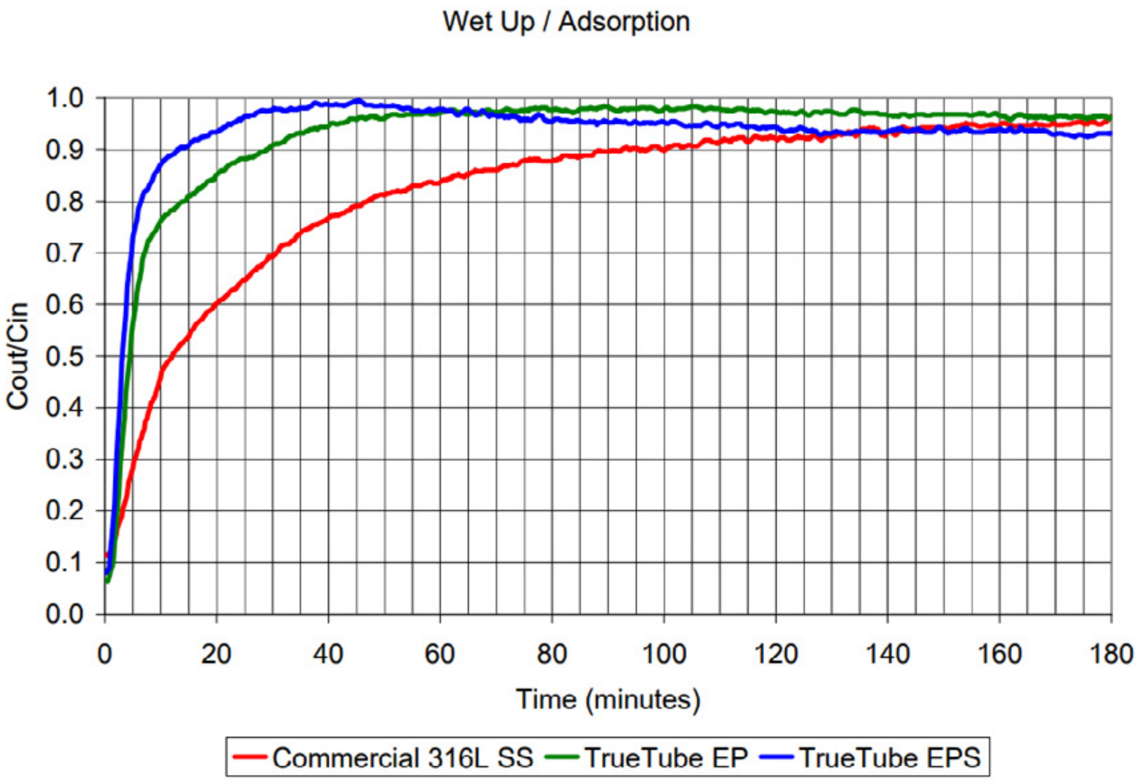
At the start of each test the reference gas was ported directly into the analyzer from the moisture generator and a base moisture concentration was recorded. The reference stream was then routed through the test tube to the analyzer. Data logging recorded the time and moisture in the stream. Data collection continued until the reference concentration was reached or there was no longer any detectable change in moisture concentration. The reference stream was again ported directly into the analyzer from the moisture generator and the ending moisture concentration was recorded. The reference stream was then switched to dry mode and routed through the test tube to the analyzer. Data logging recorded the time and moisture in the stream. Data collection continued until there was no longer any detectable change in moisture concentration.

Multiple wet up and dry down cycles were performed on each tube material. Similar results from replicate runs verified that the results reported are reproducible.

Results

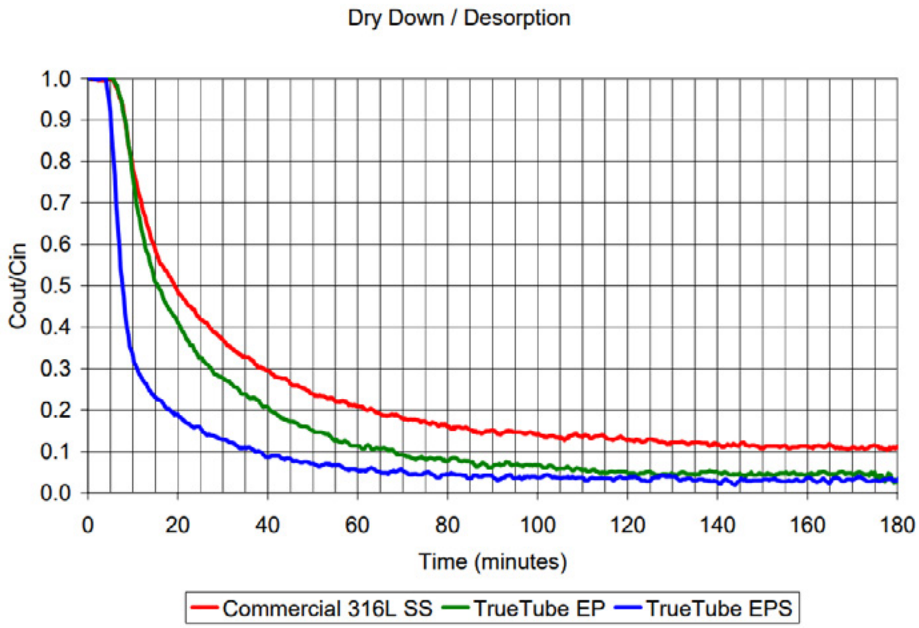
The retention time for each tube was plotted on the x-axis and the percentage of the inlet sample detected by the analyzer is plotted on the y-axis. Commercial 316L seamless stainless steel tubing, O'Brien TrueTube EP electropolished tubing, and TrueTube™ EPS SilcoNert®-coated electropolished stainless steel tubing was tested.

Wet up testing reveals the relative adsorption of moisture by the sample transport tube.



As can be seen by the adsorption test data there is a distinct difference in total response time between the different sample transport tubes tested. TrueTube™ EPS (SilcoNert®-coated) produced the fastest response time of 30 minutes to reach 98% of the input concentration. TrueTube™ EP reaches the 98% mark at 60 minutes and commercial seamless tubing is at 96% after 180 minutes. Both TrueTube products produce marked initial response within a short duration while commercial seamless tubing provides a slower but steadily improving result.

Dry down testing reveals the relative desorption of moisture by the sample transport tube.



Desorption testing provided similar relative performance improvements for TrueTube™ EP and TrueTube™ EPS over commercial seamless sample transport tube. Equivalent reductions in moisture were reached in 35 minutes for TrueTube™ EPS and 65 minutes for TrueTube™ EP while commercial seamless tubing took 175 minutes.

The following table highlights the value of TrueTube™ EP and TrueTube™ EPS over commercial 316L seamless stainless steel measuring moisture in low ppm and ppb ranges.

Time to Detect Desorption Change for Commercial 316L, TrueTube EP and EPS			
Concentration Start 10 ppm	316L SS (minutes)	TrueTube EP (minutes)	TrueTube EPS (minutes)
5 ppm	13	5	4
1 ppm	71	46	22
500 ppb	96	63	40
100 ppb	153	103	80
50 ppb	—	121	98

Acknowledgments

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