Tiger Optics | 21ST CENTURY SPECTROSCOPY

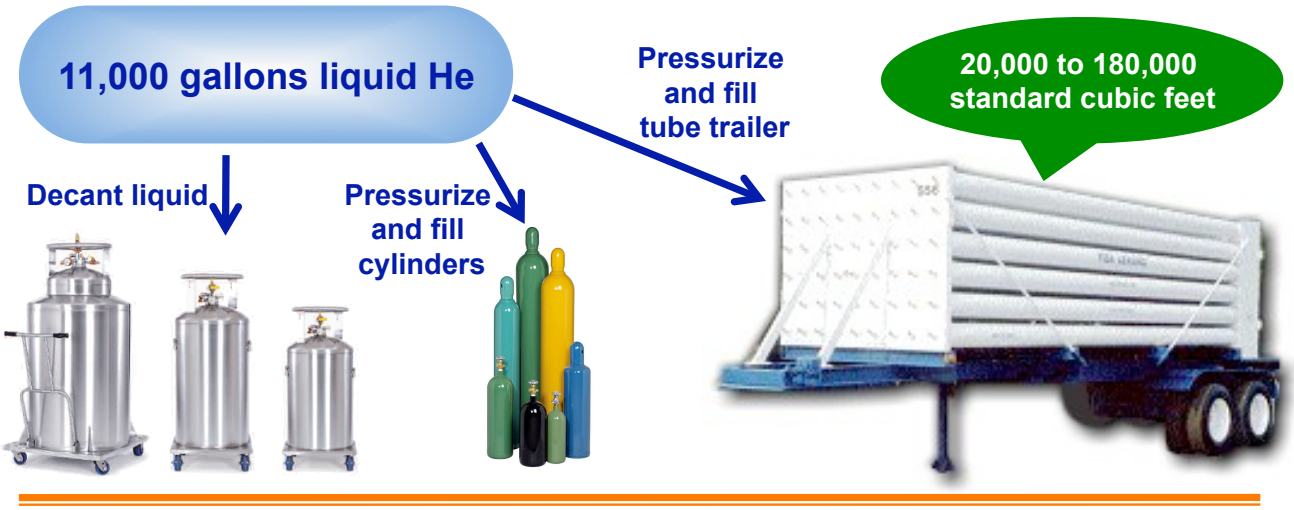
APPLICATION NOTE 1101

Use of Tiger Optics' HALO for Accurate Online Analysis of Tube Trailer Filling

Background

Industrial gas manufacturers package and deliver gases in a variety of different ways. These include on-site pipeline distribution, bulk delivery of liquefied gas into an on-site bulk container, exchange programs for large compressed gas vessels (i.e. tube trailers), and delivery of smaller cylinders containing gas or liquefied gas. Each delivery mechanism has unique advantages and also unique associated costs. Here we describe the requirements and challenges of tube trailer filling, detailing the needs related to filling high purity helium into tube trailers.

Helium tube trailer filling is a demanding activity with relatively high costs and process complexity. "Crude" helium is harvested in geographically strategic locations including Algeria, Canada, Poland, Qatar, Russia, and the United States. It is delivered to industrial gas packaging facilities around the world as a bulk liquid in 11,000 gallon refrigerated ISO tankers. The bulk liquid is not thermodynamically stable, and must be quickly and efficiently transferred to more stable product forms (i.e. pressurized gas) with longer storage potential. This is typically accomplished by decanting off some of the liquid into smaller dewer vessels for immediate sale and use, and gasifying and compressing the majority of the helium for filling pressurized vessels (compressed gas cylinders and "tubes").



Crude helium is priced at approximately $75 per thousand standard cubic feet (SCF), and high purity product containing less than 5 ppm moisture can be processed and sold for as much as $160 per thousand SCF. Therefore, efficient management of helium processing and minimization of product loss directly affect the profitability of the enterprise. Additionally, helium tube trailer filling is a time consuming process, taking at least 14 hours for a successful fill of the largest tube

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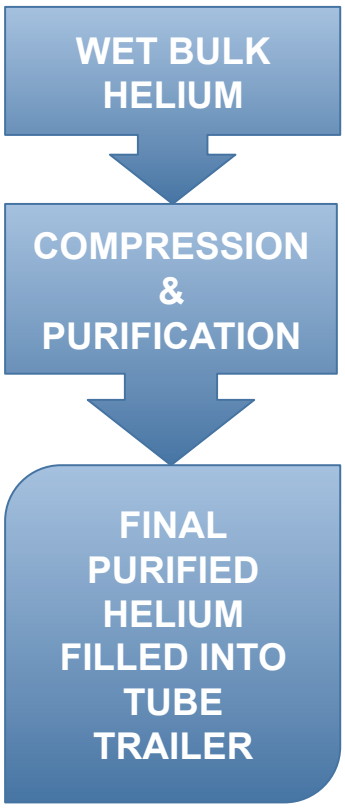
bundles (180,000 SCF). With respect to other activities at packaged gas facilities, a relatively large investment in time and product value is made for helium tube trailer products.

Typical helium tube trailer filling operations perform several steps including gasification, compression, purification, and tube filling. The goal is to fill the trailer tubes in the most energy and time efficient manner possible, and there are several points where making a fast, accurate moisture measurement can assist in achieving this goal. The major monitoring points of interest are:

Incoming Helium Product: Incoming crude helium is typically too wet to be packaged without some purification. Moisture measurements made on the crude helium allow optimization of purification procedures.

Post-purification: Purification processes typically include a selective adsorptive bed that can saturate with moisture and other impurities. Once saturated, the bed loses its capacity to retain any additional moisture and it must be regenerated. The active lifetime of the bed is a function of the moisture level in the incoming gas stream and the total time of usage. Monitoring the purification system output stream helps to indicate the active lifetime of the bed between regenerations.

Tube Trailer Inlet: Most crucially, monitoring of the helium product as it enters the tubes assures that the tube trailer is filled with in-specification product. Moisture measurement made at the point of fill will detect any quality defect stemming from bad product, inadequate purification, or compromised transfer lines. Since the fill is accomplished over such a long period of time, small variation in the moisture levels can indicate to an operator that minor process adjustments should be made. For example, an upward-shifting moisture level could indicate that the purification must be slowed, to better extract the moisture.



Traditional moisture measurement technologies have some drawbacks for these applications. Most demonstrate slow response time, limited range, and a high degree of signal averaging, which can miss a moisture excursion. At minimum this can lead to energy waste in the process, and in the worst case an entire tube trailer can be filled with out-of-specification product due to a missed moisture spike.

Lack of ability to change sampling points is another issue with traditional technologies. In order to switch from crude product to purification or final fill sampling points, the analyzer needs to be disconnected and the inlet exposed to ambient for a short period. Most technologies would experience a saturation issue in this situation, and would take hours or even days to dry back down sufficiently to make the next measurement.

Solution

For each of the measuring points highlighted above, Tiger Optics HALO and HALO-500 analyzers are optimally suited to make the measurement. The absolute technology offered by Cavity Ring-Down Spectroscopy (CRDS) is a key advantage of Tiger Optics instrumentation. With Tiger instruments, there is no zero gas and no span gas requirement. The CRDS measurement technique offers an intrinsic zero at a spectral point of no absorbance, and the HALO is engineered with an internal laser-lock reference cell that assures quantitative accuracy during measurement. With the HALO family of instruments, the time formerly spent on zeroing and spanning legacy technologies is time used making measurements. And the analyst can have the utmost confidence that they are making the most accurate measurement possible.

In addition to the outstanding accuracy, the HALO family offers the user industry-leading response speed, due to its intrinsically fast spectroscopic technique and its zero dead-volume, low wetted volume engineering. In fact, the HALO can dry down to sub-ppm readings in under 30 minutes in its initial installation. This characteristic gives the user the flexibility to sample several different measurement points in a short time period, without needing a complex, engineered sample switching system. Pairing this response speed with the small, lightweight design of the HALO instruments, the user can move the instrument from sample point to sample point with ease, speed and confidence. Figure 1 offers a representative look at the HALO's typical fast response speed to a 4 ppm moisture intrusion using flowrates of 600, 1200, and 1600 sccm.

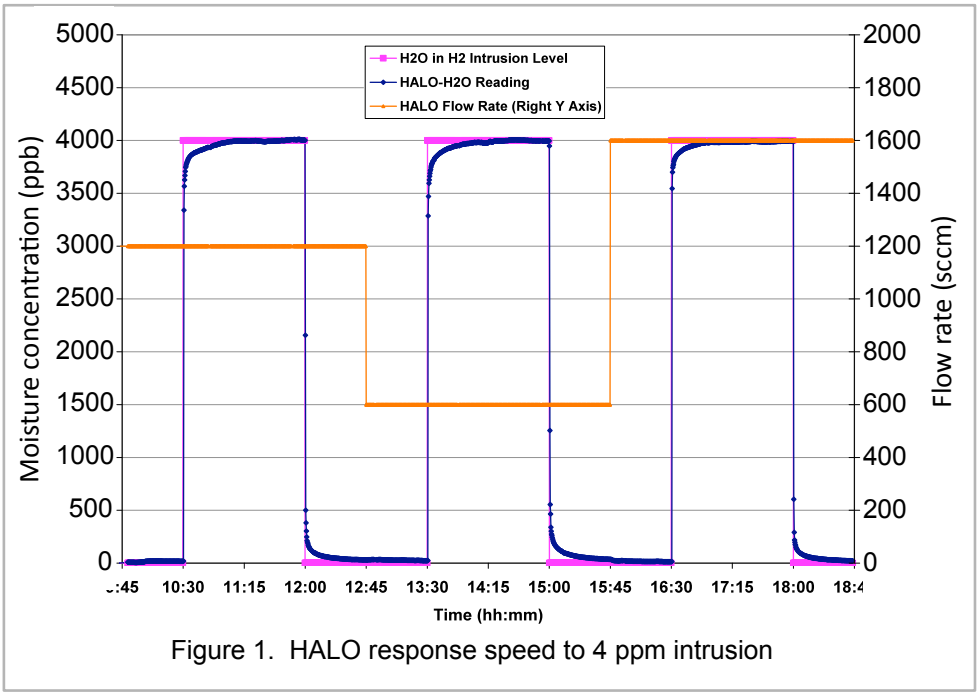


Figure 1. HALO response speed to 4 ppm intrusion

In summary, Tiger Optics HALO and HALO-500 offer helium tube trailer filling operations a superior ability to monitor, adjust and optimize all aspects of the fill process based on highly accurate measurements in real time.