

Measurement of Sulfur in Refinery Flare Gas Streams for Compliance with EPA Subpart J(a) Regulations

The Challenge

Measurement of high range and low range H₂S in refinery flare gas streams for compliance with EPA regulation NSPS Subpart J(a). The rule has placed an extra investment and operational burden on petroleum refineries to meet the regulatory requirement. AMETEK offers an economical solution to meet the challenge with an emphasis on lower capital and operating cost along with improved reliability.

The Solution and Proven Results

The AMETEK solution utilizes Tunable Diode Laser Absorption Spectroscopy (TDLAS) to measure H₂S in the process flare line to comply with the EPA J(a) regulation. Unlike other technologies like Gas Chromatography TDLAS is a non-contact technology resistant to process upsets and virtually maintenance free. Operational savings over a Gas Chromatograph are significant. Based on customer input Operation savings related to usage of Instrument Air, Carrier Gas, Calibration Gases, Electricity, Consumable Parts, Labor can be \$10,000 to \$20,000 per year! As with any compliance analyzer reliability and availability is paramount.



AMETEK Model 5100 HD TDLAS Analyzer for High / Low H₂S and gas validation system in service on a refinery flare gas line

TDLAS non-contact technology is resilient to common issues that plague other analytical analyzers like contamination of liquids, exposure to process upsets, etc.

The EPA Regulation

- ▶ In summary, routinely combusted flare gases cannot exceed 162 ppm H₂S on a 3 hour rolling average. Refineries shall continuously measure flare gas lines and record H₂S on a low range scale of 0-300 ppm.
- ▶ In addition total reduced sulfur (TRS) which is defined as H₂S + COS + CS₂ shall be continuously measured at a high range with a minimum scale of 0-5,000 ppm or 1.3 times the maximum expected concentration of H₂S (site specific). In practice the high range scale tends to be in 0-40% H₂S and higher.
- ▶ In addition to the H₂S (low range) and TRS (high range) analysis both flow and BTU must be measured, this application bulletin does not address these measurements.

The Methods of Measuring the High Range TRS

The low range (0-300 ppm) is defined as H₂S and H₂S only. For the high range the requirement is to measure TRS (defined as H₂S + COS + CS₂). The EPA document describes various choices in terms of the high range measurement to comply with the sub part J(a) requirement the most practical being...

1. Measure just the H₂S at the High range (not the COS, CS₂) and establish a correlation of the ratio of CS₂, COS to the H₂S value by grab sample and lab analysis.
2. Measure total reduced sulfur as H₂S + COS + CS₂ (using EPA method 15 as a basis).
3. Measure total reduced sulfur by oxidizing the sample to SO₂ and measure as SO₂ (using EPA ref method 15a as a basis).

Measurement of Sulfur in Refinery Flare Gas Streams for Compliance with EPA Subpart J(a) Regulations

The AMETEK solution utilizes the first technique described above; direct measure of H_2S (only) for the high range utilizing tuneable diode laser absorption spectroscopy (TDLAS). The TDLAS technique is highly specific to H_2S , fast reacting and immune from contamination from high concentrations of H_2S span gas or high H_2S event. The reasons for not measuring the COS and CS_2 are the limitation of the spectroscopy to measure COS and CS_2 at the required ranges in conjunction of the H_2S .

The Advantages of Tuneable Diode Laser (TDLAS)

- ▶ TDLAS is direct, continuous measure and non contact technique.
- ▶ The AMETEK 5100 HD has a H_2S reference cell, this ensures line lock at low concentrations as H_2S approaches zero. The technique is continuous, direct measure, (no scrubbing or switching).
- ▶ The 5100 HD is rated IP-65 for installation in a free ventilated building or three sided shelter obviating the need for a temperature controlled analyzer house and the associated infrastructure.
- ▶ An additional safety benefit of installing the analyzer in a free ventilated building or three sided shelter is the reduced risk of exposure to H_2S from the daily (high) concentration H_2S cylinder gas audits.
- ▶ Low maintenance... No carrier gas, no flame, no columns, no dilution, no switching.

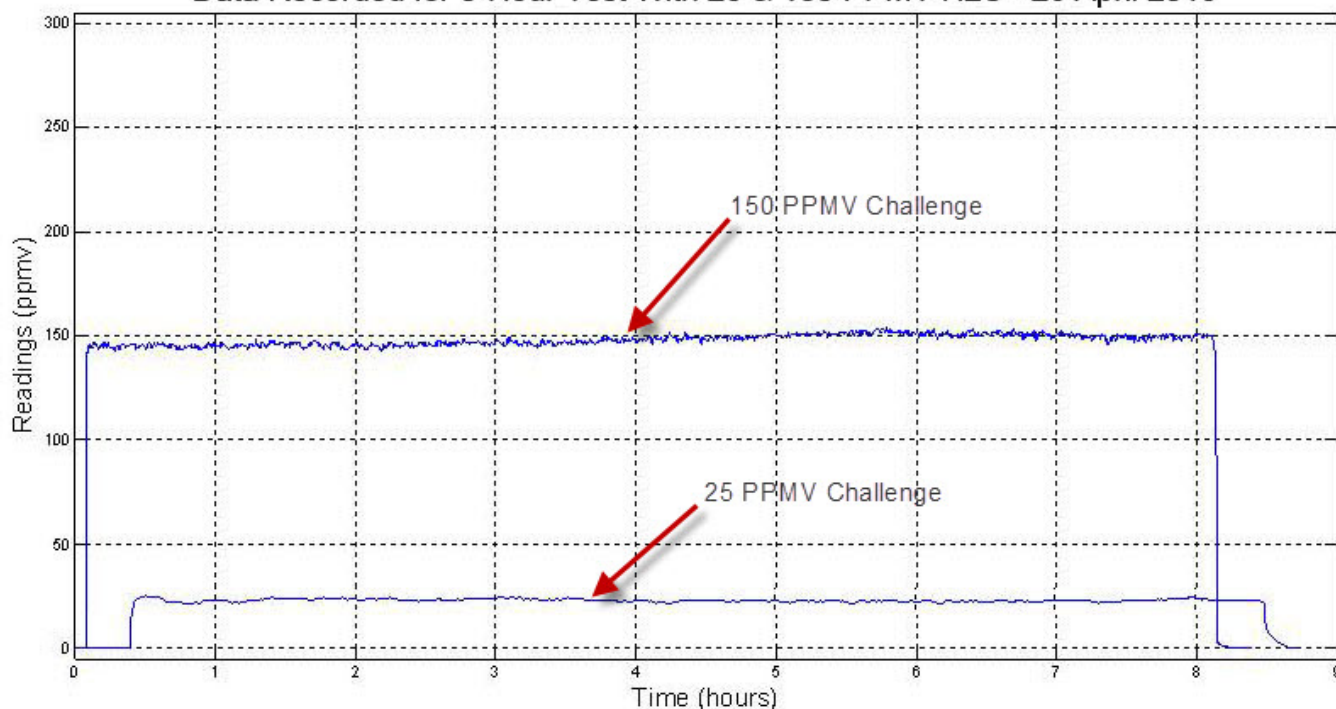
Limitations with Other Analytical Techniques

- ▶ Utilizing a single gas chromatograph (GC) for both the low (H_2S) and the high range (TRS) measurements can be compromised by high concentration H_2S daily cylinder gas audits or a high concentration H_2S process event.
- ▶ Utilizing an oxidizing technique followed by dilution and pulsed fluorescence spectroscopy has the associated complications of dilution orifices being fouled and open flame for the oxidizer.
- ▶ Both GC and oxidizing (dilution orifice) techniques are subject to damage from the ingress of liquids which can be a common occurrence due to liquid seals, addition of steam to the flare line and entrained liquid hydrocarbon.

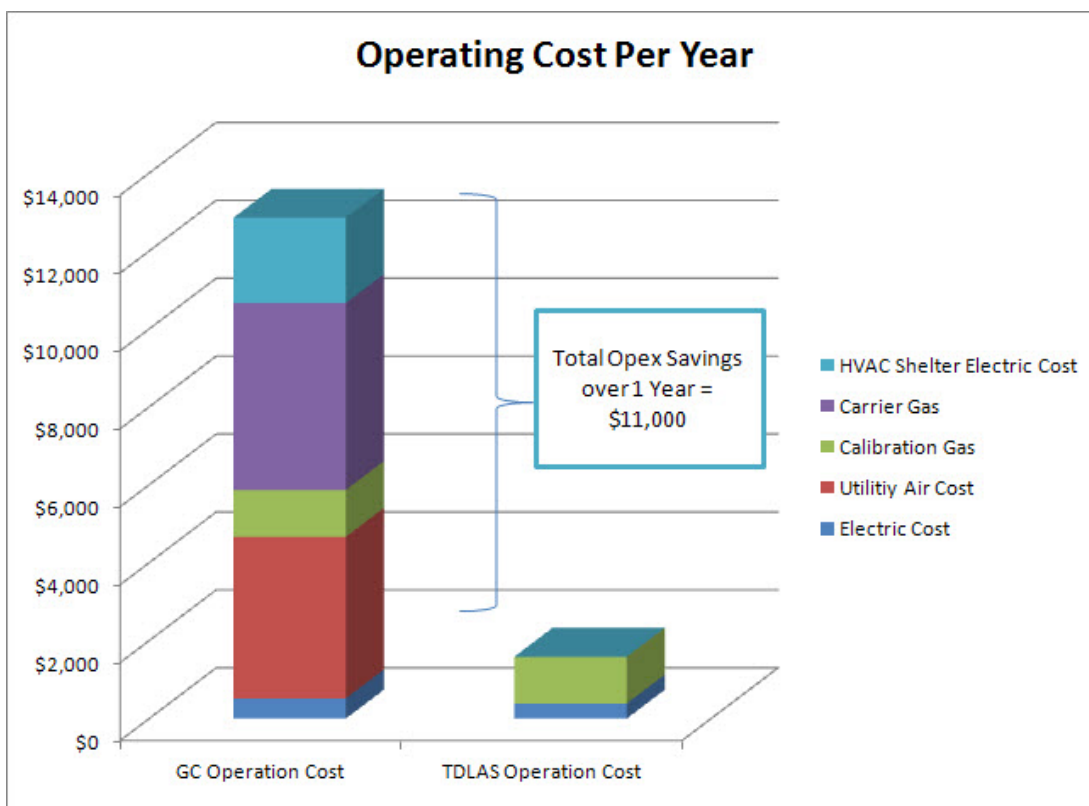
The Package and Integration Options

- ▶ AMETEK can provide full integration and system capability from three sided shelters, free standing cabinets, free ventilated shelters to full walk in analyzer houses.
- ▶ Process connection using the AMETEK Universal Model 270F Flare Stack probe, designed specifically for sulfur flare gas applications with SilcoNert™ treated surfaces.

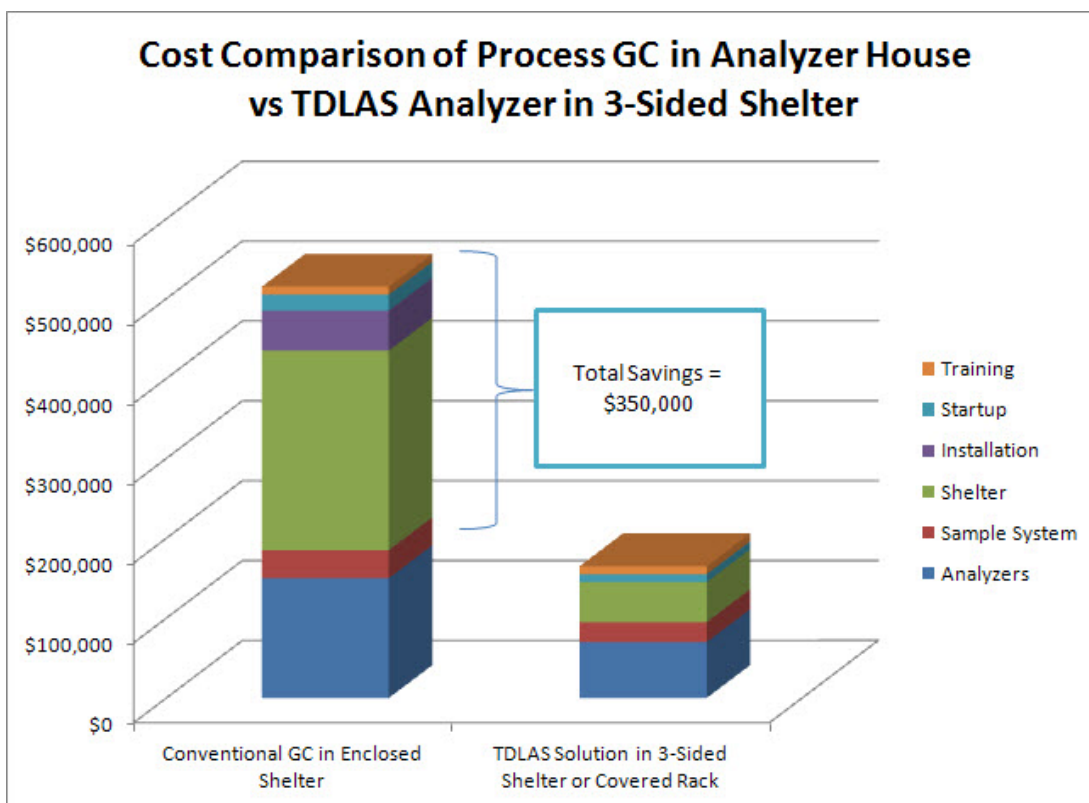
Data Recorded for 8-Hour Test With 25 & 150 PPMV H_2S - 26 April 2013



Data Collected for 8-Hour Gas Test



Operating cost comparison TDLAS vs GC



Capital Cost for TDLAS solution vs GC solution to meet Subpart J(a)

Measurement of Sulfur in Refinery Flare Gas Streams for Compliance with EPA Subpart J(a) Regulations

PROCESS Application Note



Model 5100 HD Analyzer in 3 sided shelter for flare gas application



AMETEK Universal Model 270 Flare Gas Probe

AMETEK®
PROCESS INSTRUMENTS

455 Corporate Blvd., Newark, DE 19702
Ph. +1-302-456-4400, Fax +1-302-456-4444
www.ametekpi.com



© 2011, by AMETEK, Inc.
All rights reserved. Printed in the U.S.A.
F-0411 Rev 3 (0513)

One of a family of innovative process analyzer solutions from AMETEK Process Instruments.
Specifications subject to change without notice.

SALES AND MANUFACTURING:

USA - Pennsylvania

150 Freeport Road, Pittsburgh PA 15238 • Tel: +1-412-828-9040, Fax: +1-412-826-0399

USA - Oklahoma

2001 N. Indianwood Ave., Broken Arrow OK 74012 • Tel: +1-918-250-7200, Fax: +1-918-459-0165

CANADA - Alberta

2876 Sunridge Way N.E., Calgary, AB T1Y 7H9 • Tel: +1-403-235-8400, Fax: +1-403-248-3550

WORLDWIDE SALES AND SERVICE LOCATIONS:

USA - Texas

Tel: +1-713-466-4900, Fax: +1-713-849-1924

BRAZIL

Tel: 55 19 3825 8770, Fax: 55 19 3935 8773

CHINA

Beijing / Tel: 86 10 8526 2111, Fax: 86 10 8526 2141
Chengdu / Tel: 86 28 8675 8111, Fax: 86 28 8675 8141
Guangzhou / Tel: 86 20 8363 4768, Fax: 86 20 8363 3701
Shanghai / Tel: 86 21 5868 5111, Fax: 86 21 5866 0969

FRANCE

Tel: 33 1 30 68 89 20, Fax: 33 1 30 68 89 29

GERMANY

Tel: 49 21 59 91 36 0, Fax: 49 21 59 91 3639

INDIA

Tel: 91 80 6782 3200, Fax: 91 80 6782 3232

SINGAPORE

Tel: 65 6484 2388, Fax: 65 6481 6588