SMITH ANALYTICAL

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To: Smith Analytical Clients
From: Steve Smith, Smith Analytical, LLC
Subject: Trace Technology TRACErase™
Date: August 19, 2024

IMPORTANT – ACTION NEEDED

SUMMARY:
Smith Analytical, LLC has been testing the performance limitations of commonly used catalytic devices used to reduce VOC levels in the low-pressure vents of process analyzer systems. Our testing has revealed significant limitations that may lead to excess release of fugitive emission like Volatile Organic Carbons (VOC's). We have tested and found that the claimed efficiency provided by the technical cut sheet on these devices is less than stated. The testing outcome of these systems with Methane, Ethane, Ethylene, Propane and Propylene indicates the potential release of Volatile Organic Carbons into the atmosphere.

IMMEDIATE ACTION is needed to review and mitigate the application of these devices. Through testing these systems, we have been able to develop a patent pending solution that has shown to assist in the efficiency of these catalytic devices in converting the fugitive emissions and thereby reducing the release into the atmosphere.

INTRODUCTION:
For the past twenty years, Smith Analytical along with numerous other System Integrators or Stake Holders have provided the Trace Technologies catalytic device (aka TRACErase™) to handle the mitigation of hydrocarbons from low pressure vents used in conjunction with process analyzer systems. TRACErase™ uses a technology based on a catalytic conversion process to oxidize vented samples to prevent fugitive emissions from entering the atmosphere.

During a project for a client in 2023, it came to our attention that there is different BTU throughput claims made in various vendor datasheets. The advertised BTU throughput claims ranged from 750 to 2,000 BTU/HR. Testing data was requested but not provided by the manufacturer for any of the stated BTU throughput claims, so our company undertook this testing effort. This was done so the correct number of devices could be calculated during the for the throughput of a specific analyzer vent system.

An instrumented test assembly consisting primarily of a containment system was designed and built. An emphasis on the design of the test assembly was to provide adequate oxygen within the containment environment for the catalytic device, so to accurately simulate real world use enabling us to evaluate the system performance.

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While the purpose of the test was solely to determine the BTU throughput of the catalytic device, during the first round of testing in May and June 2023, there was evidence two brand new Trace Technology catalytic devices were not completely converting the Methane in the NIST standard calibration gas into CO_2 and water vapor. Smith Analytical then used a Siemens Maxum II to measure for Methane, Ethane, Ethylene, Propane, Propylene, CO_2, O_2, N_2 and water. The complete test assembly included a Siemens GC, Siemens Ultramat IR (to record Methane, CO_2 and CO) and a Servomex 1400 paramagnetic analyzer (to measure for excess 02 inside the containment system). This equipment was used to better understand the BTU throughput and conversion efficiency of the catalytic device. Additional new catalytic devices for testing purposes were also obtained for this testing.

Various NIST standards purchased from Applied Gas were used throughout the testing program included:

1. 100% Methane
2. 30% Ethylene / 70% Propylene (these results are in the overall report and not shown here)
3. 50% Methane, 25% Ethane and 25% Propane

The final round of testing was completed in June 2024 to confirm the previous test results. The samples were then sent to a third party TCEQ accredited laboratory, Enthalpy Analytical, LLC. This lab conducted an EPA Total Organic 14A analysis on the various samples provided from our tests.

It is apparent that the conversion efficiency of the catalytic device is a function of the hydrocarbon mixture present and the provision of adequate (excess) oxygen. Heavier hydrocarbons such as Propane along with unsaturated hydrocarbons such as Ethylene and Propylene are easier for the catalytic device to convert, in preference to methane. The testing indicated that the issue with the catalytic device was the lack of adequate oxygen to convert all gases simultaneously in the region of the catalyst.

When Methane along with other hydrocarbons are present in the sample, the heavier or unsaturated molecules react first, thereby consuming the available excess oxygen, leaving free methane to pass through the device. When a stream containing 100% Methane was tested, the Methane conversion improved significantly due to the availability of excess oxygen present in the region of the catalyst, but still did not meet manufacturer claims.

During our initial testing a number of brand-new catalytic devices were tested for the efficiency of the conversion by using a NIST standard with 50% methane, 25% ethane, 25% propane mix. These catalytic devices were purchased directly from the vendor or provided by Stakeholders. The results are summarized in Table 1. All tests were performed within the manufacturers minimum recommended envelope. (750 BTU). It is evident that none of the devices performed well in this mixed service.

Note: the methane measurement from the Siemens IR analyzer is “Continuous” while the analysis results from the GC took five minutes.

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TABLE 1.0

AVERAGE CONVERSION EFFICIENCY

Standard Gas Containing 50% Methane, 25% Ethane And 25% Propane

AVERAGE TEST DATA AT 750 BTU/HR THROUGHPUT	METHANE CONVERSION SIEMENS IR (%)	METHANE CONVERSION SIEMENS GC (%)	ETHANE CONVERSION SIEMENS GC (%)	PROPANE CONVERSION SIEMENS GC (%)
SMITH ANALYTICAL AVERAGE CONVERSION DATA FOR NUMEROUS TRACE TECHNOLOGY DEVICES	15.11%	17.56%	20.30%	39.42%

To confirm our analysis results a new catalytic device was acquired and tested, samples taken were tested by the accredited laboratory Enthalpy Analytics to enable direct comparison with our own analyzers. The results show in Table 2 show that the calibration of Smith Analytical analytic equipment is well within the repeatability of the test method and therefore all earlier results were valid. Note there is a variation in performance between Table 1 and Table 2. Table 1 includes the average performance of a number of devices, whereas Table 2 is the conversion test of a single new device.

Table 2.0 provides the conversion efficiency of the catalytic device as measured by Smith Analytical and Enthalpy Analytical, LLC. This testing was conducted on June 26-27, 2024.

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TABLE 2.0
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CONVERSION EFFICIENCY

Standard Gas Containing 50% Methane, 25% Ethane And 25% Propane

TEST DATA - 750 BTU-HR THROUGHPUT JUNE 26-27, 2024	METHANE CONVERSION	ETHANE CONVERSION	PROPANE CONVERSION
SMITH ANALYTICAL CONVERSION DATA FOR A SINGLE TRACE TECHNOLOGY DEVICE (SEE NOTE 1)	29.27%	47.58%	67.17%
ENTHALPY ANALYTICAL STATE CERTIFIED LAB CONVERSION DATA FOR A SINGLE TRACE TECHNOLOGY DEVICE (EPA TOA-14 RESULTS) (SEE NOTE 1)	30.00%	47.76%	61.19%

Note 1 - Data from these tests were conducted on a single brand-new catalytic device.

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An additional test was made on pure Methane as a benchmark comparison. Table 3.0 provides the conversion efficiency of the catalytic device when 100% Methane was sent to the unit. In addition to measuring for the methane present in the effluent stream of the catalytic device, excess oxygen inside the containment system along with CO2 were measured.

TABLE 3.0
Methane Conversion Data With Catalytic Operating As Designed On 100% Methane Gas - June 27, 2024 Test

METHANE-CONVERSION (%)-SIEMENS GC	O2 (%) SIEMENS	CO2 (%) SIEMENS GC
81.83%	**20.93%**	**0.1745%**

The vendor data indicates that with a brand-new unit or new catalyst, conversion efficiency of 99.9% would be obtained. None of the Smith Analytical or Enthalpy Analytical test data supported this claim. In an effort to understand if 99.9% conversion was possible, the patent for the catalyst was reviewed. From research done by others on catalyst used to convert hydrocarbons into CO2 and water and this particular catalyst design, it was evident to Smith Analytical that the lack of oxygen in the catalyst region may be the issue with the lower conversion efficiency. To understand if the 99.9% conversion efficiency in the vendors documentation could be obtained, air was added and mixed with the combustion gas before being introduced into the catalytic device. The results of this test are noted in Table 4.0 below.

When this was done at the proper ratio of Methane to air, the Methane conversion with the unit operating at 750 BTU-HR throughput was 100% as reported by the Siemens GC. The excess O2 present in the containment system was 20.90% as reported by the Siemens GC. The CO2 concentration increased from 0.1745% to 0.2436% as reported by the Siemens GC. The increase in the CO2 indicates that air is required to obtain the advertised conversion efficiency. A sample from this test was collected and also analyzed by Enthalpy Analytical, LLC per EPA Method TO-14A. While the Smith Analytical gas chromatograph reported 100% conversion, Enthalpy Analytical reported 96.85%, 98.76 and 99.46% conversion of the various hydrocarbons present. This difference in the reported conversion is attributed to the types of detectors being used in the respective gas chromatographs. The Siemens GC used by Smith Analytical is equipped with a thermo-conductivity detector. The Enthalpy Analytical gas chromatograph utilizes a mass spectrometer for the detection method. The mass spectrometer detector is more accurate at the low end of the scale when compared to a thermo-conductivity detector. This is further evidence that >99% conversion can be obtained with the proper engineering controls and testing required to properly “Tune” the device during initial set-up.

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TABLE 4.0

Methane, Ethane & Propane Conversion Data With Catalytic Device Operating With Air Added To The Test Gas-June 27, 2024-750 BTU-HR Throughput

	METHANE (%)	ETHANE (%)	PROPANE (%)
SMITH ANALYTICAL DATA FOR CONVERSION OF 50% METHANE, 25% ETHANE, 25% PROPANE	100%	100%	100%
ENTHALPHY ANALYTICAL DATA FOR CONVERSION OF 50% METHANE, 50% ETHANE & 50% PROPANE	96.85%	98.76%	99.46%

From the testing conducted over the past year, Smith Analytical has determined the maximum BTU throughput of the catalytic device is 750 per hour provided the correct ratio of air to vent gas is obtained. If insufficient air is provided, all of the hydrocarbons will not be converted into CO_2 and water vapor.

If too much air is introduced, this can result in a flow rate the catalyst cannot handle thus resulting in the conversion not taking place or significant damage to the unit. With proper engineering controls, the 99% conversion efficiency can be obtained.

Smith Analytical has a patent pending control panel which can be installed to properly control the vent gas sent to the catalytic device, while also allowing for the unit to be tested from grade. Testing can be done by Smith Analytical or the company currently providing your facility with LDAR compliance services.

If you have any questions about this notice or the complete report, please contact Smith Analytical at (832) 738-1841 or email Steve Smith at steve@smithanalytical.com

FOR INFORMATION ON THE CONTROL PANEL FOR THE

CATALYTIC DEVICE, PLEASE GO TO:

https://SmithAnalytical.com/Products/

The complete test report is available at:

https://SmithAnalytical.com/Technical-info/

Texas Commission on
Environmental Quality

Certificate of Accreditation

Accreditation is hereby granted to

Enthalpy Analytical, LLC - Houston
2525 West Bellfort, Suite 175
Houston, TX 77054-5027

State Lab ID: T104704226
Effective Date: 07/01/2024
Expiration Date: 06/30/2025
Document ID: TX-C24-00247

Conditions of Accreditation

This laboratory has been found to conform with TCEQ rules and applicable standards for laboratory accreditation. The scope of accreditation is limited to the Fields of Accreditation (FoA) specifically listed on the subsequent page(s) of this certificate. Accreditation is for all version of a method approved per 40 CFR 136, 40 CFR 141, and/or 40 CFR 143. Continued accreditation requires ongoing compliance with all applicable standards and requirements.

Note: For the attached FoA table, matrices may include DW (drinking water), NPW (non-potable water), S (solid and chemical materials), A (air), and/or BT (biological tissue).

K Keel

Issued By: Kelly Keel, Executive Director Texas Commission on Environmental Quality
Date Issued: 07/01/2024