

## Mercaptan Instrument Development Program

**Description:** A program to develop a small, portable sensor to detect and measure mercaptan concentrations at very low levels using gas chromatography (GC) and differential mobility spectroscopy (DMS) technologies.

**Status:** Sensor prototype has been optimized to maximize accuracy of mercaptans measurement. The re-configured prototype showed success during laboratory testing and technology transfer to a commercializer is planned.

### BENEFITS

The use of odorants for natural gas detection is considered one of many major public health and safety advancements for the gas distribution industry. Small volumes of certain sulfur compounds known as mercaptans are injected into odorless natural gas to make it detectable. Currently, the primary method to detect mercaptans in natural gas is through operator “sniff” tests and costly gas chromatography lab analyses. A new technology to allow the measurement and detection of mercaptan concentrations at the parts per billion levels, detectable to the human nose, would allow a more informed view of regulations as well as the elimination of the need for utility personnel to sniff natural gas for mercaptans. A highly sensitive mercaptan sensor would also provide rapid, reliable, and continuous results during spot checks throughout the gas distribution system.

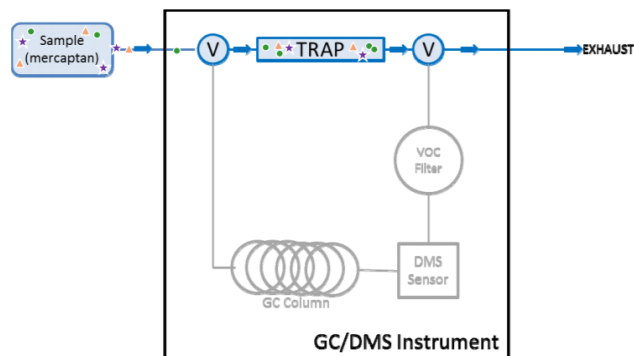
### BACKGROUND

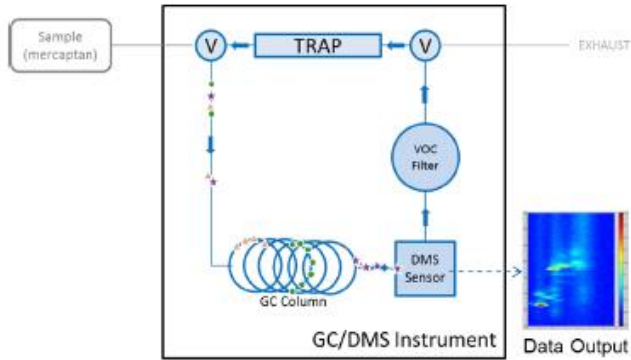
The odorization of natural gas is a federal requirement and many local distribution companies follow their own comprehensive odorization program. Distributed natural gas must be readily detectable with a normal sense of smell at a concentration of one-fifth of the lower explosive limit. To verify this requirement, utility operators perform sniff tests to confirm the gas contains odorant. Quantifying the specific concentration of odorant within natural gas distribution lines is one of the main objectives of this project. Precise, rapid quantification of mercaptan concentrations in natural gas is desired.

Following the initial feasibility study of this project, detection levels of mercaptan ranging from 0.1 parts per billion (ppb) to 8ppb were established. The human nose can detect mercaptans at a concentration of approximately 1 ppb. The successful completion of the feasibility study, laboratory testing, and initial field testing of this project provided confidence in moving forward with optimization of the engineering prototype to complete additional field testing.

### TECHNICAL APPROACH

A technology feasibility and benchmarking study completed in May of 2009 by Applied Nanotechnology Inc. (ANI) demonstrated the ability of the company’s technology to detect and measure mercaptans in natural gas at levels on 1 ppb. The technology is based on a combination of gas chromatography (GC) and differential mass spectroscopy (DMS). NYSEARCH tested the original radioactive ionization source as well as the non-radioactive one. ANI developed a GC/DMS technology using non-radioactive ionization.





**Figure 1. Diagram of mercaptan detection**

Five different mercaptans predominantly used in the gas industry were selected for characterization with the GC/DMS technology: normal-propyl mercaptan (NPM), tert-butyl mercaptan (TBM), iso-propyl mercaptan (IPM) and ethyl mercaptan (EtM) with tetrahydrothiophene (THT). Laboratory testing of the benchtop prototype proved the ability of the technology to measure the above mentioned mercaptans at lower detection levels. In the first round of field testing, ANI developed an engineering prototype of the GC/DMS tool.

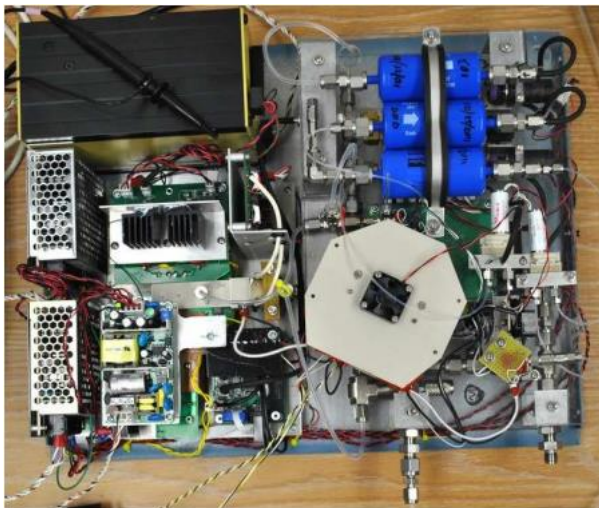
Following those field tests, the mercaptan sensor experienced instability issues and created signal fluctuations. Modifications to the system componentry were made.

U.C. Davis was hired to address the stability issues encountered with the instrument. The team at U.C. Davis has tested numerous trap materials and identified a solution that prevented further degradation of the parent mercaptan compound during analysis. Initial sorbent trap testing was performed on a mercaptan selected by funders. Additional mercaptans may also be tested. Following additional testing, it is anticipated that the product will be transferred to a commercializer for final product development.

**PROGRAM STATUS**

NYSEARCH will be working with prospective commercializers while completing system testing.

For more information contact:  
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**Figure 2. Prototype developed by ANI for NYSEARCH testing**