



TAGA SERVICES



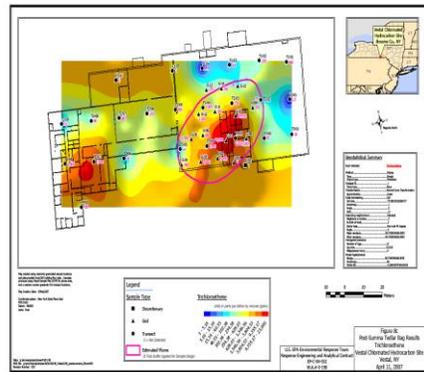
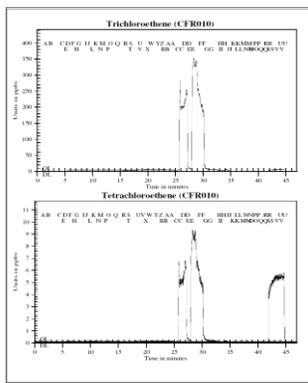
The term TAGA (Trace Atmospheric Gas Analyzer) is used to refer to both the analytical instrument and the mobile laboratory built around it. The instrumentation aboard the TAGA mobile laboratory includes: 1) a PE/Sciex TAGA mass spectrometer/mass spectrometer (MS/MS), which provides real-time monitoring for many organic and inorganic compounds at the part-per-billion by volume (ppbv) levels or lower, 2) an Agilent gas chromatograph/mass spectrometer (GC/MS), which analyzes volatile organic compounds at the ppbv level in air samples collected in Tedlar[®] bags using a loop injection system, 3) a global positioning system (GPS), which supplies accurate, real-time positional data during mobile/stationary monitoring, and 4) a geographic information system (GIS), which maps and presents in real time the TAGA's position. Additional instrumentation, including, but not limited to, a mercury analyzer and electrochemical sensors for gases, have been incorporated for specified programs. This versatile mobile monitoring system offers a wide variety of services to assist various groups within the US EPA to conduct investigatory and enforcement activities in a cost-effective manner.

EMERGENCY RESPONSE



■ **Ambient air monitoring, sampling, and analysis** - Emergency responses may be accidental, intentional, or natural. During a train derailment and the subsequent breach of tanker cars, which resulted in a large release of vinyl chloride in Paulsboro, NJ, the ambient air of the adjacent area was impacted. The TAGA MS/MS was used to monitor the ambient air during stationary and mobile monitoring events to assist with public health determinations. The Agilent GC/MS is employed to analyze for VOCs collected in Tedlar® bag samples. The GC/MS was utilized extensively at Ground Zero in New York, NY to analyze the VOCs in the smoke plumes from the towers to provide information to assist with the selection of personal protection for the search and rescue workers. More recently, the TAGA labs were used to investigate fugitive emissions from refineries and chemical facilities throughout Texas after Hurricane Harvey impacted.

VAPOR INTRUSION



■ **Subslab, indoor, and ambient monitoring and sampling** - Vapor intrusion is a driving issue within the Agency due to the health effects associated with the impacts in residences, schools, offices, and facilities. The TAGA laboratory has provided analytical data at many sites around the country. The TAGA MS/MS uses a 300-foot Teflon tube to sample indoor air from rooms within and outdoor air adjacent to the structures providing a unique capability to identify sources impacting the indoor air quality:

- Vapor intrusion
- Lifestyle products
- Outside air contaminations
- Adjoining building contribution
- Contaminated well water offgassing during washing/bathing activities
- Contaminated groundwater offgassing from wet sumps/basements
- Occupant intentional/accidental releases
- Distance dumping into fracture bedrock geology
- Contaminated groundwater becoming surface water.

The TAGA laboratories have received NELAC accreditation. The real-time TAGA MS/MS with the low pressure chemical ionization (LPCI) source was certified to analyze tetrachloroethene and trichloroethene in ambient air; the GC/MS with the loop injection system was certified to analyze benzene; 1,1-dichloroethane; 1,1-dichloroethene; cis-1,2-dichloroethene; trans-1,2-dichloroethene; ethylbenzene; methyl tert-butyl ether; tetrachloroethene; toluene; 1,1,1-trichloroethane; vinyl chloride; o-xylene; and m&p-

xylenes in the air matrix using Tedlar bags. While the MS/MS provides continuous monitoring, the GC/MS can analyze gas samples collected in Tedlar bags, within 10 minutes and generate a list of the target compounds and tentatively identified compounds due to the scan/selected ion monitoring capability.

ENFORCEMENT



Mobile monitoring in support of the Urban Air Toxics program - The Urban Air Toxics Program was initiated to reduce the public exposure to hazardous pollutants. The TAGA mobile laboratory conducted mobile monitoring in Region 6 (Baton Rouge, LA, Port Arthur, TX, and the Houston Ship Channel) using a variety of instrumentation for real-time monitoring. Besides the TAGA MS/MS, which monitored continuously for over a dozen toxic organic compounds, additional instrumentation was installed in the TAGA laboratory to monitor for hydrogen sulfide, sulfur dioxide, and elemental mercury.

DECONTAMINATION OPERATIONS

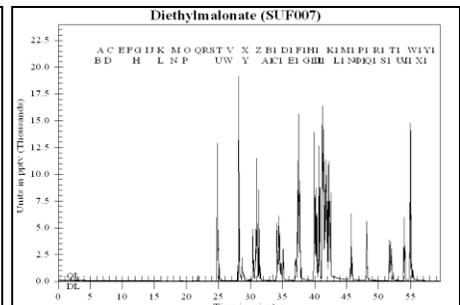
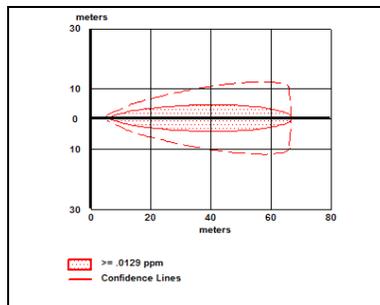


Building decontamination using a fumigant - Anthrax was released in a number of government and private buildings. The TAGA was an integral part of the fumigation activities at the Hart Senate Office Building, Brentwood and Hamilton Post Offices, Operation Lemon Drop, and former AMI facility, all suspected targets of bioterrorism. Chlorine dioxide was selected as the fumigant to kill the anthrax spores. The TAGA provided real-time monitoring of the ambient air for chlorine dioxide and chlorine along the site perimeter to ensure that the public health was protected. Additionally, the TAGA MS/MS was required by the Ambient Air Monitoring Plan and the Health & Safety Plan.

HOMELAND SECURITY



- **Chemical warfare agents (CWAs)** - The US EPA/ERT, working with the US EPA/ORD Homeland Security Research Center, contracted Battelle to develop a method for the monitoring of chemical agents using the TAGA MS/MS. The TAGA MS/MS demonstrated that CWAs can be detected at and below the parts-per-trillion by volume (pptv) level. In 2011, the US EPA/ERT employed the interagency agreement with Edgewood Chemical Biological Center (ECBC) to acquire laboratory space, dilute standards, and CWA handling expertise during testing. US EPA/ERT provided the TAGA analytical instrumentation, methodology, and staffing to perform the testing. During the Edgewood testing, the following chemical warfare agents were investigated: isopropyl methylphosphono-fluoridate (GB) [SARIN], O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothiolate (VX), and bis(2-chloroethyl)sulfide (HD) [Sulfur Mustard]. The observed detection limits using the US EPA/ERT TAGA MS/MS were very similar to the Battelle study. In preparation to address CWA issues, the TAGA system has been mounted on a cart along with an uninterruptable power supply (UPS). The UPS provides power when line power is not available thus allowing the system to be transportable. This design permits the instrumentation to be used as a continuous monitor when being moved throughout areas within buildings or placed in a subway car travelling through the critical infrastructure.



- **Validation of near-field air dispersion models** - Models provide mathematical predictions of downwind concentrations of released substances. Validation of a model

requires instrumentation that responds rapidly to concentration changes so that a centerline maximum of a gaussian plume can be determined. The TAGA MS/MS instruments provide concentration measurements with the spatial and temporal requirements necessary to validate the near-field models under real-world conditions.

ENGINEERING SUPPORT

- **Rapid analysis of gas samples collected in Tedlar® bags in order to support engineering feasibility studies.** Engineering optimization requires operating variables to be changed. Monitoring the unsteady-state and the steady-state operations determines the effects of the adjustments. The rapid analysis of the air samples collected in Tedlar® bags by the TAGA laboratory allows operating parameters to be varied while examining the emissions as a function of time for the constraint changed.

PREDEPLOYMENT AND PLANNING

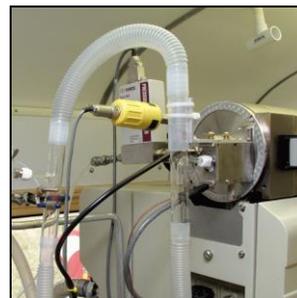


- **Staging the TAGA at events of national consequence** - There are nationally significant occurrences that require pre-deployment of additional assets to ensure that the public health is protected. These events also require supplementary planning. The TAGA mobile laboratory has been involved at many of these events ranging from the Summit of Eight to the NATO anniversary to the Super Bowl to the Presidential Inauguration.

Three active TAGA mobile laboratories are available. They are based in Research Triangle Park, NC, Edison, NJ, and Las Vegas, NV. Additionally, two TAGA on smaller platforms (6'x5'x3' carts) with an independent power supplies, which are capable of being operated in buildings, subways, and other structures that cannot accommodate the mobile laboratories, have been established. These platforms are based in Research Triangle Park, NC and Edison, NJ. Lastly, the following pages present additional information for the analytical instruments.

TAGA MS/MS

The TAGA MS/MS is a triple quadrupole mass spectrometer, capable of monitoring in the positive or negative ion mode using either a low pressure chemical ionization (LPCI) source or an atmospheric pressure chemical ionization (APCI) source.



The general theory of the TAGA MS/MS utilizes the technique of triple quadrupole mass spectrometry to differentiate and quantitate compounds. The analysis procedure involves multiple sequential steps. The initial step in the MS/MS process involves simultaneous chemical ionization of the compounds present in a sample of ambient air. The ionization produces either positive or negative ions by donating or removing one or more electrons. The chemical ionization is a “soft” ionization technique, which allows ions to be formed with little or no structural fragmentation. The ions in this step are called parent ions.

The parent ions with different mass-to-charge (m/z) ratios are separated by the first quadrupole (the first MS of the MS/MS system). The quadrupole scans selected m/z ratios allowing only the parent ions with these ratios to pass through the quadrupole. The parent ions selected in the first quadrupole are accelerated through a cloud of uncharged nitrogen atoms, which are introduced normal to the ion path in the second quadrupole. A portion of the parent ions entering the second quadrupole fragments as they collide with the nitrogen atoms. These fragmented ions are called daughter ions. This process, in the second quadrupole, is called collision induced dissociation (CID). The daughter ions are separated according to their m/z ratios by the third quadrupole (the second MS of the MS/MS system). The quadrupole scans selected m/z ratios, allowing only the daughter ions with these ratios to pass through the quadrupole. Daughter ions with the selected m/z ratios are then counted by an electron multiplier. The intensity for each parent/daughter ion pair is directly proportional to the ambient air concentration of the organic or inorganic compounds that produced the ion pair.

GC/MS

The laboratory contains a 7890 Agilent gas chromatograph (GC) with a 5975C triple axis mass selective detector (MSD). The gas chromatograph is fitted with a loop injection system to allow gas sample analysis of volatile organic compounds (VOCs). The calibration range is from 500 parts-per-trillion by volume (pptv) to 10 parts-per-million by volume (ppmv). The extended calibration range has two advantages: 1) reduces the number of dilutions for more concentrated samples (decreases the analytical error) and 2) increases analytical throughput (improves operational efficiency).



The mobile laboratories have successfully demonstrated the following:

- Ambient air monitoring,
- Indoor air monitoring,
- Soil gas analysis,
- Source term calculations through path maximum techniques,
- Decontamination ambient air monitoring for ClO₂ and Cl₂,
- Chemical warfare agents.

The real-time TAGA MS/MS data are available in near-real time via the VIPER system. VIPER is a wireless network based communications system designed to enable near real-time transmission of data from the TAGA MS/MS, GPS, and other sensors to a local computer, remote computer, or enterprise server and provide data management, analysis, and visualization.

For More Information Contact:

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