

The planar waveguide interferometer measures minute optical changes in a chemically selective sensing film incorporated into an optical system-on-a-chip. Optical changes result from physical and chemical interactions between the sensing film and analyte(s) of interest. Judicious choice of the sensing layer creates a species-specific layer with tailored sensitivity, dynamic range, reversibility, and response time. Currently contained in a handheld unit, major advantages of the planar waveguide interferometer include low power consumption, low cost, and nulling of thermal and mechanical noise. This sensor has been aptly applied to real-time detection and identification of various analytes in the vapor phase.

The waveguide surface is coated with a thin, chemically selective film which ranges in thickness from a monomolecular layer to approximately 100 nanometers. This layer interacts with the species of interest. Due to the small size of the interferometer, several sensors can be incorporated into a single chip. Incorporation of multiple sensing chemistries on a single chip can provide a sensor tailored to a specific occupational environment. To date, ammonia, benzene, toluene, ethylbenzene, xylene, and several chlorinated hydrocarbons have been detected in the part-per-million to part-per-billion range.

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MINIATURIZED PHOTOIONIZATION DETECTOR. P. Hsi, C. Hameister, RAE Systems, Inc., Sunnyvale, CA

Introduction: This article will describe several improved technologies to significantly miniaturize the photoionization detector (PID) for both personal and field volatile organic compound (VOC) monitoring.

Technology advancements in PID: (1) A new UV window seal technology allows it to be bonded into the glass envelope directly using a special glass-to-glass seal. The matching seal will not develop a minute leak when the lamp is subjected to field temperature variations. This enables the lamp to last much longer. (2) A new UV lamp driver technology is based on the principle of direct electric field excitation. In order to reduce the power consumption, a low frequency signal is used to excite the lamp. (3) The major limitation of all PIDs is the interference from nonionizable gases and UV absorbing compounds. A parallel disk design of the ionization chamber is used. The direction of the incoming gas sample is diverted to a laminar flow. The quenching effect is reduced and the linearity and sensitivity of the detector response is improved. (4) Battery powered portable products has pushed the electronic industry to make several major technology breakthroughs to meet the key demands of portable electronics.

Summary: Miniaturized PID not only reduces the fatigue of the operator in regular site survey or leak detection work, but also opens the doors to many new applications. For example, a compact PID can be incorporated into a multigas monitor to detect low level toxic VOCs in confined space entry applications. Also users can get real time readings and trend analysis of the gas concen-

tration, STEL and TWA all against programmable alarms.

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CAT SCANNING THE AIR TO MAP CHEMICALS AND EVALUATE EXPOSURES. S.K. Farhat, University of North Carolina Chapel Hill, NC, S.K. Farhat, L.A. Todd, D.J. Norton, Department of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, NC

Current techniques for evaluating exposures in indoor air typically involve integrated sampling for a limited number of workers and locations; this results in measurements which are limited in both space and time. A technique is being developed which is a major departure from currently used techniques and involves CAT scanning a room. Using this method, the concentration and flow of chemicals in air are mapped in real-time over an area; thus, a video of both spatially and temporally resolved chemical concentrations is created. This technique combines open-path Fourier transform infrared (OP-FTIR) spectroscopy with computed tomography (CT) to obtain real-time, non-invasive measurements of multiple chemicals and create concentration maps that can be used for long-term exposure assessment, source monitoring, and assessment of contaminant flow patterns in a room. This investigation used a prototype scanning OP-FTIR/CT system in a chamber, the size of a small room, to measure and map plumes of sulfur hexafluoride. As the tomographic system sampled the chamber, point samples were obtained and were measured using an ECD detector. This CT system used two portable OP-FTIR spectrometers and two virtual spectrometers. This scanning system has reduced the cost of performing industrial CAT scans and decreased the time required to scan an entire room. A range of CT configurations were evaluated and quality reconstructed concentration maps were obtained using 48 rays which completely scanned the chamber in approximately seven minutes. The positions of the concentration peaks were reconstructed within a foot and the concentrations estimated within a mean of 30%. Choice of configuration and tomographic reconstruction algorithm were found to have profound effects on the quality of the maps. The results of these experiments show that this prototype system is ready to be field tested.

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VALIDATION OF PASSIVE BADGES FOR MONITORING WIDE BOILING HYDROCARBON MIXTURES. M. O'Donnell, R. Pristas, Exxon Biomedical Sciences, Inc., East Millstone, NJ

Workplace exposures to the vapors of wide boiling hydrocarbon mixtures such as gasoline, kerosene, diesel fuel, as well as other refinery streams are a potential concern in many refineries and chemical plants. Air monitoring for aliphatic and aromatic hydrocarbons is routinely done using either pumped charcoal tube sampling or the use of passive organic vapor badges.

Laboratory testing was conducted to confirm the performance of both techniques to accurately measure airborne concentrations of

mixed hydrocarbons. Three wide boiling hydrocarbon mixtures (summer blend gasoline, winter blend gasoline, and kerosene) were used to generate airborne concentrations of hydrocarbon vapors in the range of 27-130 ppm in air. Results of analysis of vapor samples collected on charcoal tubes and passive badges from the same hydrocarbon atmospheres were compared and evaluated versus exposure chamber concentrations.

Both the charcoal tubes and passive badges were shown to give accurate and precise results for these representative hydrocarbon mixtures. Each technique met the NIOSH accuracy criteria (+/-25% accuracy at the 95% confidence level). Hydrocarbon samples were found to be stable at room temperature for at least 30 days on both devices.

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VALIDATION OF A PASSIVE SAMPLER FOR VALERALDEHYDE. S. Tsai, S. Que Hee, University of California, Los Angeles, CA

O-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine hydrochloride (PFBHA) has been used to analyze aldehydes in water because of its fast quantitative reaction to form oximes suitable for sensitive detection at the picogram (pg) level by gas chromatography/mass spectrometry (GC/MS) and gas chromatography/electron capture detection (GC/ECD). The PFBHA method also has been used to analyze aldehydes in air samples by dynamic sampling. The aim of this research was to validate a new valeraldehyde passive sampler for personal sampling in the environmental/industrial hygiene field. Effects of different temperatures, humidities, and face velocities were evaluated. Sampling capacity, shelf life, and storage stability of the sampler were determined. A 13-mm diameter and 0.2-cm thick pellet of PFBHA coated Tenax GC (10%, w/w) was made by a hand press. The sampler has a silicone membrane on top and a diffusion path length of 1.1 cm and is contained in a lapel clip-holder. The sampling constant was determined by exposures at known face velocities (20 to 70 fpm.) Valeraldehyde vapors were generated by using a syringe pump at a constant injection rate to introduce liquid aldehyde into pure air of known flow rate that was diluted appropriately before delivery into the exposure chamber. The ppm-hour levels were equivalent to 0.25, 0.5, 1, 1.5, and 2 times the PEL for 8 hours. Desired humidities (3 +/-1%, 36 +/-2% and 79 +/-2%) were generated by vaporizing specific volumes of water into the system by another syringe pump. An ice bath and heating oven were used to obtain the cold and hot exposure environments (9 +/-1 degree C, 25 +/-1 degree C, and 48 +/-2 degrees C.) The PFBHA-valeraldehyde oxime was desorbed by hexane, analyzed by GC/MS, and determined by selected ion monitoring at m/z 181. The desorption efficiency was found to be 96.5 +/-5.4%. The shelf life of the sampler was longer than 3 months, and the sample stability was longer than 6 weeks with no difference between room storage and 4 degrees C storage. The capacity was 2.83 +/-0.30 mg (using vapor spiking.) There were no significant effects from different relative humidities,

exposure temperatures, and intermittent sampling. The experimental sampling rate of this sampler for valeraldehyde vapor was 4.52 +/- 0.14 mL/min (from 8 degrees C to 50 degrees C.) The mass collected was independent of face velocities in the range of 20 to 70 fpm.

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RESULTS OF THE PRACTICE ROUNDS OF THE PASSIVE MONITOR PROFICIENCY ANALYTICAL TESTING PROGRAM. C.A. Esche, J.H. Groff, P.C. Schlecht, National Institute for Occupational Safety and Health, Robert A. Taft Laboratories, Cincinnati, OH

The Passive Monitor Proficiency Analytical Testing Program began in July 1996 to evaluate the ability of laboratories to analyze passive monitors. The program provides each participating laboratory a passive monitor sample kit containing two samples and a blank twice a year. The first year of the program will be used to establish proficiency testing performance criteria and will not affect accreditation status of participating laboratories with the American Industrial Hygiene Association (AIHA). On the first round, 164 passive monitors containing benzene, toluene, and o-xylene were sent to 148 participating laboratories. One-hundred thirty-five (83%) were 3M monitors, 17 (10%) were SKC monitors, and 12 (7%) were Assay Technology monitors. Passive monitor reference values are calculated values based upon the vapor pressure of the organic solvent and generator temperature, and are compared with active sampler results conducted prior to shipping samples to participants. A 6% relative standard deviation (RSD) is used to establish three sigma acceptable performance limits of plus or minus 18% of the corresponding reference value. This compares with an average 5% RSD over the last five years in the Proficiency Analytical Testing Program for active charcoal tube samplers. Approximately 66 to 87% of reported results on the first round were within acceptable performance limits calculated by the National Institute for Occupational Safety and Health (NIOSH). The first round demonstrated no important differences in performance among the three passive monitor types. However, problems were encountered with all three monitors regarding the information that is provided by monitor manufacturers to calculate correct air concentrations.

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AUDITING ON SITE AIR-MONITORING SYSTEMS. R. Turpin, R. Singhvi, P. Campagna, D. Mickunas, U.S. Environmental Protection Agency, Edison, NJ; J. Meyer, M. Hansen, U.S. Environmental Protection Agency, Dallas, TX; G. Ball, REAC Contract, Edison, NJ

In order to assure the quality of the data obtained by air monitoring systems (AMSs) at various hazardous waste sites, the USEPA/ERTC conducted audits of the AMS

systems. Coupled with the increasing demands on the AMS, the auditing protocols and equipment have also required increasing sophistication and flexibility. Many hazardous waste sites require a perimeter AMS in order to assure that fugitive emissions from the site are within site-specified limits. Increasing demands on the AMS are straining the resources of even the most sophisticated and up-to-date equipment. The need to provide instantaneous, or near instantaneous results, at detection levels in the parts-per-billion (ppb) and even in the parts-per-trillion (ppt) range is pushing the technological envelope. More exotic and unusual analytes present greater challenges to the sampling and analytical systems. All too often, appropriate standards and quality control protocols may not be available. Generally, an ERTC audit will consist of a review of the site-monitoring equipment, site quality assurance/quality control (QA/QC) plans and documents. The site stations are challenged with known certified standards at several concentration levels. Preferably, the challenges are conducted through the station sampling port in order to mimic, as closely as possible, actual site-sampling conditions. In order to easily adjust challenge concentrations, a dilution apparatus setup was built which allows easy and accurate changes in the challenge gases. The purpose of this paper is to demonstrate the need of a site audit program based on ERTC site audits.

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A DIRECT READING, REAL-TIME SITE PROPERTY LINE AIR MONITORING SYSTEM FOR PM-10 AND SULFUR DIOXIDE AT A FORMER REFINERY CLEAN-UP SITE. J. Olcott, K. Kratochvil, T. Polini, Envirogenics, Mercerville, NJ

The need for sophisticated, real-time, direct reading instrumentation at hazardous waste sites requires innovative technologies, to demonstrate compliance with EPA national air quality standards to protect the surrounding populations at risk. Given this need, a state-of-the-art air monitoring program was designed and implemented to assess personnel exposures and site property line air monitoring. The project includes remediation of five hydrocarbon/acid sludge lagoons containing 330,000 cubic yards of refinery waste sludge at this closed refinery site. Contaminants of concern include benzene, petroleum hydrocarbons, asbestos, sulfur dioxide, sulfuric acid, uranium, and thorium. The property line air monitoring program incorporates real time, remote, direct reading air monitoring stations at up to 12 locations. Beta-attenuation, direct reading PM-10 monitors are used to assess airborne particulates, while direct reading, pulsed fluorescence sulfur dioxide monitors are used for sulfur dioxide. Data is collected and captured with data loggers at remote stations, and transmitted via a radio frequency telemetry system to a central computer data acquisition system. The system provides graphic displays of air monitoring data acquisition system. The system provides graphic displays of air monitoring data (pollution roses) and activates audio and visual alarms

when action levels are exceeded. During off-hours a modem summons personnel by a beeper system if action levels are exceeded at any station, to enable prompt remedial action. The details of the system are presented, with presentation of monitoring data based on site activities. By availing themselves of currently available technology, industrial hygienists can play a major role in hazardous waste site clean-up activities, while protecting employees and the public from hygienically significant airborne contaminants.

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EVALUATION OF HAZARDOUS AIR EMISSIONS AT A PETROLEUM RECOVERY HAZARDOUS WASTE SITE AS ANALYZED BY THE TAGA 6000E. R. Turpin, U.S. Environmental Protection Agency, Edison, NJ; H. Schmidt, G. Zarus, A. Mignone, Roy F. Weston, Inc., Edison, NJ; L. Wilder, T. Forrester, Agency for Toxic Substances and Disease Registry, Atlanta, GA

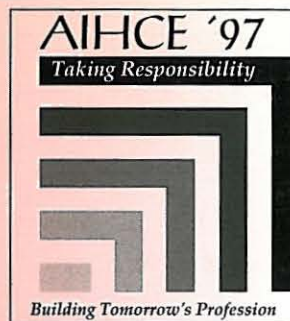
The U.S. Environmental Protection Agency's Environmental Response Team Center (U.S. EPA/ERTC) was requested by Region VI of the U.S. EPA to quantify the amounts of methane, BTEX compounds (benzene, toluene, ethyl benzene, and xylene), volatile organic compounds, and polycyclic aromatic hydrocarbons at a petroleum recovery hazardous waste site. Several environmental protection and public health organizations inevitably became involved with evaluation and quantification, including Region VI of the U.S. EPA, the Agency for Toxic Substances and Disease Registry, and the U.S. EPA/ERTC. Specific expertise was provided by each group that allowed for the determination of ambient air concentrations and for evaluation of the health impact on the local population.

Mobile ambient air and soil gas monitoring was performed by the Trace Atmospheric Gas Analyzer (TAGA) to provide a comparison and possible correlation in the contaminant concentrations between outdoor ambient air, soil, gas, and indoor environments. The objectives of this technique are to determine if levels of contaminants are exceeding prescribed levels and to ascertain whether additional testing of the area in question is necessary. In addition, gross air monitoring was performed at each location to determine total VOCs, hydrogen sulfide, and methane. This provided additional insight into the extent of the impact and assisted with the assessment of the impact on human health.

In order to accurately calculate the position of each location tested by the TAGA, a global positioning system (GPS) was employed. During testing, one GPS was used to acquire data at the location in question while a second was set up as a base station at known control points. This system is utilized during mobile monitoring to afford the opportunity to imitate the sampling run with validated data after the data collection process is completed. This report illustrates the successful techniques used at the petroleum recovery hazardous waste site and a percentage of the results procured.

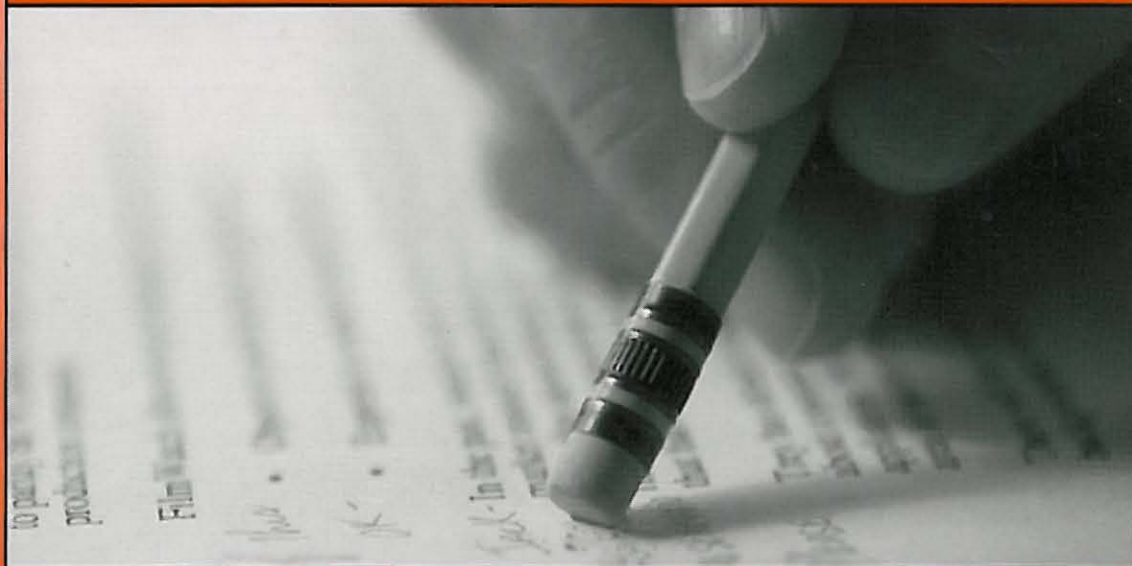
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