

renovation, and interpretation of historic factories, foundries, and mines; and field personnel at these sites will be exposed to the toxic chemicals used in such processes as tanning, machining, or textile manufacture.

Concern for the health and safety of personnel is sufficient reason to motivate cultural resource managers to use care in all aspects of their work. As an added incentive, however, OSHA and any corresponding state regulations make safe practices a legal requirement. Many international standards (such as the European Community standards) have also been written to ensure that safety is a consideration on every job.

An important component of the health and safety effort is advance project planning. At operations involving hazardous waste, OSHA regulations require that a site-specific health and safety plan be developed. The health and safety plan will help a manager to identify hazards in advance and select control measures to reduce the risk of the work. Because specific safety precautions may require extra time and equipment, such measures must also be addressed at the proposal and cost-estimating stages of project planning to ensure that they are included in the scope of work.

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Gas and Vapor Detection Systems

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VALIDATION OF DIFFUSION MONITORS. R.S. Weber, D.J. Larsen, 3M Occupational Health and Environmental Safety Division, 3M Center, Building 260-3B-09, St. Paul, MN 55144.

Sampling method validation is necessary to allow confident use of diffusion monitors by safety and health professionals. Confusing terms such as NIOSH protocol, bi-level validation and level 5 validation has made choosing a diffusion monitor difficult. In 1984, Brown et al., published an evaluation protocol for diffusion monitors. In their protocol they cited performance criteria, such as uptake rate, storage, reverse diffusion, temperature, humidity, and field evaluation. In 1987, NIOSH representatives presented a recommended protocol for evaluating diffusion monitors. Presently, the European Committee for Standardization (CEN) is developing a similar protocol. Both the NIOSH and CEN documents cite performance criteria outlined by Brown and others. These protocol are very thorough and rigorous, however, they are also costly and impractical to fully implement. In 1991, Pristas published an article that validated a diffusion monitor for benzene. His validation procedure was not as rigorous as either the NIOSH or CEN documents, however, his experimental design showed that the diffusion monitors performed within the OSHA accuracy requirement of $\pm 25\%$. In 1992, Guild et al., published a bi-level validation protocol that outlined an alternative to NIOSH protocol. This approach includes a full validation procedure on some certain compounds followed by partial validation on other members of the homologues series.

Validation of diffusion monitors should be rigorous, but also practical. Performance criteria outlined in the NIOSH and CEN protocols are valuable for evaluating diffusion monitors; however, implementation of the entire protocols for all chemicals is not realistic, practical, or necessary.

An alternate diffusion monitor validation protocol has been developed that validates classes of chemicals. Validation data on toluene, hexane and 1,1,1-trichloroethane show that this alternate protocol will accurately predict the performance of diffusion monitors. The procedure includes both laboratory and field performance criteria. Laboratory validation investigates performance criteria, such as sampling rate, reverse diffusion, face velocity, desorption efficiency, relative humidity, and temperature. Field validation investigates effects of the workplace environment on accuracy.

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DEVELOPING A NEW ALDEHYDE PASSIVE SOLID SORBENT SAMPLER. S.W. Tsai and S.S. Que Hee, Department of Environmental Sciences and UCLA Center for Occupational and Environmental Health, UCLA School of Public Health, 10833 Le Conte Ave., Los Angeles, CA 90024-1772.

The aim of this research was to develop a new aldehyde passive sampler for personal sampling in the environmental/industrial hygiene field. 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). It has also been used in a dynamic air sampling method in our laboratory. A 13 mm diameter pellet made from 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. The sampling constant was determined by exposures to different vapor concentrations and face velocities. Valeraldehyde vapors of known concentrations about the PEL were generated by using a syringe pump at a constant injection rate to introduce liquid aldehyde into the pure air stream from an air compressor before delivery into the exposure chamber. The PFBHA-standard method (reference: decafluorobiphenyl) by selected ion monitoring at m/z 181. The ppm-hour exposure conditions were equivalent to 0, 0.25, 0.5, 1.5, and 2 times the PEL for 8 hours. The face velocities ranged from 20 to 70 fpm and the relative humidities ranged from 34% to 38%. The masses collected were independent of face velocity. This was not so without the membrane. The experimental sampling rate of this sampler at these conditions was found to be 4.51 ± 0.15 mL/min. The results showed that this is a feasible method for aldehyde passive sampling.

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DETERMINATION OF METHYL tert-BUTYL ETHER IN AIR USING A DIFFUSIVE SAMPLER. M. Harper and A.A. Fiore, SKC, Inc., 863 Valley View Road, Eighty Four, PA 15330.

Methyl tert-butyl ether (MTBE) is now the second most produced non-petroleum organic chemical in the U.S., used in oxygenated fuel formulations as a response to mandates of the Clean Air Act. Recently, a method for the determination of MTBE in gasoline vapors was published by the NIOSH, which involves collection of MTBE on charcoal tubes. As the same charcoal is used in the SKC 575-001 diffusive sampler, this sampler was investigated as a method for the collection of MTBE in air. Partial validation according to the NIOSH protocol for diffusive sampler evaluation was performed based on a proposed TLV of 40 ppm. The sampler was found to collect MTBE efficiently for up to 8 hours at a rate of 13.6 mL/minute, without significant reverse diffusion under zero MTBE concentrations, even in the presence of a high concentration of a gasoline analog (600 ppm iso-octane). Recovery was in excess of 97% over the range 0.1-2X the proposed TLV, and no losses were observed during storage at refrigerated and possibly ambient temperatures. Validation experiments also were carried out near the level of detection (7 micrograms, equivalent to 0.3 ppm for an 8-hour sample) and the recovery was also acceptable (around 90%), even after storage for two weeks. No effect of relative humidity was seen in either the recovery, capacity, or storage tests. The overall bias of the sampling method was -1.4%, with a pooled coefficient of variation ($n=47$) of 9.50%, resulting in an overall method of accuracy of 20.4%. This estimate was checked using multiple badge, charcoal tube, and gas samples.

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DEVELOPMENT AND EVALUATION OF PERSONAL AND MICROENVIRONMENTAL ACTIVE AND PASSIVE OZONE MONITORS. P. Koutrakis, A.S. Geyh, J.M. Wolfson, Harvard School of Public Health, 665 Huntington Ave., Boston, MA 02115; J. Mulik, U.S. EPA, Atmospheric Research and Exposure Assessment Laboratory, Mail Dropp 44, Research Triangle Park, NC 27711.

We have recently developed active and passive samplers for personal and microenvironmental that are suitable for industrial hygiene monitoring. Nitrite ion in a stabilizing coating reacts with ozone to produce nitrate ion. Nitrate ion in the presence of a large excess of nitrite ion is measured using ion chromatography.

The passive sampler collects ozone by diffusion, with an appropriate convection barrier to moderate the effects of variable wind velocity. The limit of detection (LOD) for the passive monitor is 200 ppb•hr, which allows use for minimum exposure durations of 8 hr at 25 ppb, or for shorter times at higher ozone concentrations. With a concentration 3 times the LOD the accuracy and precision are both about 20%.

The active sampler uses a very small sampling pump with a hollow tube diffusion denuder. This sampler is more sensitive, and has better precision and accuracy than the passive sampler. The LOD is 10 ppb•hr which allows for a minimum duration of only 1 hr for 20 ppb. With a concentration at 3 times the LOD, both the accuracy and precision are about 10%.

Extensive testing for both active and passive samplers has thoroughly validated their performance as indoor and personal samplers. Depending on the specific conditions of measurement, either the passive or active monitor may be useful for industrial hygiene measurements, for both area and personal sampling. These methods have a tremendous advantage over the continental chemiluminescence instruments, due to their small size and much lower costs.

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COMPARISON OF ASSAY TECHNOLOGY ORGANIC VAPOR DIFFUSIVE MONITOR #546 WITH NIOSH METHOD #1500 FOR SAMPLING N-OCTANE UNDER CONTROLLED LABORATORY CONDITIONS. B. Samini and C. Wing, Graduate School of Public Health, San Diego University, San Diego, CA 92182-4162.

Seventy-two Assay Technology #546 Organic Vapor Diffusive Monitors (AT Monitor) and standard charcoal tube (CT) pair samples were collected under controlled laboratory conditions of N-Octane vapor at target concentrations of 150, 300, 450 ppm and face air velocities of 30 and 100 fpm. The laboratory chamber was equipped with a dynamic vapor generation system which provided continuous air flow at the target concentrations of the organic vapor by means of a calibrated syringe pump injecting pre-determined rate of octane liquid into a stream of heated air. The n-octane/air mixture was then introduced into an outer mixing chamber for uniform mixing with incoming filtered air before entering the chamber. Sample pairs were placed within four parallel tunnels in the inner chamber through with the test atmosphere was constantly pulled, in a laminar fashion, at a pre-set flow rate to provide the desired face air velocity at the surface of the AT monitors. The concentrations of n-octane within the chamber by means of a MIRAN 1-A infrared gas analyzer connected to a strip chart recorder. Sampling time in all runs was four hours. At the end of sampling time, the samples were removed and analyzed by gas chromatography following the NIOSH analytical method 1500 for the CT samples and the manufacturer's analytical procedures for the AT monitors.

Two-sample t-test indicated that there were no significant difference, in the sampling rates of the AT Monitors, between the two different face air velocities of 30 and 100 fpm under all three target concentrations.

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ABSTRACTS

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