monitor exposures to acrylonitrile. An acceptable recovery of 0.99 can be obtained using methylene chloride for elution. A loss of 8% was observed during storage of exposed samples for 2 weeks at room temperature (23°C). Samples refrigerated at 4°C showed a significantly lower loss of 4%. Refrigerated storage prior to analysis is recommended. The uptake rate for an eight-hour exposure to 6.7 ppm at 80%RH showed that high humidity did not lead to a significant decrease in collection efficiency. An exposure of 4 hours at 7.8 ppm and 80%RH followed by 4 hours at zero ppm demonstrated that reverse diffusion effects were not significant. Five concentration-time experiments varying from 2 hours at 1.2 ppm to 8 hours at 9.3 ppm showed that the calculated sampling rate of 43.8 cm^3/min to be valid. The accuracy of the sampling rate as shown by the concentration-time experiments was +/- 5%, which is well within the generally accepted level of +/-25%. Analysis of fifteen-minute samples at 7.4 and 20 ppm showed that the diffusion monitor can also be used for Short-Term Exposure Limit (STEL) sampling.

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EMPIRICAL VERSUS THEORETICAL SAMPLING RATES OF PASSIVE ORGANIC VAPOR MONITOR FOR 24 COMPOUNDS REPRESENTING 9 CLASSES OF ORGANICS. G. Mihaylov, K. Kirollos, K&M Environmental, Inc., Virginia Beach, VA.

The sampling rate (SR) of passive samplers for a particular organic vapor must be known prior to using the sampler. The SR must be provided by the passive sampler manufacturer. The sampling rate is an integral value in the equation to determine the concentration of the particular vapor collected on the sampler.

Empirical determination of SR is considered the most reliable method. However, it may not be practical to determine SR by this approach, if results are needed rapidly. In this study, a comparison between theoretically generated sampling rate (TSR) and experimentally generated sampling rate (ESR) was performed to show the ability of the theory to determine SR values. OVMs with one or two coconut-based charcoal strips were used in this study.

To determine the empirical sampling rate a series of experiments were conducted at three to four concentration levels for six hours fixed exposure time and 80% relative humidity. The temperatures ranged from 23°C to 25°C. Four to six OVMs were exposed per each data point. The results are averaged as ESR at ambient conditions and compared with TSR at the same conditions.

The ESR for 24 organic compounds representing aliphatic hydrocarbon, aromatics, aliphatic esters, alcohols, ethers, ketones, halogenated hydrocarbons, nitriles and olefins were compared with TSRs.

The study shows that TSRs can be a viable alternative to the lengthy and costly ESR.

The average bias between ESRs and TSRs is 11%. Nine compounds have a bias of less than 5% while four compounds have a bias over 20%.

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DIFFUSIVE SAMPLERS FOR CFCS, HCFCS, AND VERY VOLATILE ORGANICS. M. Parker, Assay Technology Inc., Pleasanton, CA.

Industrial hygienists have found it difficult to sample chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) refrigerants due to their high volatility. While activated carbons are the most useful media for these contaminants, previous methods focused on increasing the mass of carbon in the sampling train, e.g., jumbo charcoal tubes and multi-tube sampling trains. In practice, the goal of increasing the ratio of charcoal mass to sample volume can be achieved equally well either by increasing charcoal mass in the sampling train or by decreasing the air volume sampled. Although increased charcoal mass was chosen in the past, this approach has disadvantages, namely, that multiple tests are required to analyze multiple tubes and extra solvent is required to analyze jumbo tubes. With modern instrumentation, analytical sensitivity is not a problem; thus, a sample of equal quality can be collected on a small charcoal mass by limiting the sampling rate below the breakthrough level for very volatile analytes. Chamber studies with five representative CFCs and HCFCs were conducted in which the very volatile contaminants were sampled on charcoal tubes and diffusive charcoal samplers incorporating breakthrough studies on the tubes and reverse diffusion studies on diffusive samplers in accordance with NIOSH, CEN, and ANSI protocols. Analysis of reverse diffusion recoveries demonstrated that limiting the uptake rates for both tubes and diffusive samplers was effective in minimizing error due to evaporative losses (breakthrough, reverse diffusion, etc.) during full-shift sampling. This approach has also been applied to butadiene, vinyl chloride, methyl bromide, and propylene oxide.

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DIFFUSIVE SAMPLERS FOR ACROLEIN AND NITROSAMINES. F. Posey, Assay Technology Inc., Pleasanton, CA.

Sampling and analytical methods developed for tubes can often be adapted to diffusive (passive) sampling utilizing similar sampling media and analytical methods. This approach, used successfully in samplers for ammonia, amines, and ozone, was applied to sampling of acrolein and nitrosamines. 2-hydroxymethypiperidine reagent, described in OSHA Method 52 for active sampling of acrolein, was immobilized on a 19 mm diameter wafer placed into a polyester wafer dish and snapped into a polypropylene sampling grid having 76 parallel 1 mm sampling ports. This assembly was covered with a polyester cap and sealed in a foil pouch to prevent contamination. Similarly, silica adsorbent used for active sampling of nitrosamines was incorporated into a diffusive sampler. Acrolein and nitrosamine atmospheres, respectively, were generated in an inert, dynamic exposure chamber by flash evaporation of analyte solutions from a motorized syringe. Chamber atmospheres were verified by active sampling using a critical orifice sampler. Mass of analyte recovered was plotted versus known chamber concentrations to determine uptake rates and other sampling parameters for acrolein and for volatile stable secondary nitrosamines. Reverse diffusion and losses on sample storage were found to be less than 10% under recommended sampling conditions, while sampling times exceeding 12 hours were validated. Lowered detection limits (0.1 ppm and 0.05 ppm, respectively) were achieved by special reagent preparations with low background.

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EVALUATING PASSIVE BADGE SAMPLERS FOR PERCHLOROETHYLENE MONITORING IN DRY CLEANING OPERATIONS. L. Taylor, G. Burroughs, D. Marlow, J. Deddens, L. Ewers, J. Groff, Jr., NIOSH, Cincinnati, OH.

Perchloroethylene, the solvent used by 90% of U.S. dry cleaners, is rated a possible carcinogen (Group 2A) by the International Agency for Research on Cancer. The dry cleaning industry has begun to utilize passive badges to document perchloroethylene exposures. Although available in the commercial market, the passive badges had never been evaluated in dry cleaning operations. The objective of this study was to compare passive badge samplers to charcoal tubes for perchloroethylene monitoring in dry cleaning facilities. Researchers collected 240 paired, side-by-side personal and area samples throughout twelve dry cleaning facilities in the United States. Exposure samples were collected from operators, pressers and in selected areas of the dry cleaning facilities. Both a passive badge sample and 100 mg/50 mg coconut shell charcoal tube sample was collected, side-by-side, on an individual's lapel during an eight-hour work shift. All samples were analyzed for perchloroethylene according to NIOSH method #1003 for halogenated hydrocarbons. Quality control samples were prepared by spiking high purity (99+%) perchloroethylene onto both sampling media. Perchloroethylene exposures ranged from 0.5 parts per million to 23 parts per million, with a mean exposure of 5 parts per million. Results indicate the passive badges slightly overestimated the exposure with a mean difference of 0.1 parts per million. The difference between the passive badges and the charcoal tubes was not statistically different among the area and personal samples. A regression analysis yielded a statistically significant relationship between the methods and an $R2 = 0.98$ (p-value< 0.0001). These results indicate that passive badges are an effective alternative to charcoal tubes to monitor perchloroethylene exposure in dry cleaning operations.

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COMPARISON BETWEEN THE PERFORMANCE OF ACTIVE SAMPLING CHARCOAL TUBES (CT) AND PASSIVE ORGANIC VAPOR MONITORS (OVM) FOR 22 ORGANIC CONTAMINANTS. G. Mihaylov, K. Kirollos, K&M Environmental, Inc., Virginia Beach, VA.

Over the past two decades, OVMs have gained an increasing role in the occupational health and industrial hygiene areas as a viable alternative to traditional pump and charcoal tube "active" system. The simple use and low cost features of the OVM are well suited to the increased need for monitoring large groups of people in the workplace.

In this work, a comparison study was conducted between the traditional active charcoal tube/pump method and a diffusive monitor.

The objective of the study was to evaluate the performance and accuracy of both methods for 22 organic substances representing 8 classes of organics. Coconut-based charcoal tubes in conjunction with a calibrated pump or critical orifice were used for active sampling. OVMs with one or two coconut-based charcoal strips were used for passive sampling. All experiments were conducted in a dynamic vapor generating system connected with a gas chromatograph. Four sets of OVM/tubes were used in each trial. The tests were performed at three concentration levels under a fixed relative humidity of 80% with temperatures ranging from 23°C to 25°C.

The data for the CT showed a Mean Bias of 14.19% and Mean Coefficient of Variation (MCV) of 7.43%. The OVM data showed a mean bias of 0.69% and MCV of 4.8%. The OVM data is within ±25% accuracy at the 95% confidence level. This

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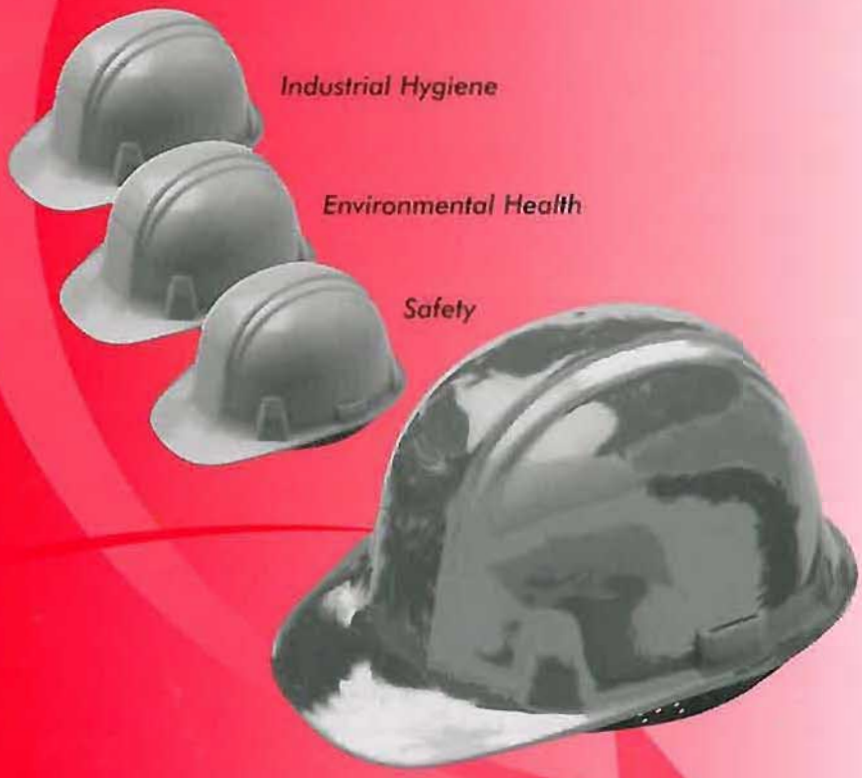

ABSTRACTS