on the floor of the booth, half-filled with a solvent-laden chemical, and (b) a rectangular tub mounted vertically in the booth, with a thin layer of residual solvent-laden chemical at the bottom of the tub. The models included a drying cart placed inside the booth. Dispersion of solvents and air mixing inside the booth was modeled using a multiphase finite-difference based numerical method, and the k-e turbulence model. It was concluded that splashback of solvent vapors from the tub mounted vertically (configuration "b") could significantly increase operator exposure. The walls of the booth were found to have a significant impact on splashback of solvent vapors from the tub. The graphical output from flow simulations was useful in hood design, as well as in employee training and acceptance of proper work practices to reduce exposure.

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DEVELOPMENT OF "NEAR PERFECT" RESPIRABLE AEROSOL SAMPLERS. C. Chen, C. Lai, National Taiwan University, Taipei, Taiwan; T. Shih, C.Y. Chen, W. Yeh, Institute of Occupational Safety & Health, Taipei, Taiwan

The recent adoption of performance standards has been the joint proposal of a compromise definition by the ACGIH, ISO and CEN. By adjusting the sampling flow rate, most of the samplers can only match the 50% cutoff size, but not the slope defined by the international communities. Combinations of foams (or other porous material) of different nominal size (10-100 ppi) and thickness (5-35 mm) were used to overcome this bias. The foam disk of 25 mm in diameter was placed in the asbestos sampling cowl. Dioctylphthalate and potassium sodium tartrate were selected as the liquid and solid test aerosols. An aerosizer was calibrated against a settling chamber and was used to measure the aerosol number concentrations and size distributions upstream and downstream of the foam. The sampling efficiency data showed that the 50% cutoff size would be met for the case of foams in series, but the slope is still sharper than the new definition. Nevertheless, the foams in parallel showed great flexibility and many of the parallel combinations would make the slope flatter, very close to the new international definition. For example, the aerosol penetration through foams in parallel (1000 ppi, 18 mm long, diameter 25 mm + 10 ppi, 15 mm long, diameter 13 mm) has a near perfect match with the respirable fraction of the new international standard, when the total flow rate is set at 8.0 L/min. The sampling train can be further miniaturized for smaller sampling flow rate to meet the capacity of the personal sampling pumps.

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A SIMPLIFIED APPROACH TO TESTING PERSONAL INHALABLE AEROSOL SAMPLERS. O. Witschger, K. Willeke, S. Grinshpun, V. Aizenberg, University of Cincinnati, Cincinnati, OH; J. Smith, P. Baron, NIOSH, Cincinnati, OH

The suggested protocol for comparison of samplers with the ACGIH inhalable sampling convention has been found by several researchers to be expensive, time-consuming, difficult, and imprecise. The present work was initiated to reduce the cost and improve the accuracy of the test protocol by mounting samplers on a simplified test body instead of a full-sized manikin. the approach was tested by first ensuring that the flow field near the sampler was similar for the full-sized manikin as for the simplified test body. The simplified test body consisted of a rectangular body with a sampler situated in the center of each vertical face. The three principal sampling regimes encountered with a manikin-mounted sampler are represented by this simpler body: isoaxial sampling, 90-degree sampling, and sampling in the wake of the manikin. The velocity vectors along trajectories approaching two commercial inhalable samplers on the manikin and on the simplified test body were measured in a wind tunnel using a 3D laser Doppler velocimeter and by smoke stream observations. The manikin results indicated a range of flow fields depending on the specific manikin, the sampler location, the symmetry of the manikin's body, and the orientation of the manikin's arms. The measurements on the simplified test body indicated that the airflows approaching the samplers fall within the range of flow patterns on a manikin. A measurement of 70 µm particles at 50 and 200 cm/s indicate that the two bodies give equivalent results at each of the three sampling angles. The advantage of the simplified test body is that fewer measurements need to be made, a smaller wind tunnel can be used for testing and less aerosol has to be generated. Faster, less expensive and more precise testing will allow the evaluation of a greater variety of inhalable samplers for industrial hygiene use.

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AN ANNULAR DENUDER SYSTEM FOR SAMPLING SEMIVOLATILE NITROSAMINES. D. Breuer, Berufsgenossenschaftliches Institut fur Arbeitssicherheit, St. Augustin, Germany

It is impossible to avoid formation of N-nitrosamines in workplaces where secondary amines are present. More than 90% of all N-nitrosamines investigated so far turned out to have a high carcinogenic potential. For this reason, a limit value was fixed in Germany several years ago for sum concentrations of N-nitrosamines at the workplace, which is 1.0 µg/m^3 respectively 2.5 µg/m^3. N-nitrosamine concentrations at the workplace must therefore be determined. Artifact formation on the sampling support resulting from secondary amines and ubiquitous nitrogen gases must be definitely excluded during sampling. Artifact formation has remained an unavoidable problem in the case of semivolatile N-nitrosamines such as N-nitrosomethylphenylamine (NMPA) and N-nitrosoethylphenylamine (NEPA). A new system, based on the denuder technology, was developed for sampling these two N-nitrosamines. The sampling support is an annular denuder (length 24 cm, diameter 3 cm) combining five concentric sand-blasted glass tubes; the inner walls are coated with a mixture from triethanolamine and tetraethyleneglycol. On condition that the airflow is laminar, only N-nitrosamines are separated. The corresponding secondary amines pass through the denuder without being retained. Artifact information therefore is excluded. Analytical detection of the N-nitrosamines is done by gas chromatography using a thermal energy analyzer. The detection limit is 0.03 µg/m^3 for both N-nitrosamines. The sampling system made its proof in workplaces of the rubber and chemical industry, where NMPA and NEPA are likely to occur. Concentrations of nitrosamines determined for manufacturing processes of rubber varied between "not detectable" and 2.8 µg/m^3. Concentrations measured at workplaces in the chemical industry, where barrels are filled with amines, achieved between 0.2 µg/m^3 and 0.8 µg/m^3. With the new denuder system, enabling the measurement of semivolatile N-nitrosamines, the quality of assessment of workplace exposure to N-nitrosamines is definitely improved.

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THE DETERMINATION OF HEADSPACE H_2S CONCENTRATIONS USING DIRECT READING MONITORS. J.L. Martin, Exxon Biomedical Sciences, Inc., East Millstone, NJ; D. Agopsowicz, T. Lisk, Exxon Chemical Company, Linden, NJ

The responses of colorimetric detector tubes and electronic direct-reading monitors were compared to evaluate their performance in the determination of headspace concentrations of H_2S generated by a variety petrochemical products. Headspace GC/MS was the standard analytical method used to evaluate the performance of the direct reading methods. Test concentrations of H_2S were generated by the controlled heating of fixed quantities of various petrochemical products in a specially designed 5-liter chamber. The headspace concentration in the chamber was allowed to equilibrate and then sampled using each of the direct reading methods. The test concentrations of H_2S generated by these products ranged between 0 and 450 ppm. Relative response factors, based upon the results obtained using the headspace GC/MS technique, were determined for each of the direct reading methods. These factors ranged from 0.91 for a direct reading electronic monitor to 1.23 for colorimetric detector tubes. The colorimetric detector tubes evaluated in this study were found to accurately estimate the H_2S concentration in the headspace of the samples analyzed. It is essential, however, that the detector tube chosen be appropriate for the concentration range studied. Electronic direct reading monitors also showed good performance in the measurement of H_2S headspace concentrations in most of the samples evaluated. In several test materials, however, the electronic monitors were found to show a higher response for H_2S. These observations are believed to be due to interference by additional sulfur compounds in the headspace of these materials.

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PRAGMATIC PRINCIPLES FOR AVOIDING MANAGEMENT PITFALLS. M.L. Sanders, Naval Engineering Field Activity, Poulsbo, WA

Making the transition from an industrial hygienist managing programs to a manager programming industrial hygienists can be traumatic and career damaging. Keen technical and verbal skills are common entrance requirements to the people-management arena, but industrial hygienists who desire to make that professional move must be aware of three particularly dangerous pitfalls which neither of those skills will protect against.

One pitfall results from failure to distinguish between leadership and management, another from failing to distinguish between organizational process and function, and the third for failing to recognize the customer. Industrial hygienists must have the insight to recognize and evaluate those pitfalls, avoiding or backfilling in order to walk safely over them.

Specific and succinct descriptions of principles for both the prevention and the resolution of these problem areas have been developed; use of these principles is the catalyst for efficacious management. Whether the professional industrial hygienist is in the private or the public sector, assuming the responsibility for a controlled management response using these principles in the face of business adversity can turn impending failure into resounding success and ensure career growth.

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SCIENTIFIC CONTRIBUTIONS TO THE REVISION OF THE OSHA'S 1,3-BUTADIENE HEALTH STANDARDS. C.T. Chen, OSHA, Washington, DC

The current OSHA's 1,3-butadiene (BD) health standard is an 8-hour time-weighted average (TWA) exposure of 1,000 ppm for workers exposure to BD which is adopted from 1968 American Conference of Governmental Industrial Hygienist's (ACGIH's) threshold limit values (TLVs®) in 1971 to prevent irritation and narcosis effects. Due to the demonstration that BD causes multiple cancers in two animal studies in 1983, OSHA was petitioned by unions in 1984 and referred by EPA in 1985 for regulatory action. In 1990, OSHA published a proposed BD standard with an 8-hour TWA exposure of 2 ppm, a short-term exposure limit (STEL) of 10 ppm, and the ancillary provisions. There are many scientific studies contained in OSHA BD docket which enhanced the completion of a BD standard. Animal bioassays, human epidemiologic studies, experimental investigations on the metabolites and their mechanism in vitro and in vivo systems provides convincing evidence that BD is a probable human carcinogen. Three out of five quantitative risk assessments used NTP study with exposures of 6.25–625 ppm BD to calculate their best estimates of risk. Due to the availability of three breakthrough studies on BD, OSHA was able to allow the use of cartridges and canisters for respiratory protection that would enhance workers' protection, address industry's concerns, and reduce compliance cost. A series of plant visits conducted by the National Institute of Occupational Safety and Health (NIOSH) produced worker exposure profiles and information on technological feasibility which greatly helped in economic analysis. An epidemiologic study sponsored by the International Institute of Synthetic Rubber Producers (IISRP) completed in late 1995 clearly demonstrated an excess risk of cancer among workers exposed to BD which is complementary to the animal studies. This promoted IISRP to engage with unions to reach agreement on a standard with an 8-hour TWA exposure of 1 ppm, a STEL of 5 ppm, and other aspects of standard. This demonstrates that studies from various disciplines of science will greatly enhance the development of a workplace health standard. The opinion expressed here is sole of author.

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CIH PLUS IHIT UTILIZATION BY INDUSTRY OR INDUSTRY GROUP, AND PRELIMINARY PROJECTIONS OF FUTURE NEED FOR SUCH INDUSTRIAL HYGIENE PROFESSIONALS. L.W. Whitehead, CIH University of Texas-Houston Houston, TX, M. West Baylor College of Medicine, Houston, TX

Estimates of future need for public health professionals are very useful for planning educational programs and incentives for graduate education, and for staffing projections. No such estimates are known to exist for