involves learning the types of work performed, understanding the hazards they create, evaluating the means to accomplish safe entries and coordinating entries with production, maintenance and safety. After this was accomplished, employees were trained on entry/rescue procedures that meet the criteria set forth in the confined space standard. The use of a well-planned confined space program integrates industrial hygiene with production demands, minimizes lost production time, maximizes productive man-hours and allows necessary work to be safely performed in any size company.

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SITE-SPECIFIC EMISSION FACTORS AND CROSSDRAFTS FOR 16 VAPOR-PHASE DEGREASERS UNDER NORMAL OPERATING CONDITIONS. E.A. Iyiegbuniwe, L. Conroy, P. Scheff, University of Illinois, Chicago, IL

This study evaluated emissions from 16 vapor-phase degreasing processes located in 14 private industrial sites. The study determined solvent emission rates using three mass balance models and, from observed source activities, developed emission factors, as well as characterized cross-drafts near local exhaust hoods. Twelve 1-hour samples were collected simultaneously with charcoal tubes at the LEV duct and at four locations at different distances from each degreaser. Samples were analyzed by gas chromatography/flame ionization detector using NIOSH Method 1022. Measurements of ventilation, cross-drafts, and source activity observations were made simultaneously with solvent concentration. Average workspace solvent concentrations ranged from 3.35 to 103 ppm for trichloroethylene, 34.9 ppm, 1.89 ppm, and 12.8 ppm for methyl chloroform, perchloroethylene, and methylene chloride, respectively. Average degreaser emission rates ranged from 5.5 to 83.2 g/min/m^2 (average=23.0 g/min/m^2). Site average emissions are in excellent agreement with published emissions for batch vapor degreasers. Workspace and LEV emissions were reasonably correlated with each other, but relate significantly to varying operating procedures and source activities. Solvent carryout, spraying with liquid solvent, drying parts above the condenser, and the number of parts entering and exiting the degreaser were shown to significantly influence high emissions. In addition, solvent transfers and draining of the degreaser accounted for high workspace emissions. Average cross-draft velocity ranged from 0.43 to 64.8 fpm (average=27 fpm). Turbulence intensity ranged from 0.42% to 86.1%. Cross-drafts observed during the present study are consistent with those used in laboratory experiments to develop predictive capture efficiency models. The ACGIH recommended flow of 50 cfm/ft^2 of tank surface area appears to be adequate for some conditions at some sites, but not for others. The current design method, which recommends eliminating crossdrafts and other disturbances to airflows is unrealistic. These results showed that crossdrafts influence hood capture efficiency and workspace emissions and therefore cannot be disregarded.

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EVALUATION OF MIST EXPOSURE CONTROL FOLLOWING INSTALLATION OF AIR CLEANERS ON MACHINING CENTERS. J. Yacher, W. Heitbrink, NIOSH, Cincinnati, OH; M. Sullivan, Sauer-Sunstrand Co., Ames, IA

The concentration of mist generated by the use of synthetic metalworking fluid (MWF) consisting primarily of water and triethanolamine (TEA) in enclosed and partially enclosed machining centers was determined by direct-reading aerosol instruments, impingers, and filter cassettes. The results were then compared to measurements made before the installation of air cleaners on twenty-five of these machining centers. The mist was generated when MWF was flooded over the parts being milled, drilled, tapped, or turned to provide lubrication and cooling and promote chip removal. The air cleaners consist of three sections: a fal-out chamber, a filter section to capture metal chips and mist, and a blower section providing airflow of approximately 0.094 m^3/s. The MWF and entrained metal chips are discharged to a "hydromation unit" for recirclation and filtration. The following instruments were used to measure aerosol concentration and size distribution and to locate emission sources: an eight-stage ambient cascade impactor (Andersen Samplers, Inc.), a quartz crystal microbalance cascade impactor (California Measurements), an eight-channel optical particle counter (Grimm Labortechnik GmbH), a hand-held aerosol monitor (HAM)/photometer (ppm, Inc.), and a real-time, respirable aerosol monitor (RAM)/photometer (MIE, Inc.). The ambient cascade impactor indicated a concentration of 0.111 mg/m^3 over a 72-hour period at a sampling point between two of the machining centers; the quartz crystal impactor indicated MWF concentration of 0.025-0.31 mg/m^3 in that same location. At a location near the "hydromation unit," the values were 0.138 mg/m^3 and 0.028-00.046 mg/m^3, respectively. These aerosol measurements were made only after installation of the air cleaners. Area samples for TEA were also taken using miniature impingers. The results for TEA improved from about 0.29 mg/m^3 before installation of the air cleaners to 0.032 mg/m^3 after. Similar results were obtained for total particulate (37-mm filter cassettes at 4 lpm), which was reduced from approximately 0.3 mg/m^3 to less than 0.05 mg/m^3. These results show the effectiveness of enclosure, ventilation, and filtration to greatly reduce the exposure to MWF mist generated in modern machining centers.

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CONTROLLING BENZENE EXPOSURE WITH LOCAL VENTILATION DURING A HAZARDOUS WASTE SITE INVESTIGATION. S. Gulbrandsen, Dames & Moore, Santa Barbara, CA

Hazardous waste investigation using mud rotary drilling methods at a former synthetic rubber manufacturing plant presented airborne benzene levels that necessitated the use of Level C or Level B personal protective equipment by investigating personnel. The use of the Level C or Level B ensembles, while providing adequate protection for benzene exposure, also presented issues such as heat stress, lower productivity, additional project expense, and community concern. Engineering controls to capture benzene vapor evolved during mud rotary drilling operations were devised. Significant vapor control was achieved by the construction of a lid for the drilling mud pit. The pit lid was fitted with flexible tubing to two drums connected in series containing carbon. The system was powered by a vacuum motor to draw the benzene emissions from the mud pit and through the carbon. The use of the described control method has been so effective that personal exposure monitoring results using NIOSH Method 1501 have demonstrated that the majority of measurements for benzene exposure are now nondetect. Continuous monitoring using supplemental direct-reading instrumentation has indicated similar results. Refinements have since been made to the original control system design, resulting in more vapor control applications at the site and improved equipment convenience. In conclusion, the use of the vapor control system allows site investigation personnel to wear Level D equipment for tasks that previously could only be approached with a Level C or Level B personal protective equipment ensemble. This is a fundamental improvement to project operations that allows investigative work to proceed at a quicker pace with reduced labor and personnel protective equipment costs.

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INDUSTRIAL HYGIENE ASSESSMENT OF THE EFFECTIVENESS OF CLEAN UP METHODS FOR MERCURY FROM BROKEN THERMOMETERS. A. Bracker, University of Connecticut, Farmington, CT; M. Heyman, State of Connecticut Department of Public Health, Hartford, CT; R. Wallace, E. Storey, University of Connecticut, Farmington, CT

In 1994 the Connecticut Department of Public Health (CT DPH) developed an interim guideline for clean-up of broken thermometers on intact surfaces in residential settings. This interim document was based upon previously published guidelines which had not used quantitative data for evaluation purposes. The effectiveness of the CT DPH protocol was evaluated in June of 1995. In an experimental chamber, 0.05 mL aliquots of metallic mercury were spilled in a controlled environment on different surface types chosen to simulate the flooring materials and furnishings found in residential settings. Mercury vapor concentrations in air were measured over time at various distances from the source as a variety of clean-up methods were utilized. Three questions were addressed by the study

1. What are the mercury air levels (mercury vapor concentrations measured in mg/m^3) after using the methods outlined in the CT

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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

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