

correctly interpreted the 1968 ACGIH TWA TLVs as upper control limits for each single shift TWA exposure.

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EFFECT OF POSITION AND MOTION ON PERSONAL EXPOSURE IN AN HVLP SPRAY PAINTING OPERATION. J. McKernan, B. Gatano, M. Flynn, University of North Carolina, Chapel Hill, NC

Worker exposure to particles is a problem in most spray painting processes. Previous studies, using a stationary mannequin and simple spray nozzle, showed that dimensional analysis could be used to correlate a dimensionless breathing zone concentration (which requires knowing the gun transfer efficiency) with a dimensionless nozzle pressure term (the Carlton number). This work expands on that study by using a real HVLP (high-volume low-pressure) gun, and adding a representative spraying motion. A robot-mannequin, capable of holding and actuating the spray gun and also performing a repeated side-to-side spraying motion was used. Vacuum pump oil was sprayed onto a flat plate in a wind tunnel to determine the relationship between nozzle pressure and breathing zone concentration. "Breathing zone" samples were collected using a cassette modified to mimic the IOM inlet. Data collected in the absence of motion show that the dimensionless concentration in the 90 degree position is lower than the 180 degree position until a crossover point is reached at low values of the Carlton number (10 to the 6th power). After this point, the dimensionless breathing zone concentration in the 180 degree position is higher than in the 90 degree orientation. For the case with motion once again, the 90 degree position was lower than the 180 degree position until a crossover point was achieved. However, after the crossover, the data for both orientations, become constant around a value approximately equal to a well-mixed condition. The resulting model stresses the association between contaminant generation, transport, and exposure. Such models are beneficial because they relate exposure to processes parameters that can be controlled to reduce it.

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EXPOSURE ASSESSMENT OF MAINTENANCE OPERATIONS OF AIR POLLUTION CONTROL DEVICES DURING "OUTAGES" OF ELECTRIC POWER GENERATION FACILITIES: THE COMPONENTS OF "FLY ASH" DUST. H. Beaulieu, Industrial Hygiene Resources, Boise, ID; A. Siert, Public Service Co. of Colorado, Denver, CO

The most difficult evaluations to be performed by the industrial hygienist are maintenance operations, although these may often result in the most significant exposures that workers may encounter. Exposure assessments were performed for maintenance workers during "outages" (shut downs) of large coal-fired electric utilities. This assessment was focused at air contaminants encountered by workers when disturbing "fly ash," the light particulate matter that accumulated in the air pollution control devices after months

of burning coal. The significant components of this fly ash were individual metal oxides, crystalline silica, and overall particulate matter (both respirable and total dust). Metal oxides encountered included arsenic (As), cadmium (Cd), cobalt (Co), lead (Pb), barium (Ba), iron (Fe), manganese (Mn), magnesium (Mg), vanadium (V), calcium (Ca), aluminum (Al), sodium (Na), and beryllium (Be).

Cleaning of baghouse systems was performed at two of the power generating stations, while cleaning electrostatic precipitators (EPs) was performed at another station (two EP units). In the stations equipped with baghouse air pollution control devices, the maintenance workers were evaluated during the following operations: filter bag removal, clean-up, and new filter bag installation. Maintenance operations in the station equipped with EPs included erection of scaffolding, shoveling ash from the shelves, wash down, and removal of scaffolding. Air sampling was conducted on workers performing these various tasks.

In a 16-day sampling period, over 700 samples were collected in the personal breathing zones (PBZs) of these maintenance workers. Workers were routinely exposed to "individual" air contaminant concentrations in excess of OSHA action levels (ALs) and PELs/TLVs for Pb, Ba, Fe, V, Ca, Al, Na, Be, respirable silica, respirable and total particulates. Workers utilized full face piece, air purifying respirators, equipped with HEPA filters, during all operations.

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METHODS TO EVALUATE EXPOSURE ASSESSMENT METHODS IN DRY-CLEANING SHOPS. L. Ewers, C. Earnest, A. Ruder, G. Burroughs, NIOSH, Cincinnati, OH

A pilot study was conducted to evaluate methods of exposure assessment in small dry-cleaning shops. The study was part of a larger campaign encouraging owners and workers to reduce their exposures to perchlorethylene (PCE), a solvent utilized by over 70% of dry cleaners and associated with adverse health effects. Practical methods that were likely to gain acceptance by small dry-cleaning operations were sought. Ultimately, we identified a need to quantify the reduction in exposure resulting from the installation of three types of engineering controls: a carbon absorber, fugitive emission system, and a refrigerated condenser, each retrofitted to existing dry-cleaning machines in separate shops. PCE exposures were evaluated by (1) area, (2) personal air, (3) end-exhaled breath, and (4) real-time monitoring. Monitoring methods were employed in each of the three shops on three occasions before intervention installation and on three occasions after installation.

Comparison of one shop with another was not possible due to small sampling sizes and differences between shops; our primary interest was the comparison between PCE exposures before and after control installation in each shop, including measures on the identical load run before and after. Results demonstrated that each monitoring method provided unique information regarding exposures. Real-time monitoring suggested that opening

of the dry cleaning machine doors was an important contribution to the overall PCE exposures, accounting for up to 70% of the exposure. Although overall the end-exhaled levels were low (<10 ppm), end-exhaled breath measurements were useful in providing detailed exposure information for individual workers in that the levels responded to changes in worker's tasks and corroborated real-time monitoring.

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TESTING COMPLIANCE WITH A 1-YEAR AVERAGE OCCUPATIONAL LIMIT VALUE. AN EXAMPLE BASED ON THE EUROPEAN COMMUNITY'S VINYL CHLORIDE LEGISLATION. T. Scheffers, DSM Chemical Co., Geleen, The Netherlands

For most carcinogens and other chronic harmful agents, the long-term cumulative dose is the relevant parameter when assessing the risk of exposed workers. In some countries this long-term aspect of risk is taken into account in the occupational limit values (LV). Examples are the biological exposure indices of heavy metals and the workplace air LVs of ionizing radiation, lead, noise, asbestos and vinyl chloride monomer (VCM).

VCM is a carcinogenic agent. Long-term high exposure may cause angiosarcoma of the liver. Therefore, the European Community in 1978 established a long-term LV of 3 ppm (LV1year): the arithmetic mean of the VCM exposures in any working year should not exceed the LV1year.

In a VCM polymerization plant in the Netherlands a baseline monitoring program has been in place for almost 10 years. Its goal is to control the location and the range of exposure distributions in specified similar exposure groups (SEGs). Using a stratified sampling sequence series, 8-hour personal air sampling concentrations are measured throughout the year during different shifts and in different seasons.

A goodness-of-fit procedure is used to establish whether modeling the SEG sample data with the lognormal distribution is appropriate. The range and the confidence limits of the 1-year average exposure are estimated using the Student based test statistic. Although the number of samples per year is limited and some 8-hour exposures do exceed 3 ppm, the 95%-tile upper confidence limit of the mean indicates that the long-term average exposure of the workers is well below the LV1year.

This example may be of value for all those who want to assess the health risk of workers with a long-term exposure to chronic toxic agents.

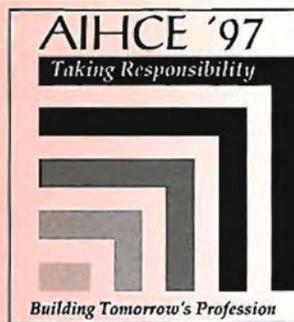
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PLANAR WAVEGUIDE INTERFEROMETERS FOR VAPOR PHASE SENSING. C. Joseph, D. Campbell, J. Suggs, J. Moore, N. Hartman, Georgia Tech Research Institute, Atlanta, GA

1997

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2

PRAGMATIC PRINCIPLES FOR AVOIDING MANAGEMENT PITFALLS. M.L. Sanders, Naval Engineering Field Activity, Poulosbo, 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 back-filling 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 profes-

sional 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.

3

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