tively; for S-PMA spiked urine samples the corresponding values at 7.5 and 150 ng/mL were 10% (mean 7.0 ± 0.7) and 4% (mean 133 ± 5.7), respectively. Between day precision values for pooled urine samples spiked with t,t-MA at 150 and 3000 ng/mL assayed over three days (n=15) were 11% (mean 164 ± 18) and 4% (mean 3110 ± 118); corresponding values for S-PMA at 7.5 and 150 ng/mL were 10% (mean 7.0 ± 0.7) and 7% (mean 133 ± 9.1). Urine samples spiked with t,t-MA were stable for one day at room temperature and 3 days at refrigerated (2-8°C) temperatures. When stored at frozen (< -10°C) temperatures, spiked urine samples were stable for at least two weeks. S-PMA spiked urine samples were stable for at least two weeks under all storage conditions. Urine samples spiked with several commonly found urinary substances gave no reportable value for either t,t-MA or S-PMA. This procedure is not only suitable for biomonitoring workers exposed to benzene, but also improves robustness of interpretability.

353.

VALIDATION OF A FIELD-PRACTICAL COLLECTION METHOD FOR BROMOPROPANE IN EXHALED BREATH.

K. Hanley, W. Sanderson, D. Booher, NIOSH, Cincinnati, OH

1-Bromopropane (1-BP) has been marketed as an alternative for ozone depleting solvents and suspect carcinogens and is used for metal, precision, and electronics cleaning; aerosols; and adhesives. Toxicity of 1-BP is poorly understood but it may be a neurologic, reproductive and hematologic toxin. Sparse exposure information has prompted NIOSH to conduct a multi-industry exposure assessment using inhalation, exhaled breath, and urinary metabolite measurements. Exhaled breath analysis can be a powerful, non-invasive tool that indirectly measures inhalation and dermal exposure. However, validated analytical methods specifically for 1-BP in exhaled breath are unavailable.

The objective of this study was to evaluate an exhaled breath method for 1-BP analysis. The method must be accurate, sensitive, and unaffected by water vapor to measure trace levels consistently without contamination or deterioration. Three liter Tedlar® breath bags were used which contained waste air diverting valves to ensure end-tidal breath collection. Bags were filled with nitrogen or breath and spiked, in triplicate, with nominal concentrations of 0.2; 0.5; 2; and 5 ppm. The bag mixture was then collected on Anasorb CMS synthetic charcoal tubes at a pump flowrate of 100 cc/min and analyzed by gas chromatography via NIOSH Method 1025. The LOD was 0.7 µg, therefore, 1-BP should be detected as low as 0.05 ppm in 3 liters. All bag samples detected the analyte, some as low as 2 µg. The mean recovery of 1-BP with this method was 0.72 and 0.73 for nitrogen and breath mixtures, respectively. Stability of BP in breath was evaluated by sampling 0.5 and 5.0 ppm bag concentrations after 3 hours and the mean recovery was nearly the same (0.735). This sampling strategy allows breath samples to be analyzed by a contract laboratory, thereby eliminating chemical analysis with portable instrumentation in field surveys.

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354.

AN OCCUPATIONAL SAFETY AND HEALTH-POLLUTION PREVENTION INTEGRATED ANALYSIS OF FORMALDEHYDE USE AND REDUCTION IN A HOSPITAL CLINICAL LABORATORY.

A. Bello, M. Quinn, T. Fuller, L. Li, University of Massachusetts Lowell, Lowell, MA

Exposure to formaldehyde poses both environmental and occupational health concerns. A moderately sized, urban teaching hospital received fines from its local water resource authority for excessive formaldehyde in the waste water discharged from the clinical laboratories. Although the hospital made several attempts, it was unable to identify all of the sources of formaldehyde in the labs and to control it effectively. The objectives of this work were to apply an integrated occupational safety and health-pollution prevention workplace survey to assess the use and disposal of formaldehyde in the hospital laboratories and to identify chemical, technical, and managerial alternatives to reduce or eliminate it. Workplace process/task maps and materials input/output analyses were developed. These were produced via work practice observations and interviews with managers and technicians using a structured work place survey. Research was conducted to identify formaldehyde alternatives for hospital applications by reviewing the scientific literature, contacting hospital laboratories already implementing formaldehyde alternatives, and discussing product specifications with manufacturers. The alternatives were compared using a set of environmental and occupational health and safety criteria. Formaldehyde was found mostly in the pathology-histology laboratories. Of the multiple chemical alternatives identified, three were selected based on the occupational and environmental criteria and on the prior experience of other hospital labs. Technical alternatives were also identified: microwave fixation combined with alternative chemical fixatives and on-site recycling of formalin. It was also found that the waste water formaldehyde would have been controlled better if occupational management plans had been implemented, including those required by OSHA's laboratory and formaldehyde standards. This work indicates that an integrated occupational health and safety-pollution prevention approach enables simultaneous reduction of the environmental and occupational health concerns caused by formaldehyde use in the laboratories. Formaldehyde alternatives are available and they can be implemented in the hospitals.

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EVALUATION OF FORMALDEHYDE EXPOSURE DURING MARQUIS TEST OF CONTROLLED SUBSTANCES.

M. Cameron, California Department of Justice, Sacramento, CA

WITHDRAWN

356.

CONTROLLING FORMALDEHYDE EMISSIONS IN AN ACADEMIC GROSS ANATOMY LABORATORY.

C. King, R. Klein, P. Labbie, Yale University, New Haven, CT

The Gross Anatomy Laboratory has long been recognized as a major source of formaldehyde exposure to medical students and instructional staff. Many of these laboratories are housed in buildings or spaces that were originally intended for other uses, and do not have the ventilation necessary for effective control. Other factors, such as larger class sizes, outdated facilities and equipment, and differing methods of cadaver preservation, have all contributed to increase formaldehyde exposures and subsequent complaints from users. Different medical schools have dealt with this problem in varying ways; adding or increasing general exhaust to the room, experimenting with the percentages of formaldehyde in the embalming solutions, supplying their students with respirators, and designing local exhaust to their tables. While local exhaust systems are among the most effective methods, there is great variability between designs for these tables. Most are designed to be used with relatively high volumes of air, which is not feasible at many institutions. Here at Yale, a new building that will house the Gross Anatomy Laboratory has been designed with a limited amount of exhaust and make-up air that can be supplied, as well as restrictions on the orientation of the exhaust inlet. We have evaluated several designs of locally exhausted anatomy tables to determine their effectiveness at low air volumes within the boundaries given to us by the architects and project management team. Direct reading measurements and standard exposure monitoring methods were used in these studies. The results confirm that a well-designed locally exhausted table can be effective at controlling formaldehyde vapors even with lower than ideal air flows.

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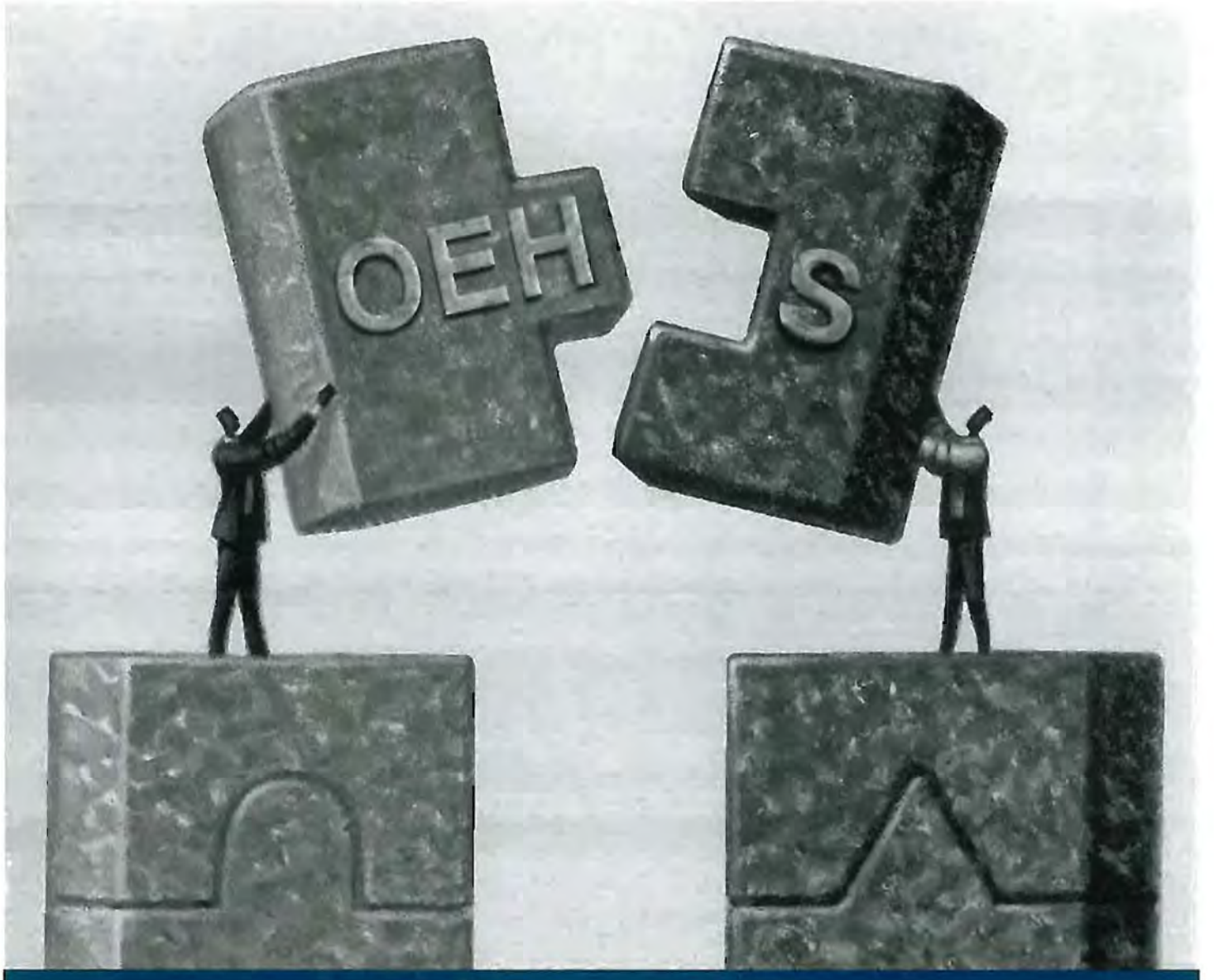

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PF 101 Agricultural Health and Safety

Papers 1–6

1.

RELATIONSHIPS BETWEEN WORK EXPOSURE AND RESPIRATORY OUTCOMES IN POULTRY WORKERS.

S. Kirychuk, J. Dosman, P. Willson, L. Dwernychuk, University of Saskatchewan, Saskatoon, SK, Canada; J. Feddes, A. Senthilselvan, C. Ouellette, University of Alberta, Edmonton, AB, Canada

A pilot study was conducted on 74 poultry barn workers in Western Canada during the winters of 1998–2000. General respiratory health, current, chronic and work related respiratory symptoms; general work duties, and work-site factors were ascertained, pre-exposure, by questionnaire. Personal airborne exposure levels and changes in symptoms and lung function were measured across the work-shift for all workers. Workers were classified according to the type of poultry operation (floor based, n=53; cage based, n=13) in which they worked. There was no significant difference in daily hours spent in the barn between those who worked with caged poultry (5.41±2.35 hours) and those who worked with floor-based poultry (4.42±2.48 hours). Age of birds was 47.10±58.36 days for floor based versus 155.91±63.01 days for cage based facilities. There were no significant differences in personal environmental measurements between cage-based and floor-based facilities (ammonia 13.22±13.70 ppm, 17.34±16.35 ppm; total dust 5.74±4.85mg/m^3, 10.01 ±8.84 mg/m^3; endotoxin 6046±6089 EU/m^3, 5457±5934 EU/m^3 respectively). There were no significant differences in across work-shift change in pulmonary function indices between workers from cage and floor-based operations. For the entire sample total dust dose (work hours/day x total dust) significantly correlated with across-shift change in FEV_1, whereas endotoxin dose and ammonia dose did not. Stocking density was significantly correlated with average ammonia (ppm, p=0.002) and ammonia dose (ppm x work hours/day; p=0.004) in floor based operations and with total dust (particles/ml, p=0.002) in cage based populations. Stocking density was also significantly correlated with chronic cough (p=0.003) and across work-shift cough (p=0.05) and chest tightness (p=0.06) for workers from floor based operations; and with phlegm when working (p=0.018) and chest tightness across the work-shift (p=0.004) for workers from cage based operations. Type of poultry production operation and therefore type of work exposures appear to significantly impact symptoms experienced by workers exposed to these atmospheres.

2.

DUST GENERATION SYSTEM FOR AGRICULTURAL SOIL DUST.

K. Lee, R. Domingo-Neumann, R. Southard, UC Davis, Davis, CA

Agricultural workers are prone to exposure to mixed dust of inorganic and organic compounds. Diverse working conditions and operations in agriculture make direct measurements of the mixed dust exposure difficult. This study was conducted to develop a new dust generation system to determine possible exposure potency indicators of soil samples. The dust generator consists of a blower, a rotating chamber and a settling chamber. The rotating chamber has inner baffles to provide sufficient agitation of the samples while the chamber is rotating. A blower provides air into the rotating chamber, and the suspended dust is moved to the settling chamber through a perforated pipe. A small fan inside the settling chamber helps maintain suspension of the dust. Various size fractions of dust are sampled on filters suspended in the chamber via outlet ports and attached pumps. Air pressure is released through a filter plate mounted on the wall of the settling chamber. Various operating conditions were evaluated: air intake from blower, speed of rotation, soil mass and sampling time. To evaluate the characteristics of dust from the system, we collected dust samples from agricultural fields while the soil was prepared for

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