405.

A THEORETICAL WORK-FACTOR BLOOD-LEAD PREDICTION MODEL FOR CONSTRUCTION WORKERS. K. Vork, M. Nicas, S. Hammond, University of California at Berkeley, Berkeley, CA

A new model is introduced to address the continued problem of lead poisoning among bridge repair workers. We have derived this model based on a conceptual framework, linear systems theory and stochastic inputs. Our model combines work factors such as task exposure rates, air concentration and respirator penetration distributions with initial lead body burden and a published physiologically based pharmaco-kinetic model to estimate blood lead levels in individual workers.

The Connecticut Road Industry Surveillance Project (CRISP) introduced a new method to control lead exposure. Records from over 90 bridge projects provide information about worker exposures and control techniques. Exposure profiles and initial body burdens of lead from Abrasive Blasters obtained from CRISP records were used to test the model. Predictions compared to measured blood lead values with a regression slope of 1.0 plus or minus 0.10 for over 90 percent of the worker profiles.

We illustrate in two hypothetical scenarios that target blood lead levels can be anticipated and alternative methods for achieving them can be evaluated. For a defined sequence of tasks to be performed over a one-month period, the model generates a probability distribution of possible blood lead levels at the end of the period. Variability in possible blood lead levels is due to the stochastic nature of the ambient lead concentrations and respirator penetration values. We use the criterion that the 95th percentile of the blood lead distribution is less than 20 micrograms per deciliter for an acceptable task sequence.

The model provides for a new way to evaluate the efficacy of the various techniques used during CRISP, allows for the dynamic estimation of blood lead levels before they occur, and a method to anticipate costs and plan projects that balance the constraints of production and worker protection.

406.

DEVELOPMENT OF A RAPID ON-SITE METHOD FOR THE ANALYSIS OF DUST WIPES USING A FIELD PORTABLE X-RAY FLUORESCENCE ANALYZER. S. Clark, W. Menrath, P. Succop, M. Chen, J. Grote, University of Cincinnati, Cincinnati, OH

Lead levels of dust wipes collected from housing undergoing risk assessment and those for which lead hazard control work had been completed were analyzed using field portable X-ray fluorescence analyzers (XRF). The dust wipes were then digested and analyzed by atomic absorption (AA) spectroscopy in the laboratory. In order to be 95% certain that the AA lead level of a dust wipe would be 40 ug or lower, the current HUD standard for floor dust wipes, the XRF lead level should not exceed 26.8 ug. The apparent limit of detection for this instrument was 6 ug. The corresponding XRF levels for AA values of 250 ug (window sill standard) and 800 ug (window trough standard) are 98.8 ug and 256 ug, respectively. For a prototype instrument tested earlier, the corresponding XRF levels were 33.2, 134 and 322 ug, respectively. An inter-instrument comparability study to determine the variability of six instruments from the same manufacturer revealed close agreement among the instruments, with one instrument tending to have readings that were about 11% lower than the others which varied from the overall mean by -4.6 to +6.6 %. Because instrument performance can change over time, it is recommended that a series of quality control samples covering the range of interest be tested each day the instrument is used. Using appropriate quality control procedures, the portable XRF analyzer is capable of providing reliable lead wipe level determinations. Research is currently underway to explore the utility of the portable XRF to provide on-site lead loading levels as the clean-up after lead hazard reduction is completed, to reduce the rate of clearance failures.

Respiratory Protection

Papers 407–413

407.

REDUCING RESPIRATOR FIT-TEST ERRORS: A MULTI-DONNING APPROACH. D. Campbell, C. Coffey, P. Jensen, NIOSH, Morgantown, WV; Z. Zhuang, NIOSH, Pittsburgh, PA

Because fit-testing is the only assurance that an individual has an adequately protecting respirator, the error rates of current fit-tests are of concern. Previous laboratory studies with filtering-facepiece respirators have found significant fit-test error rates. The alpha error (failing a respirator/subject combination that should pass) ranged from 51 to 84 percent. The beta error (passing a respirator/subject combination that should fail) ranged from 3 to 11 percent. High error rates can result in individuals being assigned inadequately fitting respirators. These high errors also cause the fit-tests to yield inconsistent results which can cause the meaningfulness of the test to be questioned. In order to reduce the alpha and beta error inherent in current fit-test methods, a new approach to fit-testing filtering-facepiece respirators is proposed for consideration. Unlike current fit-tests which use a single donning of the respirator, the proposed test involves multiple donnings in order to reduce the element of chance in the fit-test result. And, unlike current fit-tests that measure only faceseal leakage, the proposed test is based on a measurement of total leakage (faceseal plus filter). Utilizing total respirator leakage can result in simpler, quantitative fit-test instrumentation and a fit-test that is more relevant to the workplace. Analysis is presented that indicates the proposed multi-donning fit-test has the potential to simultaneously reduce both the alpha error and the beta error to half that of current fit-tests.

408.

POWERED AIR-PURIFYING PARTICULATE RESPIRATOR INTEGRITY TESTING WITH A DOP CHALLENGE AEROSOL. S. Martin, E. Moyer, P. Jensen, NIOSH, Morgantown, WV

Several workplace protection factor and simulated workplace protection factor studies have been conducted on Powered Air-Purifying Respirators (PAPRs). While these serve to provide useful information regarding the performance capabilities of PAPRs under certain workplace or simulated workplace conditions, most fail to address the issue of total PAPR integrity over time. PAPR integrity over time is of importance in protecting worker health over the course of a work shift or for the recommended service lifetime of the filter(s)/OV cartridge(s) or PAPR battery pack, whichever is less. The need for PAPR integrity testing has become even more important since the inception of 42 CFR 84 and the influx of electrostatic filters into the PAPR market. On July 10, 1995, 42 CFR Part 84 replaced 30 CFR Part 11 as the active certification regulation for all non-powered air-purifying particulate filter respirators. However, the certification requirements for PAPRs were transferred to Part 84 without major changes or modifications. In light of recent findings regarding electrostatic PAPR filter efficiency degradation, this study was conducted to learn how current NIOSH-certified PAPRs would perform under an 8-hour integrity test, similar to the DOP loading test described in 42 CFR 84. In this study, PAPR units, four with mechanical filters and one with electrostatic filters, were tested using a TSI Model 8122 Automated Respirator Tester, with and without the built-in breathing machine. The two tight-fitting PAPRs, both with mechanical filters showed little effect on performance resulting from the breathing machine. Two of the loose-fitting PAPRs (one with electrostatic filters) indicate that integrity testing without the breathing machine is a more stringent test. The last loose-fitting PAPR gave results that were inconclusive. The PAPR with the electrostatic filters gave higher maximum penetration values during integrity testing, which is probably attributable to filter efficiency degradation.

409.

THE EFFECTS OF ORGANIC VAPORS ON THE EFFICIENCY OF ELECTROSTATIC RESPIRATOR FILTER MEDIA. S. Martin, T. Wigal, E. Moyer, NIOSH, Morgantown, WV

New 42 CFR 84 electrostatic non-powered, air-purifying respirator filters, approved for use in conjunction with organic vapor cartridges, were tested for filter efficiency degradation resulting from organic vapor exposures.

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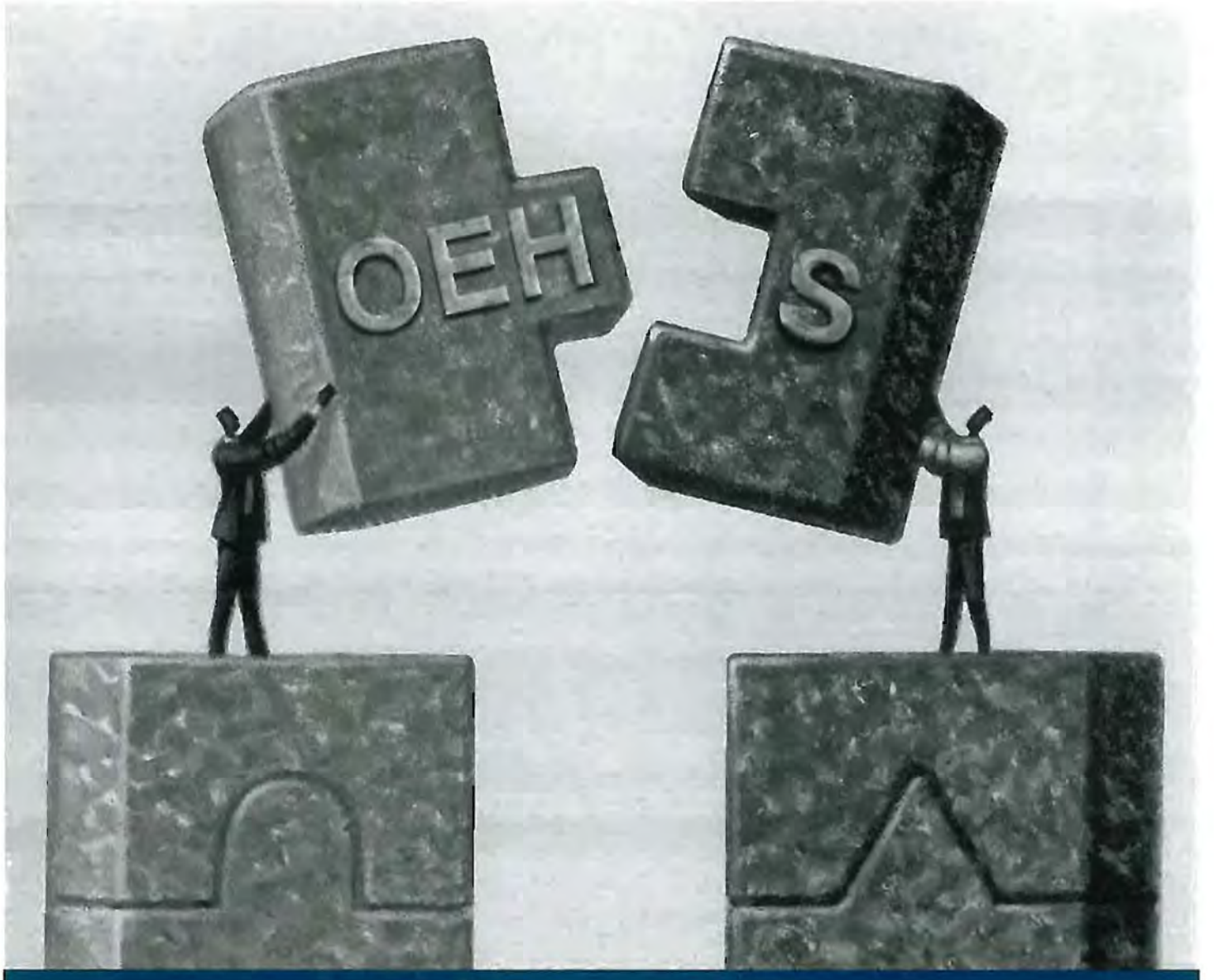

ABSTRACTS

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2002 Abstract Index by Session Topic

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