

here is shown to be a sensitive and reliable approach for the quantification of total aliphatic isocyanates.

### 349

**PARTICLE PENETRATION THROUGH INTACT SKIN AND A METHOD FOR DETERMINING POTENTIAL EXPOSURE THROUGH SURFACE CONTAMINATION.** M. McCawley, S. Tinkle, M. Berakis, NIOSH, Morgantown, WV; M. Kent, Brush Wellman, Inc., Elmore, OH.

Results from studies of intact skin samples have shown that particles less than one micrometer in size are capable of penetrating intact skin. This occurs when the skin is flexed, but is not seen when particles are placed on stationary samples. This mechanical transport is capable of moving the particles through the stratum corneum and into the epidermis and dermis. In these latter layers of the skin, particles are potentially available for recognition by the immune system. This may have implications for any immunological disease and is of particular concern for chronic beryllium disease (CBD) as well as latex sensitivity. To determine the potential for exposure from surface contamination we used a personal impactor operated at 20 liters per minute with only the seventh stage and final filter. The calibration cowl was used with the impactor to provide a 0.5 cm opening and sufficient vacuum to remove particles from surfaces. Particles collected in this way on the final filter were less than one micrometer. Not only were solid surfaces and soiled clothing found to contain measurable amounts of submicrometer beryllium in beryllium manufacturing facilities, but washed clothing and surfaces, especially fabric surfaces, in presumably clean office areas also contained measurable amounts of beryllium. This may help explain the occurrence of CBD in office workers in the beryllium industry.

### 350

**EFFECTS OF ETHANOL AND PHENOBARBITAL ON HEMOGLOBIN ADDUCTS FORMATION IN RATS EXPOSED TO BENZIDINE AND DIRECT BLACK 38.** C. Kim, J. Roh, H. Kim, Y. Yoon, Yonsei University, Seoul, Republic of Korea; S. Lee, Catholic University, Seoul, Republic of Korea.

The objective of this study is to evaluate the effects of pretreatment of ethanol (EtOH) and phenobarbital (PB), which are known to affect metabolism of xenobiotics, on the formation of hemoglobin adducts in the rats administered benzidine (BZ) and Direct Black 38 (DB38). The experimental rats were divided into BZ and DB38 groups; each group was subdivided into control, EtOH, and PB groups. The blood was separated into hemoglobin and plasma immediately after taking the blood samples, and the adducts were undergone basic hydrolysis to convert them into aromatic amines. Hydrolyzed BZ, monoacetylbenzidine (MABZ), and 4-amino-biphenyl (4ABP) were separated by reversed-phase liquid chromatography without derivatization, and quantitative analyses of them were performed by a high performance liquid chromatograph equipped with electrochemical detector. The quantitative amount of the metabolites was expressed by hemoglobin binding index (HBI). BZ-, MABZ-, and 4ABP-HBI of BZ-EtOH and BZ-PB groups were increased more than those of BZ-control group. In DB38 group, all of HBIs but BZ-HBI were increased more than those of DB38-control group regardless of the pretreatment. These results are attributable to the fact that EtOH and PB induced N-

hydroxylation related to the hemoglobin adduct formation. Above results indicate that EtOH increased the adduct formation by inducing N-hydroxylation, but also induced N-acetylation. PB induced N-hydroxylation and increased the adduct formation in BZ group, but decreased the adduct formation in DB38 group due to decreasing the azo reduction. This result suggests that the effects of EtOH or PB need to be considered in the biochemical monitoring of BZ and DB38 for the assessment of intermittent exposure of BZ and DB38.

## Agricultural Health & Safety Papers 351-354

### 351

**WIPE SAMPLING TO ASSESS PESTICIDE EXPOSURES ON SKIN: PRELIMINARY METHOD EVALUATION.** M. Boeniger, T. Carreón, W. Sanderson, NIOSH, Cincinnati, OH; M. Nishioka, Battelle, Columbus, OH.

Background: Skin exposures to pesticides in agriculture are considered to be the primary route of worker contact. However, there remains a paucity of data about how to quantify and interpret sampling results. A preliminary range finding and method evaluation survey was recently performed in California in preparation for a larger study to determine exposure reduction intervention effectiveness. Methods: Hand wipes (using the NHEXAS isopropanol moistened J&J Sof-Wick gauze wipe method consisting of 2 consecutive wipes) were obtained during harvesting of a strawberry field that had been previously sprayed with malathion. Various approaches were used that would provide useful information for a larger study. Results: Mean whole hand pre-wash and post wash malathion loading (n=6) was 6696 ng and 2469 ng, representing a 63% reduction of surface hand concentration, while mean digit pre-wash and post-wash malathion loading (n=6) was 1312 ng and 893 ng, for a 32% reduction, respectively. Consecutive wiping of contaminated skin did not indicate highly efficient removal with each wipe. Average decline was 47% for 2nd digit wipe and 37% for 3rd digit wipe. Conclusions: The EPA hand wiping method did not apparently efficiently remove the amount of malathion loading present either before or after washing, although when loading was low (as when wearing gloves) removal appeared complete. Perhaps alternative sampling methods are more efficient, but this would need to be similarly evaluated. Efficiency of skin sampling methods and comparison to other methods continues to be a significant need in exposure assessment characterization.

### 352

**DEVELOPMENT AND EVALUATION OF A PESTICIDE RISK REDUCTION PROGRAM IN THAILAND.** O. Krissanakriangkrai, P. Bigelow, R. Buchan, Colorado State University, Fort Collins, CO; S. Pannarunothai, Naresuan University, Phitsanulok, Thailand.

Thailand, one of the largest users of pesticides in South East Asia, allows the use of over 300 pesticides including many that are banned or subjected to restrictions in other countries. The result is often the sale of unregistered products with poor labeling, making it difficult for farmers to choose the appropriate product and apply the products in a safe manner. Most farmers have limited knowledge and awareness about how to properly use pesticides. In Thailand, they routinely mix several types of pesti-

cides to apply at one time to eradicate and control diverse kinds of pests, however, this leads to pest resistance and major pest outbreaks. The goals of this program were to reduce the risk of pesticide use, promote sustainable agriculture, and strengthen the human resource development for health promotion in the community, by demonstration workshops to local public health volunteers and farmers. The study incorporated a Pretest, Posttest Control Group design. Questionnaires were used to obtain information in order to evaluate changes in knowledge, attitudes and behaviors related to the proper use of pesticides and Integrated Pest Management (IPM). A cholinesterase blood test was used to evaluate pesticide exposures. Ninety-nine farmers (majority growing rice) in Prompiram district, Phitsanulok Province, Thailand were enrolled in the study. After the training the use of respiratory protection increased and there was a significant reduction in post-test knowledge, attitudes, and cholinesterase levels ( $p < 0.05$ ). The results indicate that pesticide risk reduction programs can be effective; however, further research is needed in the area of agricultural economics as the costs of IPM and pesticide safety for individual farmers impeded implementation.

### 353

**THE USE OF CAB ENCLOSURES FOR EXPOSURE CONTROL DURING COMPOSTING.** J. Burkhart, C. Piacitelli, D. Yereb, G. Kullman, NIOSH, Morgantown, WV.

Industrial hygiene surveys were conducted at 3 composting operations through the National Institute for Occupational Safety and Health (NIOSH) Health Hazard Evaluation Program. These facilities composted green wastes, wood chips, and sewage sludge to produce Class A compost. Measurements were taken for respirable and total dust, endotoxins, culturable fungi, and culturable bacteria. Samples were collected inside and outside of the equipment cabs of scarabs, loaders, chippers, and trucks to assess worker exposures and the exposure reduction accomplished through routine cab enclosure. Concentrations of total dust collected outside the cabs had a mean of 5.5 mg/m<sup>3</sup> and a standard deviation (SD) of 8.2 mg/m<sup>3</sup>; concurrent total dust concentrations taken inside the cabs had a mean of 0.47 mg/m<sup>3</sup> and a SD of 0.25 mg/m<sup>3</sup>. Concentrations of culturable fungi measured outside the equipment cabs had a mean of  $1.5 \times 10^5$  CFU/m<sup>3</sup> and a SD of  $2.5 \times 10^5$  CFU/m<sup>3</sup>; concentration measurements inside the equipment cabs had a mean fungal concentration of  $4.1 \times 10^4$  CFU/m<sup>3</sup> with a SD of  $1.1 \times 10^5$  CFU/m<sup>3</sup>. These data show that routine cab enclosure reduces worker exposures to organic dusts during the operation of composting equipment. Additional exposure reductions are possible through more efficient use of cab enclosures.

### 354

**MIGRANT TOBACCO WORKERS IN KENTUCKY: A SAFETY AND HEALTH GUIDELINE.** T. Bernard, R. Keller, J. Morgan, N. Davis-Smith, Murray State University, Murray, KY.

America's largest producer of burley, dark fire-cured and air-cured leaf tobacco, is Kentucky, where tobacco is grown in 119 of the state's 120 counties. Production of dark tobacco increasingly relies on hired migrant labor at critical periods in crop development. Migrant workers are considered to be at higher risks of injury because: (1) their work is often concentrated in labor-intensive crops; and (2) lack of

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