

for) chemical protective gloves can be demonstrated. When a task is completed, the gloves are carefully removed. Wipe samples are taken from the hands of the employee. When there is a positive indicator response to the samples, either the gloves were ineffective at preventing skin contact with the diisocyanates (1910.138 Hand Protection), or the employee hand was contaminated prior to donning the glove. The inspector may then review the employer's workplace hazard assessment and equipment selection, with regards to skin contact with diisocyanates, detrimental work practices, and the type of gloves used. An interview with the person who certified and/or performed the hazard assessment, and any documentation will support the review (1910.132 (d) Personal Protective Equipment, General Requirements). OSHA has issued serious citations using this method.

**177.**  
**NOVEL USES OF SORBENT FILTERS TO ASSESS POTENTIAL SKIN EXPOSURES.** M. Boeniger, C. Lorberau, NIOSH, Cincinnati, OH; J. Snyder, R. Thacker, G. Antonious, University of Kentucky, Lexington, KY; E. Vo, S. Berardinelli, NIOSH, Morgantown, WV

Reported are some novel uses of reverse phase sorbent in the form of an extraction disk for various purposes related to quantifying skin exposures. NIOSH has evaluated these commercially available sorbents for field extracting foliar dislodgeable pesticide residues from leaf washes, as passive aerosol collectors for pesticides exposure studies, and as under-glove collectors for chemical permeation. In the first case, the lipophilic pesticides chlorpyrifos, malathion, and diazinon were successfully retained on and eluted from C18 (octadecyl bonded silica) extraction disks. While leaf material did not have a measurable effect on recovery of these pesticides, wash surfactant caused an overestimate of malathion quantification. Sample recoveries in fortified field samples were lower in liquid wash samples, for diazinon (-40% bias) than in the extraction disks. Use of these disks for quantifying field residues was demonstrated to be advantageous in reducing losses during shipping and reducing shipping volumes, and is a viable alternative to transporting frozen liquid samples. In a second laboratory study, liquid spiking of both cotton gauze and styrene-divinyl benzene resin (XAD-2) disks was performed with 7 pesticides. Although recoveries were similar after storage for up to 30 days, initial exposure to elevated temperatures and humidity resulted in significant losses (>70%) from gauze for some pesticides which was not seen with the disks. In the final study, the C18 disks were challenged against solvent breakthrough through polymer membranes used in making gloves. Appreciable amounts of methanol, acetone, trichloroethylene and toluene were detected in the disks at the instant of breakthrough detection using the

ASTM F 739 method, indicating high sensitivity. Thus, this sorbent might be used for in-use testing of gloves and possibly for detecting permeation of non-volatile chemicals. These three specific examples indicate the broad potential uses of these sorbent materials for characterizing skin exposures.

**178.**  
**CHARACTERIZING PESTICIDE RESIDUE TRANSFER EFFICIENCIES USING FLUORESCENT TRACER IMAGING TECHNIQUES.** E. Cohen Hubal, J. Suggs, N. Tulve, U.S. EPA, Research Triangle Park, NC; M. Nishioka, Battelle, Columbus, OH

To reduce the uncertainty associated with current estimates of children's exposure to pesticides by dermal contact and non-dietary ingestion, residue transfer data are required. Prior to conducting exhaustive studies, a screening study was conducted to identify important parameters for characterizing these transfers. In this study, parameters that affect residue transfer from surface-to-skin were evaluated using a fluorescent tracer as a surrogate for pesticide residues. A fluorescent tracer was applied as a residue at levels typical of residential pesticide applications to surfaces of interest. Controlled transfer experiments were conducted by varying contact parameters with each trial. The mass of tracer transferred was measured and the contact surface area estimated using video imaging techniques. In addition, laboratory evaluations were conducted to relate transfer of tracer to transfer of pesticides. To efficiently identify parameter changes resulting in significant effects, the Youden ruggedness test was used to select the combination of parameters varied in each contact trial. In this way, more than one parameter could be varied at a time and the number of trials minimized. Parameters evaluated included: surface type, surface loading, contact motion, pressure, duration, and skin condition. Both transfers onto and off of the hand were measured. For each set of conditions, contacts were conducted sequentially three to seven times. Results of this study show that surface loading and skin condition are among the important parameters for characterizing residue transfers ( $\alpha = .05$ ) and these parameters continue to be significant with repeated contact. Surface type is also significant, though less so under the conditions tested ( $\alpha = .1$ ). Duration of contact is not significant over the range of parameters tested in this study.

(Disclaimer: This work has been funded by the United States Environmental Protection Agency under contract no. 68-D-99-011 to Battelle. It has been subjected to Agency review and approved for publication.)

**179.**  
**USE OF THE MACROACTIVITY APPROACH TO ASSESS CHILDREN'S DERMAL EXPOSURE TO PESTICIDES IN RESIDENTIAL ENVIRONMENTS.** N. Tulve, E. Cohen Hubal, L. Sheldon, U.S. EPA, Research Triangle Park, NC; P. Hore, Environmental and Occupational Health Sciences Institute, Piscataway, NJ

In the macroactivity approach, dermal exposure is estimated using empirically-derived transfer coefficients (TC) to aggregate the mass transfer associated with a series of contacts with a contaminated medium. The macroactivity approach affords the possibility of developing screening level exposure assessments in a short-time frame with few resources. However, this approach was developed to assess occupational exposure in an agricultural setting where workers are engaged in similar activities and are exposed to relatively homogeneous environmental concentrations of pesticides. The macroactivity approach needs to be tested in a residential environment with children. The Children's Post-Application Pesticide Pilot Study is a collaborative effort between the EPA and the Environmental and Occupational Health Sciences Institute (EOHSI) in New Jersey. Nine families with children (<5 years old) were recruited for this study. Homes were monitored for 28 days following a pesticide application. Four-hour videotape segments, time-activity diaries, cotton dosimeters, and transferable residue loadings were collected during the study. Activities and locations for children were determined from videotape segments and diaries. Transferable residue loadings were measured using a surface sampler (i.e., Liroy-Weisel-Wainman quantitative surface sampler or alcohol wipes). Cotton socks or pajama pants were used to calculate potential exposure to pesticide residues through the feet, knees, legs, and bottom. Transferable residues and cotton dosimeter measurements were used to calculate TCs.

TC values for six children (one-active play, five-quiet play) were determined. TC values ranged from 4300-84000 cm<sup>2</sup>/hr (socks), 4000-28000 cm<sup>2</sup>/hr (legs), 41-3900 cm<sup>2</sup>/hr (knees), and 2100-7900 cm<sup>2</sup>/hr (bottom). TCs were found to depend on the activity level of the child, as well as the surfaces contacted.

This work has been funded in part by the USEPA under Contract No. 0D-5227-NAEX to EOHSI. It has been subjected to Agency review and approved for presentation and publication.

**180.**  
**DERMAL EXPOSURE TO POLYCYCLIC AROMATIC HYDROCARBONS AT THE FINNISH COKE OVEN.** L. Pyy, M. Mäkelä, E. Hakala, Finnish Institute of Occupational Health, Oulu, Finland

In last decade several studies have indicated that among coke oven workers, the skin is the main route of uptake of polycyclic aromatic

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## ABSTRACTS



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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<sup>3</sup>, 10.01 ±8.84 mg/m<sup>3</sup>; endotoxin 6046±6089 EU/m<sup>3</sup>, 5457±5934 EU/m<sup>3</sup> 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<sub>1</sub>, 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