213.

TERTIARY AMINE COMPOUNDS ASSOCIATED TO VISION DISTURBANCES AMONG WORKERS AT A PRINTING COMPANY. C. Cook, NIOSH, Cincinnati, OH

Background: In February 2001, NIOSH began a health hazard evaluation at a flexographic printing company to investigate work-related vision disturbances among workers to assess exposures to tertiary amine compounds, specifically dimethylisopropanolamine (DMIPA), dimethylaminoethanol (DMAE), and total amines. The plant's production area has two divisions, the line division (complaint area) and prime division (non-complaint area). Line workers reported vision disturbances at work that subsided a few hours after leaving the plant. Both divisions used inks that contained DMAE. Of the several ink additives used, one containing DMIPA was used almost exclusively in the line division.

Methods: An air sampling method was developed by NIOSH that involved collecting DMIPA and DMAE on XAD-7 resin sorbent tubes. Personal breathing-zone (PBZ) air sampling was performed that included 108 full-shift samples and 30 short-term (15 minute) PBZ samples. Samples were analyzed by gas chromatography equipped with a flame ionization detector. Eye exams were performed on workers before and after each work-shift.

Results: For DMIPA, the mean TWA concentrations were higher in the line division than the prime division (7.7 vs. 2.1 mg/m3, respectively). For DMAE, however, the mean TWA concentrations were lower in the line versus prime division (2.3 vs. 3.5mg/m3, respectively). The 15-minute samples for both divisions showed median TWA concentrations of 9.3 mg/m3 for DMIPA, 3.7 mg/m3 for DMAE, and 12 mg/m3 for total amines.

Conclusions: While the dominant amine exposure for workers was DMIPA, both DMAE and DMIPA were associated with blurry, halo, and blue-gray vision, corneal opacity, and decrements in visual acuity and contrast sensitivity. Although these conditions are reversible, they pose a safety hazard at work and when driving home.

214.

ASSESSMENT OF CREOSOTE EXPOSURE AMONG WOOD PRESERVATION WORKERS: A PILOT STUDY. G. Sirianni, R. Wheeler, B. Gunter, Jonathan Borak & Company, Inc., New Haven, CT; H. Cohen, University of New Haven, West Haven, CT; J. Borak, S. Chemerynski, Yale University, New Haven, CT; F. Jongeneelen, IndusTox Consult, Nijmegen, Netherlands

Traditional methods of exposure assessment for creosote-exposed wood preservation workers (WPW) have been based on gravimetric measurement of the benzene-soluble fraction (BSF) of breathing zone particulates. This approach assumes that inhalation is the dominant route of exposure and that BSF meaningfully reflects exposure dose of the relevant toxicants, notably polycyclic aromatic hydrocarbons (PAHs). The purpose of this pilot study was to compare and correlate measures of inhalation exposure (BSF and specific PAHs) and biomarker-related measures of systemically absorbed creosote components. Subjects included 34 WPW at one creosote facility. Full-shift inhalation exposure was assessed by OSHA Method #58 (particulate collection on Teflon filters, extraction with benzene and weighing, followed by HPLC analysis for 16 PAHs). Gaseous PAHs were collected by ORBO 43 adsorbent tubes placed behind the Teflon filters and analyzed by HPLC for 16 PAHs. Urinary 1-hydroxypyrene (1-OHP), a biomarker of pyrene exposure, was measured by the method of Jongeneelen. Each worker provided post-shift and next day urine samples. Of 34 air samples, 14 (41.2%) were below limits of quantitation (LOQ) for BSF, while 3 (8.9%) were >0.100 mg/m3. The majority of PAH results from the Teflon filters were below LOQ for all 16 PAHs. At least some individual PAHs were detected in ORBO tube samples, but at generally low levels. Of 66 urine samples, 21 (32%) were < 1 µg/g creatinine, 27 (41%) were between 1-2.5 µg/g creatinine and 18 (27%) were > 2.5 µg/g creatinine; 7 were > 10 µg/g creatinine. There was no association between BSF and 1-OHP (r2 = 0.051). A weak association was seen between 1-OHP and ORBO tube pyrene levels (r2 = 0.035). Toxicokinetic modeling showed that body dose could be attributed to dermal, not inhalation uptake. These findings indicate that traditional methods of exposure assessment do not accurately characterize creosote exposure in WPW.

215.

COMPARISON OF STYRENE EXPOSURE IN TWO OPEN MOLD FIBERGLASS REINFORCED PLASTIC (FRP) MANUFACTURING SITES. C. Lungu, P. Russell, University of Minnesota, Minneapolis, MN

Two open-mold FRP manufacturing sites were evaluated to assess personal exposure to styrene based on a number of sampling techniques. First, direct reading instrument measurements were conducted in conjunction with work practice observations to map out styrene concentration distribution in each site. During subsequent visits personal and area sampling was conducted. Workers directly involved in the application of resin or handling off-gassing products wore diffusive sampling badges and charcoal sampling tubes attached to personal sampling pumps. Badges were also used as area samplers to measure styrene concentration and four other VOCs (acetone, toluene, MEK, and total xylenes) to assess potential interference. Samples were analyzed by gas chromatograph equipped with FID. Ventilation was also measured at various locations, around work-stations, and ventilation profiles were obtained from measurements and existing data at both sites.

The results show that work practices affect the most workers' exposure levels. At Site 1 which utilized booths for the entire process exposure levels were overall lower than at Site 2 where booths were used for spray applications only. For example, the exposure levels in the drying area at Site 1 were close to the detection limit for a 15 minutes sampling time but were in the range of 30 to 112 ppm at Site 2. However, workers that operated spray guns or hand rolled resin had the greatest exposure regardless of work practices or even spray gun technology.

Based on data obtained in this study a simplified compartmental model was developed to predict exposure levels at various distances from individual sources, each work station in which styrene was used being considered an individual source. Further development and validation of the model could be used for predicting fugitive emissions from personal exposure data and better establish the role of emission rate associated with various tasks.

216.

PERFORMANCE OF EXPOSURE MODELS IN EXPERIMENTAL ROM FOR VARIOUS THERMAL CONDITIONS, AIRFLOW AND WORKER LOCATIONS. E. Lee, C. Feigley, J. Khan, University of South Carolina, Columbia, SC

Most simple mathematical models now in use for estimating exposure do not account for variation in airflow patterns and thermal conditions. Here measured breathing zone concentrations were compared with model estimates for various physical factors to explore model applicability.

Contaminant distribution in the breathing zone (elevation=1.5m) in a 2.86(L)x2.35m(H)x 2.86m(W) room with a contaminant source (99.5% propylene) on a 1-m high pedestal was monitored using photoionization detector for steady conditions.

Factorial combinations of two Reynolds number (Re=2870 and 2070), two Archimedes number (Ar=14700 and 30000) and three worker locations (absent, north of source, east of source) were studied. A mannequin located at 0.5m from the source was used to represent a worker. Concentration estimated from the completely-mixed models for one-zone (CM-1) and two-zones (CM-2), and the uniform turbulent diffusivity model (UD) were compared with experimental results. Model performance was evaluated in the "near-field" and "far-field" of the source.

In the near field for the CM-1, CM-2, and UD models, the mean errors (± SD) were -44(±17)%, 28(±39)% and 74(±106)%. The far-field mean errors for the CM-1 and CM-2 were both -17(±14.9)% because these models are mathematically identical for the far field. The far-field mean error for the UD model was -20(±21)%. Although the mean error in the near field for CM-2 was lower than that for CM-1, the CM-2 estimates showed more variability than the CM-1 estimates.

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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 facil-

ities. 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/m³, 10.01 ±8.84 mg/m³; endotoxin 6046±6089 EU/m³, 5457±5934 EU/m³ 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