

this preliminary study was to define the limits of reuse of chemical protective gloves based on the breakthrough time (BTT). Different glove materials, including neoprene and nitrile synthetic rubber, were selected for this study. The permeation for these materials was measured in a closed loop system using a 2.5 cm permeation cell and a MIRAN infrared analyzer. Neat 99% toluene was used as the challenge chemical. BTT and steady-state permeation rates (SSPR) were determined for triplicate samples of each material. Following the exposure, the samples were thermally decontaminated for 16 hours at 100° C. BTT and SSPR were measured for the second time and the decontamination procedure was repeated. For neoprene challenged with toluene, the BTT increased slightly during the first three exposure/decontamination cycles with BTT of 116, 115, and 109 % compared to that of the new material, respectively, while SSPRs consistently decreased with SSPR of 82, 71, and 70 % compared to that of the new material. On the other hand, the nitrile material challenged with the toluene yielded BTT that is slightly decreased as the result of increasing the number of toluene exposure/decontamination cycles. The BTT of the new material was 24.3 min and decreased by 16% to 20.3 min after four exposure/decontamination cycles. SSPR were virtually unchanged after three exposure/decontamination cycles. Neoprene gloves have a red inner liner. Thermal decontamination affected the color of the inner surface of the neoprene glove material, causing it to become darker. However, no obvious change in nitrile could be detected. These results indicate that multiple reuses of some chemical protective gloves could be safe if effective decontamination methods are used.

136. PERMEATION OF CAPTAN FORMULATION THROUGH NITRILE PROTECTIVE GLOVE MATERIAL. R. Phalen, S. S. Que Hee, University of California at Los Angeles, Los Angeles, CA

Wettable powders of the fungicide captan (CASRN #133-06-2) are applied in agriculture by spraying over fields, applying onto the soil, or by dipping roots to be planted into a concentrated solution. Potential for dermal contact exists with such applications, the manufacture of captan, and its formulating. However, there are no permeation data available. The aim of this study was to assess the permeation of a wettable-powder formulation (48.9% captan and 1.1% related derivatives) as it would be sprayed in agriculture. A popular disposable nitrile glove material, Safeskin Blue Nitrile of 0.116 ± 0.004 mm thickness, was evaluated. Testing involved using the I-PTC 600 permeation cell in accordance with the American Society for Testing Materials (ASTM) F739-96 method, "Standard Test Method for Resistance of Protective Clothing Materials to Permeation by Liquids or Gases Under Conditions of Continuous Contact". A worst-case aqueous

concentration of 217 mg/mL of the 50% wettable powder was tested to maximize permeation. The collection medium was hexane. Samples were collected at 2, 4, and 8-hour intervals. Analysis was conducted using non-polar capillary column gas chromatography (GC) with electron capture detection (ECD) and mass spectrometry (MS). The GC/ECD least quantifiable limit was about 6 ng whereas that for GC/MS was approximately 30 ng at m/z 79. The collection medium had to be concentrated before an aliquot was injected. The calculated permeation rate by GC/ECD was about 600 pg/cm²/min after 8 hours, a very low rate.

137. GLOVE PERMEATION AND DETERMINATION OF BENOMYL IN BENLATE 50% WP PESTICIDE FORMULATION BY GC-MS AND GC-EC. H. Zainal, S. Que Hee, University of California at Los Angeles, Los Angeles, CA

Benomyl is the active ingredient of the pesticide, Benlate 50% WP. Long-term human skin exposure to Benlate 50% WP causes skin irritation. Benomyl is a suspected carcinogen. The aim of this study was to investigate the protectiveness of gloves used by farm workers, pesticide sprayers, and formulators. A sensitive analytical technique was first developed to determine benomyl. A mass of 10 mg of benomyl was dissolved in 10 mL methanol. One mL of this solution was evaporated to dryness under a stream of nitrogen. A volume of 0.5 mL of acetonitrile was added, followed by 20 µL of diisopropyl ethyl amine and 20 µL of pentafluorobenzyl bromide. After vortexing and heating at 60°C for 16 hours, evaporation under nitrogen, 0.1 mL water was added. Extraction with isooctane (5x0.5 mL) followed by reducing the volume of the combined extracts to 0.5 mL. On gas chromatographic-mass spectrometric analysis, m/z values of 551, 492, 292, and 181 were observed at a retention time of 41 minutes. This confirmed the formation of di-pentafluorobenzyl carbendazim. Treatment with acetonitrile at 60°C caused the degradation of benomyl to carbendazim that was then derivatized. The base peak at m/z = 492 was used for selected ion quantitation. This resulted in an LQL of 6 ng and a linear range of 10-200 ng. In contrast gas chromatography-electron capture at the same chromatographic conditions resulted in an LQL of 2 pg and a linear range of 4-60 pg. Thus chromatography-electron capture was used as the method of choice. The permeation of benomyl through "SAFESKIN" nitrile glove material using ASTM type I-PTC 600 permeation cell that employed isopropanol as collection fluid and a challenge solution of 1.2 mg/mL suspension of benlate 50% WP in water was <100 pg/cm²/min.

138. EFFECTIVENESS OF FIVE COVERALLS AGAINST LIQUID JP-8 PENETRATION. R. Walton, U.S. Air Force, San Antonio, TX; D. Carpenter, KARTA, San Antonio, TX

The purpose of the research effort was to identify if any commercially available coveralls provided greater dermal protection against liquid JP-8 than the cotton coveralls currently worn by the USAF aircraft fuel cell workers.

We evaluated five different types of coveralls including the cotton, which served as the baseline. The evaluation criterion was based on three separate parameters: (1) Resistance to liquid JP-8 penetration, (2) Heat stress (3) Ergonomic/Comfort.

The coveralls ability to resist liquid JP-8 was evaluated both quantitatively and qualitatively. We obtained the quantitative data using a new dermal patch (activated charcoal cloth), which were placed inside and outside the coverall in the high contact areas. The qualitative data was based on a study participant questionnaire.

The heat stress associated with each coverall was also evaluated quantitatively and qualitatively. We obtained the quantitative data through environmental chamber testing and again the qualitative data through the questionnaire.

The ergonomic/comfort of each coverall was only evaluated through qualitative data. Again it was based on the study participant questionnaire.

The final evaluation criterion clearly indicated one coverall provided statistically significant increased dermal protection.

139. SELECTION OF PROTECTIVE GLOVES. N. El-Ayouby, NIOSH, Pittsburgh, PA

Skin disorders resulting from hazardous exposures in the workplace account for 15% to 20% of all reported occupational diseases. Irritant and allergic contact dermatitis and burn injuries caused by chemicals account for about 50% of the skin disorder. A variety of protective gloves are available in the marketplace. However, the user must know the criteria for selecting the proper glove for protection against chemical, physical or biological hazards. The glove material must also not cause side effects to the workers, such as latex allergy.

To develop recommendations for selecting appropriate protective gloves, the author performed a critical review and synthesis of the scientific literature, national standards, pertinent federal regulations, and available manufacturer and other data regarding the performance of gloves against physical, chemical, and biological hazards. Using several industry examples, the author presents a systematic process for appropriate glove selection, reviews the regulations and standards pertaining to gloves, and provides information for establishing a training program for glove usage and maintenance.

AIHce 2002, June 1-6, San Diego, California

This information is available in a document that will assist the user in the proper glove selection.

PF 120. Contaminant Control *Papers 140-147*

140. EFFECTIVE PRACTICES IN CONTROLLING LONG-TERM EXPOSURE TO WAFER FAB TECHNICIANS AT A SEMICONDUCTOR MANUFACTURING FACILITY. S. Chunduri, AMD, Austin, TX

To minimize exposures to chemicals, the semiconductor industry has consistently invested in extensive engineering controls achieving a great degree of success. Very few studies have been published documenting the long-term success of the engineering controls in semiconductor industry. Data for one typical manufacturing operation at one semiconductor manufacturing site are presented here. Different wet bench (also known as sinks) designs, engineering controls, work practices, procedures for maintenance of engineering controls are presented. Ammonium hydroxide is a common reagent that is used extensively in the semiconductor industry for wafer cleans at wet benches. Potential for airborne exposures to ammonia were evaluated for wafer fab technicians to measure the performance of controls at a semiconductor plant in diffusion module operations. Full shift personal exposure sampling data from 1991 to 2000 were analyzed to assess exposures to wafer fab technicians for a typical semiconductor manufacturing facility. Of 133 samples analyzed, 19 had detectable levels of airborne ammonia. Of these 19 positive samples, 18 were very low with a mean time-weighted average concentration of 1.13 ppm.

141. OPEN SYSTEM CHEMICAL OPERATIONS. F. Renshaw, Rohm and Haas, Bristol, PA

Chemical processing operations which are conducted in open systems may pose health as well as safety hazards to operating personnel. The extent and risk of such operations were the subject of a study conducted across the performance polymers manufacturing operations of one chemical company.

A survey was conducted in 50 plants to establish where open system operations exist, the nature of materials in use and precautionary measures in place to safeguard personnel engaged in these operations. Survey results were used to rank and prioritize all open systems. A combined industrial hygiene and fire protection control strategy was adopted and a plan implemented to address these open systems. The highest priority systems were those which involved a hazard of fire or explosion from feeding solids into flammable atmospheres. Workplace exposure hazards from inhalation, skin contact or eye contact with a group of 20 listed toxic materials also emerged

as high priority systems to be addressed. Classical industrial hygiene control measures and fire protection principles proved to be very adaptable and complementary in addressing the operations of concern. The prevalence of open systems was found to be related to the fundamental processes associated with the various businesses. Prioritization of operations proved to be very beneficial in gaining the understanding and support of management in addressing open systems. The benefit of addressing industrial hygiene and safety hazards together was compelling.

142. ULTRA PURE SODIUM DODECYL SULFATE EXPOSURE ASSESMENT INVOLVING MULTIPLE DEPARTMENTS AND VENDORS IN CHEMICAL AND PHARMACEUTICAL PRODUCTION. C. Baker, Chiron Corporation, Emeryville, CA

Ultra Pure Sodium Dodecyl Sulfate (UPSDS) is a key ingredient in chemical and pharmaceutical production. UPSDS is a fine powder manufactured to custom specifications with minimum moisture content and no additives. An UPSDS exposure assessment was prompted after employees working in a bulk powder UPSDS handling operation reported exposure symptoms including coughing, sneezing and rash. Reporting symptoms led to medical monitoring for one bulk powder handling employee sensitized to UPSDS. UPSDS is a known irritant and sensitizing agent. Most literature on UPSDS is limited and attributes sensitization to contaminants within the material not the material itself. This lack of information contributed to the poor UPSDS handling practices within the facility. The sensitization of an employee to UPSDS prompted departments to re-evaluate the use of the material utilizing an exposure assessment format. An UPSDS exposure assessment defined: 1) areas where UPSDS was used at the facility, 2) data and incident reports documenting lack of control of the material, 3) control recommendations for the material in 3 specific areas of the facility, 4) occupational health specific training on the health hazards of UPSDS. This exposure assessment resulted in ordering vendor material in specific containers, installation of mechanical ventilation in all areas where UPSDS is used, and repackaging of in-house stock into smaller containers for daily use in a chemical fume hood or HEPA filtration unit. The implementation of these exposure controls was only possible through the coordination and cooperation of multiple departments within the company and UPSDS vendors and distributors. The process of completing a multi-departmental exposure assessment demonstrated the complexities involved in changing handling and shipping practices of a key ingredient in a chemical or pharmaceutical product and the need for excellent communication between departments to accomplish these changes.

143. THE USE OF ASBESTOS SETTLED DUST SAMPLING FOR DETERMINING IF NEGATIVE-PRESSURE AIR FILTRATION MACHINES HAVE BEEN CONTAMINATED. P. Prendergast, State of WV General Services Division, Charleston, WV

A government building, as part of a renovation involving the replacement of the metal roof deck, required the removal of 1,000 square feet of asbestos containing fireproofing and 500 square feet of asbestos containing acoustical plaster. The building is a three-story structure that connects two multi-story structures. The filtered air from the negative pressure containment was vented to a stairwell because it was impractical to vent the air to the outside of the building.

Daily air samples were collected around the outside perimeter of the containment and analyzed by transmission electron microscopy. Once the removal process had begun, elevated perimeter air sample results indicated there was a problem with the integrity of the containment. Work was immediately suspended and the containment was thoroughly inspected. Initial inspections did not reveal a breach in the containment. Attention was then turned to the two negative air machines that were cleaning the air in the containment. Inspection of these machines found that one of the small brackets that held the primary HEPA filter in place was damaged.

In order to confirm that the integrity of the filtration system had been compromised, surface dust samples were collected in accordance with ASTM method D5755 on the interior surfaces of the compartment behind the filtration system where the fan cage is located. These samples indicated that the interior surfaces of the machines were contaminated with asbestos fibers. The average surface concentration was 3.7 million structures per square centimeter. Asbestos fibers were being dispersed into the ambient air by the machines. The air filtration machines were replaced and the removal operation continued.

The ASTM asbestos settled dust method can be used as a tool to ensure air filtration machines used for asbestos removal have not been contaminated, before, during or after asbestos removal projects.

144. VALIDATION OF DUST CONTROL EFFICIENCY USING LACTOSE AS A SURROGATE AT A PHARMACEUTICAL COMPANY IN INDIA. T. Mehta, M. Mehta, ISS, Baroda, India; K. Tait, Pfizer Inc., New York, NY

The efficiency of dust control equipment is often known from the exposure assessment data of pharmaceutical active compounds, after the equipment is installed. By the time, the exposure assessment data are obtained, the exposure may have already occurred. Equipment modifications to increase dust control efficiency after installation are difficult.

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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/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 FEV₁, 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