powdered latex glove use was being phased out, there were concerns over potential reservoirs and airborne exposures of latex allergen. We evaluated latex allergen concentrations in air and in settled dusts collected from floors, chairs, and ventilation systems.

Air sampling and ventilation dust microvacuum sampling were conducted using 2-micrometer pore size, 37-millimeter (mm) polytetrafluoroethylene (PTFE) filters in open-faced cassettes. Air sampling time was during the hours of 7 a.m. to 7 p.m. for four days. Floor and chair dusts were collected onto 142-mm diameter glass fiber filters with a commercial vacuum. The filters and dusts were analyzed for latex allergen using a competitive inhibition immunoassay.

Latex concentrations in air were below the limit of detection for the method (LOD = 0.16 ng latex allergen/m^3). Hospital B had significantly higher concentrations of latex allergen in ventilation system dust than Hospital A. Latex concentrations in ventilation system dust ranged from <LOD to 376 ng/mg of dust. Sixty-two percent of the ventilation dust samples were below the limit of detection (21/34). Latex concentrations in the floor and chair dust ranged from 0.05 to 108 ng/m^2 in the floor and 0.35 to 274 ng/chair in the chair samples. The overall geometric means across all floor and chair sampling sites were 1.26 ng/m^2 and 24.1 ng/chair, respectively.

Although the air samples were negative, there were reservoirs of latex allergens in the hospitals. To protect sensitized individuals, it would be prudent to properly clean these areas to lower the potential for re-aerosolization and occupant exposures.

103.

CARBON MONOXIDE EMISSIONS AND EXPOSURES ON RECREATIONAL BOATS UNDER VARIOUS OPERATING CONDITIONS. G. Earnest, A. Echt, J. McCammon, K. Dunn, R. McCleery, D. Hammond, L. Blade, NIOSH, Cincinnati, OH.

National Institute for Occupational Safety and Health (NIOSH) researchers evaluated carbon monoxide (CO) exposures on over twenty recreational boats in the U.S. Most of the evaluated boats were speed boats or cabin cruisers ranging in age from new to 25 years old. These boats had gasoline-powered, propulsion engines and the evaluated cabin cruisers used gasoline-powered generators to provide electricity. NIOSH researchers are aware of 106 nationwide CO poisonings associated with recreational boats (non-houseboats) over approximately the past decade. This study was performed for the U.S. Coast Guard to better understand how CO poisonings occur on recreational boats and identify the most hazardous conditions. Boats were evaluated while stationary and at three to five speeds ranging from 2.5 to 25 miles per hour. Carbon monoxide concentrations were measured using multiple real-time instruments at different locations on the boats and at various distances behind the boat while moving. Study results indicated that stationary conditions were generally the most hazardous; however, many boats had fairly high CO concentrations near the rear deck while moving. Most of the evaluated boats generated hazardous CO concentrations (with peak CO concentrations commonly exceeding 1000 ppm and average CO concentrations well over 100 ppm on the boats' rear decks). Two boats, one using a 150-hp Evinrude Ficht engine and the other using a 40-hp Johnson engine, had dramatically lower CO concentrations than any of the other evaluated boats having peak and average CO concentrations an order of magnitude lower than most other boats. These two new engines utilized recently developed technologies to burn cleaner and comply with recent EPA regulations. Elimination of uncontrolled gasoline-powered marine engines and more wide-spread use of cleaner burning drive engines and generators would help to reduce but not eliminate the CO poisonings seen on recreational boats.

104.

CHARACTERISATION OF AMBIENT ETHYLENE-OXIDE AND HYDROGEN CHLORIDE EXPOSURE. C. Barnard, C. Weyers, Technikon Free State, Bloemfontein, South Africa.

Data available on low-level chronic exposure to gases present in the ambient air of welding workshops are limited. This is especially true with regard to South African welding conditions. A study was conducted to determine the ambient gas exposure (ethylene-oxide (C_2H_4O) and hydrogen chloride (HCl)) of welders in a large engineering plant in Bloemfontein, South Africa. The aim of the study was the characterisation of gas exposure during summer and winter months, for the determination of possible health risks after chronic low-level exposure.

Gases were sampled by means of a direct reading instrument namely, the Process Monitoring System (PMS-64). The system was placed at a stationary sample base in the centre of the workshop. Data were collected during one week of each month, extending from February (summer) to July (winter). The data were retrieved from the system, processed, and calculated into eight-hour TWA concentrations.

The concentrations found in the welding shop were compared to the environmental Threshold Limit Values® (TLVs®) or occupational TLVs® recommended by global authoritative organisations. In the absence of such specific TLVs®, an environmental TLV®, calculated as one fortieth of the occupational TLV, was used. High C_2H_4O concentrations were found in the welding shop as a result of the oxy-ethylene welding process. Previous research concluded that C_2H_4O, at levels found in this study, could possibly be a powerful mutagen, neurotoxin, and potential carcinogen. Consistent low-level concentrations of HCl were detected, which caused welders to be chronically exposed. This could cause chronic irritation of the upper respiratory tract and eyes.

It is concluded that the welders exposed to the ambient air in the workshop could experience some health problems after chronic exposure. The results emphasise the importance of exposure characterisation studies in order to identify pollutants and to implement engineering control of emission sources.

105.

CADMIUM EXPOSURE DURING REFURBISHING OF GAS METER FERRULES AND THE SUBSEQUENT ACTIONS TO ELIMINATE OVER-EXPOSURE AND REDUCE SURFACE CADMIUM. S. Vogl, P. Hand, L. Schumann, Clayton Group Services Inc., Edison, NJ; J. Raspa, New Jersey Natural Gas, Wall, NJ.

In December 2001, OSHA released the Hazard Information Bulletin (HIB)—*Potential Hazards Associated with the Refurbishing of Gas Meters* outlining potential elevated cadmium exposures during wire brushing of gas meter ferrules. In response to the HIB, NJ Natural Gas (NJNG) performed personal and area air sampling for cadmium during wire brushing. Results indicate employee exposures ranged from 1.5 to 36 µg/m^3. Area concentrations ranged from 0.5 to 1.3 µg/m^3. The OSHA PEL for cadmium is 5 µg/m^3. Surface sampling of floors, horizontal surfaces, elevated surfaces, ventilation systems, and office spaces showed surface concentrations were <10 to 23,000 µg/ft^2. Bulk dust samples showed cadmium content ranging from 1400 to 4000 ppm.

Procedures to eliminate over-exposures and reduce surface cadmium were necessary. These response actions were needed promptly and had to be addressed while minimizing the impact to site activities and services.

A site-wide cleanup was undertaken. Cleanup techniques included the use of "negative pressure enclosures," HEPA filter equipped vacuuming, and wet-wiping. Cleanup occurred while the site remained mostly active. Airborne cadmium concentrations during and after cleanup ranged from <0.221 to <0.353 µg/m^3. Surface concentrations following cleanup ranged from 0.325 to 293 µg/ft^2.

Wire brushing operations have stopped. Employees were notified of sampling results and the hazards of cadmium via a company-wide meeting. Employees were also provided with biological monitoring. Biological monitoring yielded normal results. NJNG worked with meter vendors to prevent future purchases of meters with cadmium-containing ferrules. Non-brushing techniques, including whole ferrule replacement and whole meter-top replacement, are now used in place of wire brushing.

Task procedure changes and ultimate cadmium elimination will reduce employee exposure. Cleanup was successfully conducted while minimizing the impact to the site's ability to provide utility support services.

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