

were reduced by 96%, from 136 +/- 51 ppm to 6 +/- 4 ppm, and from 125 +/- 47 ppm to 5 +/- 3 ppm, respectively. Potential failures of the emission controls were also identified and included air filter blockage, spark plug malfunction, and faulty alarm function design. While the addition of emission controls significantly reduces the CO exposure risk, the burnishers are still capable of producing excessive CO emissions under certain conditions, and CO may accumulate to unsafe levels when burnishers are used in areas with inadequate ventilation. Recommendations for safe use are provided. Electric burnishers are advised if guidance is not strictly followed or later proves inadequate.

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Paper Withdrawn by Author

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FREQUENTLY ASKED QUESTIONS ABOUT OSHA'S HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200). T. Towers, OSHA, Washington, DC

More than 10 years after the implementation of the Hazard Communication Standard by OSHA, there exists a lack of understanding as to the responsibilities of the various members of the regulated community in complying with the provisions of the standard. This is evidenced by the number and substance of inquiries received by OSHA on the subject. This paper examines the distribution of inquiries by provision and attempts to provide guidance to those who need to know more about hazard communication or "right to know." The information was obtained by telephone message records maintained by the author and from others in the agency who routinely respond to inquiries. The records were collected over a 4-year period.

Typical questions which are frequently asked involved obtaining, preparing, and maintaining material safety data sheets; acceptability of various electronic storage methods; content of labels; roles of manufacturers and distributors; and the use of one format in preference to another for material safety data sheets and labels. Responses are provided for several of the more frequently asked questions, along with information on obtaining assistance from various sources. Recent developments, such as the recommendations of the National Advisory Committee on Occupational Safety and Health (NACOSH), which address several of the frequently asked questions, are presented.

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RECOMMENDED OCCUPATIONAL EXPOSURE LEVELS FOR LACTATE ESTERS. J. Clary, Bio Risk, Midland, MI; V. Feron, TNO-Toxicology, Zeist, The Netherlands; J. van Velthuisen, PURAC biochem bv, Gorinchem, The Netherlands

Lactate esters, finding new uses as nonozone-depleting and biodegradable solvents, have a low order of acute oral and inhalation toxicity, but are potential eye and skin irritants. Ethyl lactate in rats did not produce any developmental effects or other signs of toxic-

ity other than skin irritation (dams) in a dermal development study. In an aerosol study of 2-ethylhexyl lactate no signs of maternal toxicity or teratogenic effects were noted. Delayed ossification observed in the treated fetuses was likely due to stress induced by the combination of exposure conditions and the irritant nature of 2-ethylhexyl lactate.

Subacute inhalation studies (ethyl, isobutyl, and 2 ethylhexyl lactate) produced degenerative changes in the nasal cavity in all studies. The NOAEL in the vapor studies (ethyl, isobutyl) was 200 mg/m³. Lactates do not appear to cause systemic toxicity, except at very high concentrations (2500 mg/m³ for ethyl lactate and 1800 mg/m³ for 2-ethylhexyl lactate). This would suggest that sensory irritation and local toxicity data may be used to establish suitable workplace vapor exposure levels. Respiratory irritation tests (RD50) were conducted on ethyl and butyl lactate.

A workplace vapor level below 75 mg/m³ should prevent sensory irritation. The NOAEL for local toxicity in the vapor inhalation studies also supports a workplace level of 75 mg/m³ (safety factor of 3). However, aerosol exposure to 2-ethylhexyl lactates produced minimal changes in the nasal cavity at 75 mg/m³, and therefore aerosol exposure should be minimized. The low vapor pressure and low odor threshold of lactate esters make it very unlikely that humans would be exposed to irritating vapor or aerosol levels.

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POLYMER FUME FEVER AT AN INDUSTRIAL VALVE MANUFACTURER. A. Echt, F. Bresler, R. Hughes, C. Hayden, NIOSH, Cincinnati, OH

National Institute for Occupational Safety and Health (NIOSH) investigators performed an evaluation at a plant where fluorocarbon polymer-lined valves were produced following a management request concerning polymer fume fever. Polymer fume fever has been described as shaking chills, muscle pain, shortness of breath, chest tightness, and a feeling of ill health, with or without fever, which occurs near the end or soon after a work shift; symptoms completely resolve within 24 hours. The principle concerns in occupational exposure to the decomposition products of fluorocarbon polymers is their potential for causing polymer fume fever and respiratory tract injury. Exposure to the decomposition products of fluorocarbon polymer results from inhalation of fluorocarbon polymer, or from inhalation of a single or several decomposition products.

Confidential health interviews were conducted with 11 employees in the lined-valve production area. The interviews assessed individual practices regarding smoking and eating at work and evaluated the occurrence of polymer fume fever over the 2 years preceding the survey. The 2-year cutoff was chosen because of process and ventilation changes 2 years before the evaluation. Ten of 11 employees interviewed reported symptoms associated with polymer fume fever. Five of these 10 symptomatic employees had polymer fume fever episodes during the 2 years preceding the survey, 4 of whom reported episodes the

past year.

Nine personal breathing zone (PBZ) and five general area (GA) air samples were collected for fluorides using NIOSH Method 7902. Five of nine PBZ samples had detectable hydrogen fluoride, with 8-hour TWA concentrations of 0.005 ppm to 0.010 ppm. Eight-hour TWA concentrations of HF in the GA samples ranged from 0.004 ppm to 0.008 ppm.

The investigators determined that a health hazard existed from exposure to fluorocarbon polymer decomposition products and recommended ventilation changes, including enclosing extrusion presses; and practice changes such as prohibiting smoking in the work area.

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A CHARACTERIZATION OF PAINT EXPOSURES DURING TREE-MARKING OPERATIONS. B. Reh, NIOSH, Cincinnati, OH

The National Institute for Occupational Safety and Health (NIOSH) and the United States Forest Service (USFS) is currently conducting an epidemiologic study to assess the potential that exposures to tree-marking paint might be causing reproductive problems. Since exposures during tree-marking operations have never been quantified, an industrial hygiene survey was conducted at two USFS regions to characterize current exposures to these paints. Seven bulk paint samples were analyzed for volatile organic compounds (VOCs) and elements, and the results were used to select specific compounds for personal exposure assessment based on whether the compounds have had any documented association with reproductive health effects and whether a method for assessment existed. The personal exposure assessment consisted of collecting full-shift personal breathing zone (PBZ) air samples during tree-marking operations and spot urine samples at the end of the shift from 10 workers (5 per region). PBZ samples were analyzed for toluene, xylene, ethyl benzene, propylene glycol monomethyl ether acetate, n-butyl acetate, methyl isobutyl ketone (MIBK), a total hydrocarbon measurement (based on Stoddard solvent), elements, and total particulate. Urine samples were analyzed for hippuric acid (toluene metabolite), o-cresol (also a toluene metabolite), total methylhippuric acids (xylene metabolites), mandelic acid (ethyl benzene metabolite), methyl ethyl ketone (MEK), and MIBK. The results suggest that paint exposures as a result of marking trees are quite low. Except for low concentrations of Stoddard solvent (1.02 to 6.3 mg/m³) and xylene (0.07 to 0.12 ppm), inhalation exposures to VOCs were not quantifiable. This is not surprising, since the work is outside. The results are similarly low or not detected for inhalation exposures to elements. The urine sampling results suggest that internal doses received from paint exposure also range from not detected to quite low. In both locations, the hippuric acid concentrations were all well below the 1.5 grams per gram of creatinine (g/g Cr) which is normally found in urine. o-Cresol was not detected in workers from one region, but was detected in workers from the other at concentrations just above the analytical limit of detection and the refer-

ence range of <0.1 milligrams per liter (mg/L), which suggests that the internal dose to toluene was low. Also, two workers from one region and three from the other had detectable MEK concentrations in their urine that were all an order of magnitude below the American Conference of Governmental Industrial Hygienists Biological Exposure Index (ACGIH BEI™) of 2 mg/L, but above the reference range of <0.1 mg/L for unexposed populations. Overall, the PBZ and urine samples suggest a very low level of VOC and element exposure from tree-marking operations. These sampling results indicated that the only individual compounds that a tree-marker might have been exposed to in detectable concentrations during these surveys and that have a slight but potential, association to reproductive health effects were MEK, toluene, and manganese. All the measured exposures were well below any current occupational exposure limits, but the relevant occupational exposure limits are not based on reproductive effects. Reproductive systems are quite sensitive, and even very low paint exposure could not be completely dismissed as a possible contributor to reproductive health effects, if any association is documented by the epidemiologic study.

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POLYCHLORINATED DIBENZO-P-DIOXIN AND FURAN SURFACE CONTAMINATION AND CHLOROFORM EMISSIONS AT A PAPER MANUFACTURER. K. Hanley, R. Mouradian, M. Kiefer, NIOSH, Cincinnati, OH

The National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation to assess employee exposures to polychlorinated dibenzo-p-dioxin and furan (PCDD/F) congeners, and chlorinated volatile organic compounds (CVOCs) formed as by-products during wood pulp bleaching. The survey included environmental monitoring for PCDD/F surface contamination and air monitoring for CVOCs.

Surface wipe samples were collected and analyzed for the 2,3,7,8-tetra PCDD/F isomers as well as total tetra-chlorinated through octachlorinated PCDD/F isomers. The PCDD/F concentrations are reported as 2,3,7,8-TCDD toxicity equivalents (I-TEQ) using the 1989 International Toxicity Equivalency Factors. The I-TEQ levels from the wipe samples ranged from 13 to 651 picograms per square meter (pg/m²) in the bleach plant and from 86 to 1049 pg/m² in the paper mill. The highest PCDD/F contamination was obtained near the dry end of a paper machine and on a hardwood bleaching rinse tank. Surface wipe samples confirmed the potential for workers to be exposed to low levels of PCDD/F. However, all I-TEQ concentrations were well below the National Research Council guidelines of 25,000 pg/m² for PCDD/F surface contamination.

Area and personal breathing zone air samples were collected and analyzed for CVOCs. Mass spectroscopy analysis qualitatively identified chloroform, 1,1,1-trichloroethane, carbon tetrachloride, dibromochloromethane, and bromodichloromethane as the major com-

pounds; these compounds were quantitatively analyzed with gas chromatography. Area concentrations of chloroform obtained near bleaching rinse tanks ranged from 1.8 milligrams per cubic meter (mg/m³) to 116 mg/m³ and were highest at the hypochlorite stage. Some worker exposures exceeded the NIOSH recommended exposure limit (REL) for chloroform of 10 mg/m³. A follow-up visit was conducted to assess the impact of process changes on airborne chloroform concentrations. Chloroform levels were substantially lower, indicating that reduced use of hypochlorite during pulp bleaching was successful in lowering workers' exposures below the NIOSH REL.

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AN ALTERNATE APPROACH TO ESTIMATING THE FIT OF SINGLE USE RESPIRATORS: DEVELOPMENT OF A QUANTITATIVE FIT TESTING METHOD. J. Campbell, U. Bickis, Phoenix OHC, Inc., Kingston, Ontario, Canada

Traditional quantitative fit-testing (QNFT) methods have involved the purchase of dedicated equipment and have not been applicable for use with single use dust/mist/fume respirators. A method for QNFT single use particulate respirators was developed using equipment and materials readily available to occupational hygienists.

Subjects donned probed respirators and were exposed to a sodium chloride aerosol inside a modified fit-testing hood. Two light scattering aerosol monitors, connected to a computer and chart recorder, continuously monitored the aerosol concentration inside and outside the respirators. Using this apparatus, QNFT was conducted on 25 subjects for 2 different makes of respirators. Fit factors were determined for both of the respirators while the subjects completed activities ranging from normal breathing and talking, to the spectrum described in CSA Standard Z94.4-93.

Geometric mean fit factors determined for individuals ranged from 33 to 1654. Activities that involved facial distortions (e.g., smiling, grimacing) generally yielded lower fit factors than other tasks. In conclusion, it was demonstrated that using traditional occupational hygiene equipment, single use dust/mist/fume respirators may be quantitative fit-tested. As this study was conducted in the laboratory, the reported fit factors are higher than would be expected under workplace conditions.

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IMPLEMENTATION OF A NEGOTIATED CONSENT AGREEMENT BETWEEN THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA) AND THE REFRACTORY CERAMIC FIBER COALITION (RCFC) TO COLLECT AIRBORNE FIBER EXPOSURE DATA. E. Casey, Unifrax Corp., Amherst, NY; K. Dorman, Thermal Ceramics, Augusta, GA; J. Treadway, Premier Refractories & Chemicals, Inc., Erwin, TN

In 1993, the Refractory Ceramic Fibers Coalition (RCFC; an industry trade association) and the Environmental Protection

Agency (EPA) entered into a voluntary consent agreement to assess occupational exposures to airborne fiber. Under Section 4 of the Toxic Substances Control Act (TSCA), the consent agreement was implemented to provide data to assist in the assessment of occupational exposures to refractory ceramic fiber (RCF) both within primary manufacturing and end-user facilities. A major component of the consent agreement was continuation of a comprehensive product stewardship program (PSP) which commenced prior to the signing of the consent agreement. The PSP involves seven key elements: health effects research, workplace monitoring, exposure assessments, communications, product research, special studies, and study of workplace controls. To date, the RCFC has provided data to the EPA involving hundreds of workplace monitoring samples from RCFC manufacturing and end-user facilities. Following the conclusion of the 3rd year of the consent agreement, 90% of airborne fiber samples fell below the 1.0 f/cc 8-hr time weighted average (TWA) industry sponsored recommended exposure guideline (REG). To date, the PSP has shown significant progress in assessing and reducing occupational exposures to RCF.

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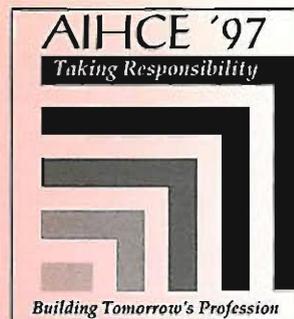
AN EXPOSURE ASSESSMENT SURVEY OF AN ISOTHIAZOLINONE-BASED BIOCIDES AMONG POWER PLANT WORKERS. C. Cook, NIOSH, Cincinnati, OH

In September 1995, the National Institute for Occupational Safety and Health (NIOSH) conducted an industrial hygiene survey at a manufacturing plant to assess power plant workers' exposures to biocide containing 1.5% isothiazolinones. After isothiazolinone-based biocide was first introduced at the plant in 1987, workers reported dermatitis, skin rash, eye and upper respiratory irritation while performing maintenance duties on water cooling towers. Employees became particularly concerned about the known mutagenicity properties of the biocide.

Isothiazolinones are heterocyclic organic compounds present in several chlorinated and unchlorinated forms. Isothiazolinones are nonoxidizing antimicrobial agents that are effective against gram-positive and gram-negative bacteria, as well as fungi, yeast, algae, and legionella pneumophila. Isothiazolinones are used industrially as antibiofoulants and slimicides in metalworking fluids, paper mills, swimming pools, leather and fabric, and water cooling towers.

Sixteen personal breathing zone (PBZ) samples (13 full-shift, three 15-minute short-term) and 21 area air samples for isothiazolinones were collected. Analyses of PBZ samples revealed none-detectable levels. A 15-minute area air sample collected above a biocide storage tank measured isothiazolinone concentration of 0.92 milligrams per cubic meter (mg/m³), exceeding a chemical manufacturer's recommended 15-minute short-term exposure limit (STEL) of 0.30 mg/m³. A second area air sample revealed a trace concentration at an employee break area. Currently, there are no occupational exposure criteria established by NIOSH or the Occupational

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