

from 0.01 $\mu\text{g}/\text{m}^3$ to 4.8 $\mu\text{g}/\text{m}^3$ at the blast-furnace plant and from 0.01 $\mu\text{g}/\text{m}^3$ to 2 $\mu\text{g}/\text{m}^3$ at the steel-making plant. Six percent of the results exceeded 2 $\mu\text{g}/\text{m}^3$ – Polish TLVs for BaP.

The observed levels of HpU in urine were from 0.50 to 2.25 $\mu\text{mol}/\text{mol}$ creatinine preshift at the blast-furnace plant, and from 1.39 to 8.96 $\mu\text{mol}/\text{mol}$ creatinine postshift; from 0.06 to 1.20 $\mu\text{mol}/\text{mol}$ creatinine preshift at the steel-making plant, and from 0.60 to 4.78 $\mu\text{mol}/\text{mol}$ creatinine after work, respectively. They were from 0.11 to 0.85 $\mu\text{mol}/\text{mol}$ creatinine for the control group.

It was concluded that the difference between the HpU concentration in the urine of the workers exposed to PAHs and the nonexposed workers proves usefulness of this marker as an indicator of PAH exposure.

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CARE: AN INDUSTRIAL HYGIENE PROGRAMME TO CONTROL EXPOSURES ACROSS THE REFRACTORY CERAMIC FIBRE (RCF) INDUSTRY IN EUROPE. P. Sebastien, D. Webster, C. Burley, J. Deadman, P. Class, B. Brown, H. Wimmer, D. Maxim, European Ceramic Fibres Industry Association 9ECFIA, Paris, France,

Introduction: A voluntary monitoring program, CARE (Controlled and Reduced Exposure) was developed by the European Ceramic Fibre Industry Association (ECFIA) in 1995 and was introduced in 1996. The first three years of this program have been completed.

In December 1997, a European Directive classified Refractory Ceramic Fibre (RCF) as a category 2 carcinogen, which reinforced the need for the CARE program.

Aims: To develop an industrial hygiene program across the RCF industry to assist RCF producers and users in controlling exposures to airborne fibrous dust.

Methods: In the last three years, regular air monitoring was conducted in the plants of ECFIA members producing RCF. In addition, nearly 200 surveys were conducted in a representative group of transformers and end-users of RCF-containing products.

Personal monitoring was used to assess workplace concentrations of fibrous dust within several job categories. A total of 2016 measurements were collected. Concentrations, together with relevant industrial hygiene information, were reported to a single database. This information was used to develop several communication tools for RCF users as a whole.

Results: Operations carried out by RCF users could be distributed into seven categories. In each category, the mean exposure (geometric mean adjusted for respirator use) systematically decreased between the first and third years of the program: Making modules (0.88/0.17), Making boards and shapes (0.41/0.08), Finishing (0.64/0.39), Installation (0.42/0.17), Assembly (0.33/0.17), Removal (0.75/0.26), and Auxiliary (0.27/0.13).

Discussion: To date, a systematic reduction of exposure has been noticed over the course of the program. A survey is being carried out among CARE participants to try to identify the determinants of this decrease. In the meantime, a detailed code of practice is being circulated among RCF users.

The continuation of CARE would aim to reach a wider audience through the publication and presentation of its findings.

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AIRBORNE CONCENTRATIONS OF PETROLEUM-BASED SOLVENT COMPONENTS DURING PARTS-WASHING OPERATIONS. J. Spencer, S. Canter, Environmental Profiles, Inc., Baltimore, MD

Petroleum-based solvents are used in a number of industries for cleaning or degreasing small parts. Since petroleum is constituted of many chemicals, there is potential for employee exposure to a number of chemicals as well as total hydrocarbons. Because of this potential, air monitoring was performed on individuals using these solvents in parts-washing sinks in a variety of workplaces while these solvents were used under standard work practice conditions.

Workplaces evaluated included automobile service stations, a train repair facility, truck repair facilities, and various industrial work environments. Chemical exposures evaluated included mineral spirits, toluene, and xylene. Personal breathing zone and area monitoring was performed using standard OSHA and NIOSH sampling and analytical methods. The results of this sampling indicated no exposures above OSHA permissible exposure levels.

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EVALUATION OF AIRBORNE BENZENE LEVELS FROM THE USE OF LOW-LEVEL BENZENE-CONTAINING SOLVENTS. J. Spencer, Environmental Profiles, Inc., Baltimore, MD

Retrospective industrial hygiene evaluations of worker exposures to benzene from solvents containing less than 0.1% benzene by volume are important in determining the likelihood of prominent toxicological effects. Historically, more benzene-containing products were used in the occupational setting than exist today. The OSHA benzene standard, 29 CFR 1910.1028, generally excluded benzene-containing products from this regulation when the benzene content was less than 0.1% by volume.

The focus of this study was to apply standard industrial hygiene evaluation tools to determine the breathing zone and bystander airborne benzene concentrations while cleaning parts with a benzene-containing petroleum distillate.

The assessment was approached from three aspects. First, using standard air monitoring procedures, typical automotive repair facilities were selected where a mineral spirit (stoddard solvent) based solvent was used intermittently by mechanics. Task duration and frequency were measured. General ventilation velocity and proximity to local exhaust systems were measured and considered. Benzene was added to the solvent to achieve 0.1% benzene content. Personal and area air samples were collected and analyzed for benzene and total hydrocarbons.

Second, the environmental data (air flow speed, room size, task time) collected from the field studies were applied to a standard industrial hygiene diffusion and Two-Box models and the results calculated.

Third, the general literature and government publications were searched for studies of the same or similar exposure conditions. The results of the field studies, modeling, and literature search were well correlated. Airborne benzene exposure values consistently fell below the OSHA permissible exposure limit of 1 ppm as an 8-hour time-weighted average (TWA) and the short-term exposure limit (STEL) of 5 ppm.

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BENZENE EXPOSURE TO EMPLOYEES PERFORMING LOADING, UNLOADING, AND LIGHTERING OPERATIONS OF FUELS ON BARGES. S. Vogl, L. Schumann, Clayton Environmental Consultants, Edison, NJ

Assessments were performed over a period of seven years to determine personal exposures to and area concentrations of benzene, and to establish regulated areas during the transfer of fuel to and from ships. Benzene is a known constituent in the fuels, ranging from less than 0.01% to greater than 3% (that is, regulated under OSHA [29 CFR 1910.1028] and the U.S. Coast Guard [46 CFR Part 197, Subpart C]).

Personnel have increased exposure potential while loading and unloading fuel products during hose connection/disconnection, gauging, and sampling. Living areas on board barges were also monitored during these operations to determine “noncontact” benzene exposure potentials. Barges are either loaded or unloaded at docks or are used for “lightering” purposes just off-shore.

Initial monitoring showed benzene exposures to be as high as 65 ppm, with some samples being overloaded, possibly representing higher exposures. Samples were then collected periodically for seven years while corrective actions were investigated. Factors considered to influence exposures were temperature, wind direction, workplace procedures, and employee positioning.

Successful engineering and work practice controls include the use of vapor recovery systems, worker education and training, a closed hatch policy, careful adjustments of high velocity vents, and rapid efficient gauging and sampling techniques. Because of these preventive measures, benzene exposures were generally reduced to below the time-weighted average (TWA) standard of 1 ppm.

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ENGINEERING CONTROLS FOR FURNITURE STRIPPERS TO MEET THE NEW OSHA PEL FOR METHYLENE CHLORIDE. C. Fairfield Estill, R. Kurimo, D. Watkins, NIOSH/Division of Physical Science and Engineering, Cincinnati, OH

OSHA recently lowered the permissible exposure limit (PEL) for methylene chloride to 25 ppm with an action level of 12.5 ppm. Small businesses are now required to use engineering controls to meet this standard. This research was conducted at a small furniture-stripping facility with one worker who strips furniture using a dip tank. In the mid-1980s, this facility was found to have exposures to methylene chloride as high as 2000 ppm. In 1991, engineering controls were installed at the dip tank, and exposures were reduced to 59 ppm.

A follow-up survey in 1997, however, showed that exposures at this facility had increased to 74 ppm. In 1998 and 1999, to reduce the methylene chloride levels to below the OSHA standard, improvements were made. These included larger ducts, more gradual transition duct, new fan for the dip tank, ventilation system in the rinsing area, and paraffin wax in the stripping solution.

Ten one-hour samples were collected on the left lapel in the employee’s breathing zone. Area samples and bulk samples were also collected. The 10 breathing zone samples had a mean time-weighted average (TWA) concentration of 7.6 ppm and ranged from not detectable to 14.3 ppm. The mean breathing zone concentration was statistically less than the 1997 OSHA PEL of 25 ppm (t-test, $df = 9$, $p = 0.01$). For area samples, TWAs of 4.9, 8.1, and 6.1

ppm were found in the stripping, rinsing, and drying areas, respectively. Fifty-two percent of methylene chloride was found in the stripping solution and 0.03% was found in the rinsing water.

The results from this survey show that worker exposures to methylene chloride while stripping furniture can be controlled below the 1997 OSHA PEL of 25 ppm.

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THE IMPACT OF OSHA'S FORMALDEHYDE STANDARD ON OCCUPATIONAL EXPOSURE TO FORMALDEHYDE. E. Grossman, J. Martonik, OSHA, Washington, DC

In December of 1987, OSHA published a comprehensive health standard for occupational exposure to formaldehyde, reducing the PEL from 3 ppm to 1 ppm and adopting ancillary requirements for respiratory protection, hygiene protection, medical surveillance, and training, among others. The PEL for formaldehyde was further reduced to 0.75 ppm in May of 1992.

Analysis of OSHA's enforcement database shows that promulgation of this standard has not greatly reduced exposures to formaldehyde because they were quite low before the new standard was adopted. This is due largely to the irritating effects of formaldehyde. Nonetheless, the data show that exposures have, on average, gone down, particularly in the manufacturing industries, and extreme exposure in the service industries has been reduced. The most frequently violated provision of the standard is the exposure monitoring provision.

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EXPOSURES AND EMISSION FACTORS FROM A FLUX-CORED ARC WELDING OPERATION. B. Thielen, R. Wadden, J. Franke, L. Conroy, P. Scheff, University of Illinois at Chicago, Chicago, IL

In the past 10 years, continuously-supplied-electrode arc welding processes, such as flux cored arc welding (FCAW), have been replacing manual arc welding in industry. In addition to the potential for increased exposure due simply to the productivity gain from automatic welding processes, there may also be differences in composition and weld fume generation rate that have health implications for welders.

A detailed data set was collected during two days of FCaw operations at a large-equipment fabricator. The data included more than 160 hourly particulate samples collected on polycarbonate filters in open-face cassettes (personal exposure, overhead crane, area). Each sample, along with the corresponding weld wire and base metal, was analyzed for elemental composition by proton-induced X-ray emission spectroscopy. Observations were made at five-minute intervals of all worker activities in the welding area and of crane movements along with measurements of area ventilation.

Personal exposures were determined for eight welders. Four weld fume exposures were in excess of the 8-hour ACGIH TLV of 5 mg/m³. Seven workers were overexposed to manganese (which was at higher concentrations in particulate than in either base metal or welding wire), three workers exceeded allowable iron exposure values, and two were overexposed to chromium.

Area concentrations and ventilation data were combined with a completely mixed space mass balance model to determine emission rates. Comparison of the emission rates with welder activity revealed

an association that resulted in a lower-bound area emission factor of 103 mg particulate per welder*minute. This value agreed reasonably with field-study literature values. The existence of the emission factor also confirms the consistency and accuracy of the concentration data and allows the observations to be generalized to other settings that involve industrial welding.

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EXPOSURE TO HEXAVALENT CHROMIUM AND OTHER HAZARDS IN A PLASMA SPRAY OPERATION. D. Gold, Cal/OSHA, Foster City, CA

Plasma spraying is a thermal spraying method in which metals are passed through a plasma arc and heated to temperatures above 10,000°C. This process is used to apply coatings or to build up worn parts. At the machine shop discussed in this presentation, workers used a hand-held plasma gun to apply nickel and Chromium III ceramic powders in a waterfall spray booth.

Although some researchers believe that all forms of chromium are carcinogenic, hexavalent chromium is recognized as a human carcinogen by IARC and other agencies, and exposures to Chromium VI are more tightly controlled. Because of the high temperatures in this process, it was possible that there was significant oxidation of the chromium to the hexavalent form. Sampling was conducted in this shop on two operations, to determine exposure to Chromium VI, total chromium, nickel, and noise.

The NIOSH 7300, 7600, and 7604 methods were used. During the second operation, an exposure that was 72 times the ceiling limit (0.1 mg/m³) for Chromium VI was detected, as were exposures that exceeded the 8-hour time-weighted average (TWA).

During the spray operations, employees were exposed to noise of approximately 110–114 dBA. Exposure to Chromium VI was approximately one-sixth to one-third the total chromium measured. At the time of the initial inspection, employees used half-face air-purifying respirators for which they had not been fit-tested or trained.

Changes in engineering controls and personal protective equipment resulted from this investigation, which should lower the risk to these employees of developing lung cancer.

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DIPHOTERINE[®] FOR EMERGENT DECONTAMINATION OF EYE/SKIN CHEMICAL SPLASHES. A. Hall, Toxicology Consulting and Medical Translating Services, Elk Mountain, WY; J. Blomet, L. Mathieu, Laboratoire PREVOR, Valmondois, France; J. Nehles, Mannesmann Hoesch Prazisrohr, Remscheid, Germany

Introduction: Diphoterine[®] is an hypertonic, polyvalent, amphoteric compound specifically developed in France as an eye/skin chemical splash decontamination solution. *In vitro*, it chelates nearly 600 acids, alkalis, oxidizing and reducing substances, and solvents. Its chemical bond energy for these compounds is greater than that of tissue receptors. Its hypertonicity impedes chemical tissue penetration.

Diphoterine chemical reactions are not exothermic, thus not releasing heat that could further damage tissues exposed to chemicals. In animals, Diphoterine and its acid/alkaline decontamination residues are not irritating and essentially nontoxic. In previously reported cases, Diphoterine prevented or decreased the severity of chemical eye/skin burns with 96% sulfuric acid, 100% acrylic acid, 50%

acrylamide, solid sodium hydroxide flakes, and dimethylethylamine.

In two European workplaces, Diphoterine initial decontamination was associated with significant decreases in lost work time and the need for additional burn treatment as compared with plain water irrigation.

Case Reports: From 1994 to 1998, 24 workers in a German facility had eye/skin splash exposure to weak or strong acids or bases. Following immediate Diphoterine decontamination, no eye/skin burns developed and there was no need for further medical or surgical burn treatment. Two workers each had one lost work day; the other 22 workers lost no work time.

Discussion: The cases reported here demonstrate that Diphoterine can be efficacious for decontamination of eye/skin chemical splashes. Diphoterine washes harmful chemicals off the exposed tissues while neutralizing them.

Diphoterine decontamination may completely prevent eye or skin burns following chemical splashes, thus preventing pain and sequelae, the need for further medical or surgical burn treatment, and lost work time.

Conclusion: Diphoterine can be a safe and efficacious solution for initial decontamination of eye/skin chemical splashes.

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MICROBIAL LEVELS ON INTERIOR SURFACES OF VENTILATION DUCTWORK, CLOSED CELL FOAM VS. FIBROUS GLASS INSULATION AND GALVANIZED METAL. P. Ellringer, S. Hendrickson, Tamarack Environmental Inc., St. Paul, MN; C. Yang, P&K Microbiology Services, Inc., Cherry Hill, NJ

Fifty years ago, ductwork surfaces in contact with air streams were mostly galvanized steel. Due to energy concerns starting in the 1970s, most commercial ductwork was installed with fibrous glass insulation on its interior surfaces. Concerns have been raised that fibrous glass insulation on the interior of ventilation ductwork may increase the microbial levels inside buildings, creating indoor air quality problems.

This presentation compares the microbial levels on interior ductwork surfaces of fibrous glass, closed cell foam, and galvanized metal over a four-year period. Microbial surface wipe and bulk samples were taken on fibrous glass insulation, closed cell foam insulation, and galvanized metal located within 3 meters downstream of the cooling coils in three air-handling units in an office building located in Minnesota.

Microbial samples were initially collected on November 5, 1995. These areas were retested on March 24, 1999. These areas were cleaned and repeat microbial samples were taken on March 31, 1999 and August 5, 1999.

The results indicate that the average microbial levels in fibrous glass insulation are hundreds — and in some cases thousands — of times higher than the microbial levels found on closed cell foam insulation or galvanized metal, when these materials are all treated to the same environment.

Elevated microbial levels might cause health concerns for some office workers. Closed cell foam insulation and galvanized metal interior ductwork surfaces seem to be better in preventing microbial growth than fibrous glass insulation on interior ventilation ductwork surfaces.

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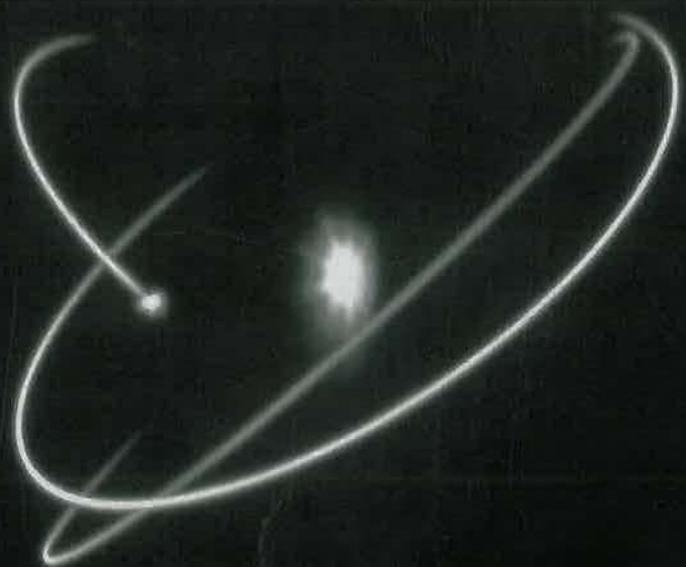
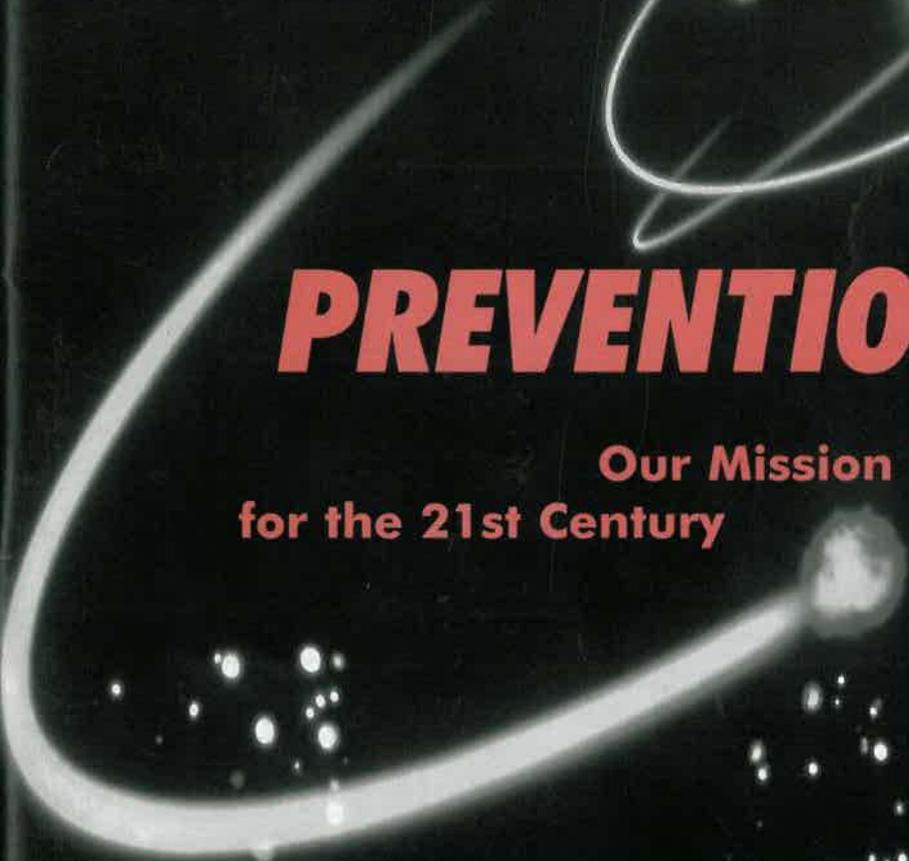


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