

performing precision stamping of CuBe alloy were very low.

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OCCUPATIONAL EXPOSURES TO DIESEL PARTICULATE MATTER IN MINNEAPOLIS-ST. PAUL TRANSPORTATION SYSTEMS. G. Ramachandran, D. Kittelson, W. Watts, C. Kreager, D. Paulsen, University of Minnesota, Minneapolis, MN.

Traditional exposure assessment of diesel particulate matter (DPM) has been based on the mass concentration metric. However, recent studies have suggested that particle number and surface area concentrations may be more health-relevant indices. The purpose of this project was to evaluate low level exposures to DPM for three categories of workers — bus drivers, parking ramp attendants, and garage mechanics — in the Twin Cities and University of Minnesota transportation systems. We evaluated exposures using the mass concentration of elemental carbon (EC, NIOSH method 5040), as well as with an array of aerosol instruments designed to measure the mass of black carbon (aethalometer), surface area (diffusion charger, and photoelectric aerosol sensor), and number concentration (ultrafine condensation particle counter), and size distribution (scanning mobility particle sizer) in real time. The relationship between different exposure metrics (based on mass, surface area, number) was studied, and we identified differences in the exposures of the three occupational groups, as measured by these exposure metrics. The three occupational groups have exposures between 1 - 10 micrograms per cubic meter, i.e., at the low end of occupational exposures and near the high end for ambient exposures. The three groups did not differ statistically in terms of their mass exposures to EC, although the mean exposures were lowest for the ramp attendants and highest for the garage mechanics, with the bus drivers representing an intermediate level of exposure. In terms of surface area concentrations, the garage mechanics had an exposure distribution that was distinctly different from bus drivers and ramp attendants (who had exposure distributions very similar to each other). In terms of number concentrations, the ramp attendants had much lower exposures than garage mechanics. Thus, depending on the exposure metric chosen, the three occupational groups have similar or different exposures, with obvious implications for future epidemiological studies.

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GENERATION OF RESPIRABLE QUARTZ DUST FROM MASONRY SAWING. K. Linch, W. Miller, NIOSH, Morgantown, WV.

A lack of information about the amount of quartz dust generated from sawing masonry makes it difficult for masonry contractors to determine if a silicosis hazard exists at their work-sites and what level of dust control or personal protection is needed. Estimating concentrations during all possible work-site conditions is unrealistic. The approach taken here was to determine the generation rate of respirable dust and quartz from four samples of typical masonry sawn using two types of commonly used masonry saws. Each type of masonry was sawn during eight sampling runs under controlled conditions in a 700 ft³ dust chamber. During each run, four area sampling stations were used and a total of 16 respirable dust samples were obtained. The four samples of masonry used were: concrete blocks, common face bricks, fire bricks, and concrete paver

bricks. The two saws used were a table saw using water on the blade and a hand-held chop-saw used without water being applied to the blade or dust collection. Using the chop-saw without dust control, the mean generation rate of respirable quartz: for the concrete blocks was 570 mg/min (540 - 590 mg/min, 95% C.I.); for the concrete paver bricks was 670 mg/min (650 - 710 mg/min, 95% C.I.); for the common face brick was 450 mg/min (410 - 470, 95% C.I.). Insufficient dust was collected to allow quartz results above the limit of quantification for the fire brick samples; however, the respirable dust generation rate was 2400 mg/min (2200 - 2500 mg/min, 95% C.I.) which contained approximately six percent quartz. Concrete blocks were used to compare dust generation rates between the two saws and indicated that 270 times more respirable dust was generated when using the hand-held chop saw versus the stationary saw using water on the blade. This data indicates that using the typical gasoline powered masonry chop-saw without dust control potentially generates unacceptable amounts of respirable quartz.

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CONTROL TECHNOLOGY AND EXPOSURE ASSESSMENT FOR OCCUPATIONAL EXPOSURE TO CRYSTALLINE SILICA: REPORT OF 32 CASE STUDIES. A. Echt, M. Gressel, D. Almaguer, NIOSH, Cincinnati, OH.

A major study to evaluate respirable crystalline silica exposures and document associated engineering controls was conducted in support of OSHA rule-making by NIOSH. This study examined 32 sites in a variety of manufacturing and construction settings. Personal air and bulk samples were collected in accordance with NIOSH Methods 0600 and 7500.

At each site, information pertinent to process operation and control effectiveness (control methods, ventilation rates, work practices, use of personal protective equipment, etc.) was collected. The summary of engineering control information included such items as ventilation flow rates and distance measurements. The proximity of the control systems to open doors or windows, general ventilation intakes and exhausts, and other interacting equipment (i.e., pedestal fans) were also noted. The age and history of the control systems, cost of control installation, maintenance practices, and operation and maintenance costs were determined from facility management, when possible. Historical sampling data were also collected when possible (i.e., sampling data from before and after a control was installed).

Crystalline silica is present in a variety of workplaces, encompassing construction, maritime and industrial settings. Silica may be present as a raw material (i.e., brick and plate glass manufacturing), as a processing material (i.e., foundries), or as a naturally occurring mineral in the workplace (i.e., tunnel construction, rock drilling, and excavation). As such, worker silica exposures are controlled to widely varying degrees, using widely varying methods. In this study, 30% (224/740) personal breathing zone samples exceeded the NIOSH REL of 0.05 mg/m³, and 20% (147/740) exceeded their calculated OSHA PEL. Construction represented the highest exposures. In thirteen construction sites in this study, 66 of 152 (43%) samples exceeded the REL, while 54 (36%) of the samples were in excess of the PEL. In five foundries, 32% (90/281) and 22% (62/281) samples exceeded the REL and PEL, respectively.

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CONFINED SPACE ENTRY TRAINING IN RURAL COMMUNITIES. J. Stearne, Victoria University of Technology, Melbourne, Australia.

There are a number of rural communities that sustain industries that require training in confined space entry. Such industries range from rice-harvesting and processing to chip-board manufacture to hydro-electricity generation. These industries often attract plant workers and process operators who have had a minimum of secondary schooling and in many cases, English is their second language. The aim of the training program was to introduce workers to hazards in confined spaces with emphasis on toxic gases and low oxygen levels and to cover a number of other important areas such as lower explosive limits, noise and its associated problems and explain the concepts of hazard and risk. In many rural communities numeracy and literacy often pose problems to those who carry out training programs, particularly where certification for confined space training requires a written examination and a practical demonstration of equipment operation. To overcome these problems and to ensure that the trainee feels at ease in this situation a one-on-one oral examination carried out by a trained supervisor has helped solve what can often turn out to be an embarrassing predicament for both parties. To ensure that the worker is able to function more effectively within the organisation many companies, with the worker's consent, have introduced and/or encouraged numeracy and literacy programs within the local community. Confined spaces are dangerous places and every effort is needed to protect the health and safety of all workers.

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LOCKOUT/TAGOUT: HELP IN PREPARING AN EFFECTIVE PROGRAM. E. Cook, OSHA Salt Lake Technical Center, Salt Lake City, UT; W. Siegfried, OSHA Office of Health Compliance Assistance, Washington, DC; C. Ogden, D. Keyes, ATL International Inc., Germantown, MD.

OSHA often cites deficiencies in required written programs. And, written program deficiencies frequently indicate problems in implemented practices, putting workers at risk. From 1990 through 1998, OSHA's lockout/tagout standard was one of the most often-cited safety standards in general industry. To help employers understand more clearly what OSHA looks for in a written program, and to improve worker protection, the Agency has developed a new software tool, e-LOTO. The e-LOTO software is a Microsoft Access program that can be downloaded from the OSHA web site. The software prompts users for site-specific input and generates a written LOTO program that reflects OSHA requirements. The written program generated by e-LOTO reflects 29 CFR 1910.147 requirements as they apply to the user's facility. The program details the lockout/tagout requirements and procedures that must be followed. It also describes the training the user/employer provides to protect employees who service or maintain machines and equipment and

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ABSTRACTS