of 0.051 mg/m(3) to 33.617 mg/m(3). Several workers were not aware of respirable silica in the products they used or the hazards associated with respirable silica. Engineering controls on construction sites to mitigate exposure were routinely not in place. However, many workers were using proper Personal Protection Equipment (PPE). Stone installers were found to be at highest risk for overexposure and therefore at highest risk for contracting work-related Silicosis. Several stone installers did not use engineering controls, did not wear PPE and were not aware of respirable crystalline silica as a hazard.

8

WET CONCRETE SAW CUTTING INSIDE - HOW MUCH WATER IS ENOUGH? M. Flanagan, University of Washington, Seattle, WA; C. Loewenherz, NYCosh, New York, NY; G. Kuhn, Washington Department of Labor and Industry, Seattle, WA.

It is well known that water spray reduces dust exposures when cutting concrete. The purpose of this study was to determine whether overexposures can occur when wet cutting, and whether the amount of water delivered to the blade can effect exposure.

Wet cutting exposures evaluated included concrete coring, wall sawing and slab sawing. Both walk-behind and hand-held saws were evaluated. Based on some minimal prior sampling data indicating overexposures when working inside, projects were monitored when cutting inside, assuming that this would be a worst case scenario. In most cases, only one tool was used for a full shift. For slab sawing, the water flow rate, cut area ($ft.^2$), and blade diameter were recorded. Full shift samples were collected for tool operators (11), sawyer helpers (3), and cutting area (4).

The five slab operator quartz exposures (mean of 0.31 mg/m^3) and two of the three wall saw operator exposures (mean of 0.13 mg/m^3) were over the Washington State PEL of 0.1 mg/m^3. The two concrete boring operator exposures were below the PEL (mean of 0.02 mg/m^3).

Three electric slab saw jobs had similar cut areas (83-100 $ft.^2$), indicating that the amount of material removed was fairly comparable. Two of these saws had a water flow rate of 0.5 gal./min. and mean operator exposure of 0.33 mg/m^3, while the other saw with a flow rate of 2.0 gal./min. had an operator exposure of 0.11 mg/m^3.

Quartz overexposures can occur with long periods of wet slab cutting and wall cutting inside. The amount of water applied can effect exposure, particularly in a more enclosed environment.

9

EXPOSURE TO SILICA DUST DURING CONCRETE GRINDING IN CONSTRUCTION INDUSTRY. F. Akbar-Khanzadeh, R. L. Brillhart, Medical College of Ohio, Toledo, OH.

Studies assessing exposure to silica dust during concrete grinding within construction settings are scarce because of the dynamic nature of this activity and because of confounding factors. Thus, a study was conducted to explore this issue. A total of 49 personal, respirable samples were collected from employees in standing position using hand-held grinders to polish concrete. Of the 49 grinders used, only 15 were equipped with local exhaust ventilation systems. The major confounding factors such as wind speed and direction, relative humidity and ambient temperature were determined. Each employee was monitored for entire shift, but to make the sampling task specific, air sampling was activated only during actual grinding. Sampling time ranged from 10-200 minutes with a mean and median of 85 and 73 minutes, respectively. The concentration of respirable particulates ranged from 0.3 - 81 mg/m^3 [mean (SD) of 18.6 (20.4) mg/m^3]. The concentration of crystalline silica in samples ranged from 0.02 - 7.1 mg/m^3 [mean (SD) of 1.2 (1.4) mg/m^3]. Although the local exhaust on the grinders was not effective enough to eliminate overexposure [mean (SD) of 0.38 (0.29) mg/m^3], it reduced the silica dust level significantly ($p < 0.001$) compared to grinders without the local exhaust [mean (SD) of 1.5 (1.5) mg/m^3]. For those situations in which dust was moved away from the breathing zone by wind, there were no significant differences between cases with or without local exhaust on the grinder (4.4 v 3.5 mg/m^3), showing the importance of an employee's orientation regarding the direction of wind while grinding. More than 92% of samples exceeded the recommended exposure limits, indicating a strong need to devise methods for controlling employees' exposure to silica dust during this activity.

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EXHAUST VENTILATION DESIGN AND OCCUPATIONAL EXPOSURE TO RESPIRABLE CRYSTALLINE SILICA DURING READY-MIX CONCRETE TRUCK DRUM CLEANING. D. Almaguer, NIOSH, Cincinnati, Ohio; A. Echt, S. Shulman, NIOSH, Cincinnati, OH.

A study was conducted to evaluate worker exposures to respirable crystalline silica during interior cleaning of ready-mix concrete truck drums. This study was conducted at a ready-mix concrete plant with a fleet of 27 ready-mix trucks. Ready-mix drum cleaning operations are conducted once per calendar year, during the winter slowdown. The cleaning of ready-mix drums becomes necessary as the drum interior becomes caked with cured concrete requiring worker entry to the drum, a confined space. The worker utilizes a jackhammer to break the concrete layer and remove the cured concrete from the drum interior. Two control systems were designed to reduce employee exposures during drum cleaning operations. One, a local exhaust ventilation (LEV) system was designed to be attached to the jackhammer being used for breaking cured concrete lining the drum interior. The second, a general exhaust ventilation (GEV) system was designed to remove dust from the drum interior. To determine the effectiveness of the designed controls, personal breathing zone air samples were collected on employees required to enter the drum interior to remove cured concrete. Respirable particulate samples were collected at a flow rate of 1.7 liters per minute using a 10-mm nylon cyclone and a pre-weighed, 37-mm diameter, 5-μm pore-size polyvinyl chloride filter, in accordance with NIOSH Method 7500. Samples from four control combinations (no controls, LEV, GEV, and LEV/GEV combined) were collected in randomized blocks to determine the effectiveness of the control designs in reducing worker exposures during concrete removal operations. Statistical analyses of the sampling results indicate that the use of LEV alone was the most effective control, reducing airborne silica concentrations by about 48 percent ($p<0.05$). No statistically significant reduction (relative to no control) was determined from use of GEV.

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RESIDENTAL CONSTRUCTION SAFETY AND HEALTH: HOMESAFE AUDIT RESULTS. D. Gilkey, Colorado State University, Ft. Collins, CO.

The HomeSafe Pilot Program is a strategic partnership between OSHA Region VIII and the Home Builders Association (HBA) of metropolitan Denver. The 10-point safety and health program was developed by this partnership to address the major risks and hazards unique to residential construction sites. Investigators evaluated site conditions and work practices using a 117-item audit tool developed by researchers at Colorado State University. Participating companies were evaluated at their onset into the program and intervals thereafter. A cohort of n=41 companies with a mean score of 69 at the time of their initiation into HomeSafe were followed for two years. On retest their mean score had increased to 76 demonstrating a significant improvement (p=.036) with prolonged exposure to HomeSafe. Significant improvements (P=.006) were also seen when comparing the cohort to n=41 controls with a mean score of 66. Differences were also noted among trades with roofing and drywall experiencing the largest increases (12%) from previous scores of 80 and 67 to 92 and 79 respectively. Roofers and framers made up 22% of trades evaluated and are at significant risk on construction sites. Analysis of HomeSafe hazard categories showed the best compliance to safe work practices pertained to use of fall protection systems (mean=89) followed by ladders (mean=88) and PPE (mean=83). The findings indicate that HomeSafe has positively impacted the safe work practices and site conditions of residential construction jobsites in the Denver metro area of Colorado. These data support the potential for positive outcomes with strategic partnership between public and private sectors.

12

A BLUEPRINT FOR INTEGRATING HEALTH HAZARD CONTROLS INTO CONSTRUCTION PROJECTS. M. Goldberg, Hunter College School of Health Sciences, New York, NY; N. Clark, C. Lema-Foley, N. Zuckerman, Mount Sinai School of Medicine, New York, NY.

The use of health hazard controls in the construction industry is relatively recent. We describe a methodology for assessing the extent of integration of health hazard (lead and silica) control programs into construction projects, and recommend an occupational health management system for enhancing integration. The successful implementation of control programs depends upon the expertise and training of construction company personnel, the close supervision of these programs and timely assessment of effectiveness. We summarize a project whose goal is to develop tools that facilitate control integration into infrastructure rehabilitation projects. The project is a collaborative effort among researchers, contractors, building trade unions, insurance companies, and local government agencies. The tools consist of Hazard Planning and Control Packets (HPACs). The development of HPACs was based upon exposure assessment for lead and silica, structured interviews with management, union personnel and workers at the site, audits of site conditions, evaluation of safety meetings, discussion groups with site staff, and in-depth discussions with insurance company and local transportation agency personnel. Depending upon the application, each HPAC contains audit forms, training programs, scheduling triggers,

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ABSTRACTS