Occupational exposure to silica dust has historically been known to cause chronic respiratory conditions. Workers and workplaces within agricultural industries remain removed from the attention of occupational health and safety. To date, the identification and degree of exposure of respirable dust, crystalline silica, and endotoxin exposure throughout the potato harvesting process has been uncharacterized. A description of the potential occupational risks in this setting was therefore warranted. The agricultural practices specific to potato harvest, the geographic region, and the soil of the San Luis Valley, are believed to contribute to an occupational risk. The purpose of this research was to identify the components of dust during the fall potato harvest in the San Luis Valley of Southern Colorado. The testing sites were located within three counties of this valley, including seven farming locations. The farm sites were chosen based upon their location, variable soil types, and owner interest. The following parameters were measured: respirable dust, and respirable silica by the 10 mm cyclone; bacterial endotoxin (EU/m^3) by the Limulus amoebocyte lysate test; and scanning electron microscopy for particle identification purposes. All exposures were based on an 8-hour time-weighted average. Exposure impact included the following variables: location of the farming site, soil type (sand, rock, loam), individual job description, weather conditions (wind, rain, wet or dry soil during harvesting operations), humidity, and temperature. Results of air monitoring, and the identification, classification, and quantification of agricultural worker exposure to these risks have been reported with a maximum respirable silica (quartz) of 0.105 mg/m^3 identified, slightly exceeding the ACGIH TLV of 0.10 mg/m^3. This information will allow employers to recognize where silica dust is generated and allow for planning and control implementation to adequately protect workers.

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POLLUTION PREVENTION TO REDUCE WORKER EXPOSURE: ALTERNATIVES TO CHLORINATED CLEANING SOLVENTS. M.J. Ellenbecker, K.B. Thomas, Toxics Use Reduction Institute, University of Massachusetts Lowell, MA

An important source of worker exposure to solvents is parts cleaning. Such exposures typically are reduced by a combination of engineering controls, administrative controls, and personal protective equipment. Recent pollution prevention research, however, has suggested that a far more satisfactory approach, substitution, may be appropriate in many applications including parts cleaning. This paper discusses the results of a specific substitution research project, and the general conclusions that can be drawn about the use of this methodology by industrial hygienists.

This research program investigated the feasibility of nonsolvent alternatives for cleaning metal surfaces at two parts manufacturers and an electroplating job shop. The facilities all used vapor-phase degreasers employing trichloroethylene, 1,1,1-trichloroethane, methylene chloride, and CFC-113. At each facility a complete pollution prevention options assessment was performed, consisting first of options identification followed by technical, financial, and occupational/environmental health and safety (H&S) analyses. Options considered included various aqueous cleaning alternatives such as pressure spray washers, ultrasonic systems and immersion tanks, abrasive blasting, and CO_2 blasting.

Each technical evaluation identified viable nonsolvent alternatives, all of which reduced worker/environmental exposures. The financial analysis results were mixed. There was clear financial benefit to the parts manufacturers; the annualized costs of the new processes were less than the degreasers. Here, the nonsolvent substitution clearly is preferable, since it eliminates worker exposure while saving money. The job shop cleans a variety of substrates and soils, so that several cleaning systems were required to replace the degreaser. The financial analysis indicated that the new systems would be somewhat more expensive, so that there was no financial incentive to make the substitution.

The research reported here offers lessons that can be extended beyond these three companies. These lessons, including the benefits of the pollution prevention approach to industrial hygiene, are discussed fully in the complete presentation.

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EVALUATION OF CONTROLS USED TO REDUCE WELDING FUME EXPOSURES. M. Wallace, NIOSH, Cincinnati, OH

This report summarizes the data collected during a major control technology study of welding operations conducted at seven field sites. The purpose of the study was to evaluate the effectiveness of various engineering control measures in reducing welding fume exposures. Welding parameters varied at each location; however, all used arc welding techniques. Types of arc welding evaluated included shielded metal (stick or SMAW), gas metal (GMAW or MIG), flux cored (FCAW), and gas tungsten (GTAW or TIG). Metals welded included aluminum, mild steel, galvanized steel, and stainless steel. Five studies were conducted at industrial sites, while two studies were conducted at a union training center for welders and at a vocational school. The majority of evaluated control measures were classified as ventilation units, including portable and fixed local exhaust hoods, canopy hoods, and fume extraction welding guns. At one industrial site, rather than using ventilated measures, fume levels were controlled by modifying the process that involved using pulsed arc welding techniques in place of conventional GMAW techniques. During each field study, industrial hygiene air samples were collected to determine total welding fume concentrations and levels of airborne metals. The NIOSH analytical methods for total particulates (0500) and elements (7300) were followed. Additional information on total welding fume exposures was collected using real-time aerosol instrumentation. Results indicated that the ventilated controls ranged from being completely ineffective (a canopy hood system) to very effective, reducing workers' fume exposures by up to 83% (a fume extraction gun system). The process modification control method resulted in a 24% reduction in welding fume exposures. Overall, however, even with controls, exposure levels for total welding fume and metals such as hexavalent chromium, arsenic, and manganese occasionally still exceeded limits set by the ACGIH, NIOSH, and OSHA.

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THE DEVELOPMENT OF CONTROLS AND INK SUBSTITUTES FOR REDUCING WORKPLACE CONCENTRATIONS OF ORGANIC SOLVENT VAPORS IN A VINYL SHOWER CURTAIN PRINTING PLANT. H.V. Piltingsrud, A. Zimmer, NIOSH, Cincinnati, OH; A. Rourke, Ohio Bureau of Workers Compensation, Dayton, OH

During the summer of 1994 there were complaints of noxious odors reported by football players at a practice field located in Cincinnati. During Ohio Environmental Protection Agency (OEPA) investigations of industries surrounding the field, they inspected a printing facility located approximately one-quarter mile from the practice field. The facility produces vinyl shower curtains having screen-printed designs on them. Printing is carried out by means of movable screen printing units, having polyester screens approximately 6 × 6 feet. The printing units move over tables approximately 7 feet wide by 150 feet long. Four printing tables are located side-by-side in a room approximately 50 × 200 × 12 feet high. The OEPA found that they were not the source of the odor in question; however, they were in regulatory noncompliance for uncontrolled volatile organic compound (VOC) discharges to the environs resulting from their use of organic solvents in their printing process. The company was then required to install an air incinerator at the facility to treat discharged air. The cost of such equipment was very high, and the capacity of the incinerator they installed resulted in a reduction in the flow of discharged air to approximately one-third of previous levels, increasing solvent vapor concentrations within the workplace atmosphere to levels exceeding NIOSH, OSHA, and ACGIH acceptable concentration levels for worker exposure. Consequently, workers were required to wear organic vapor cartridge respirators nearly full time. The printing company requested NIOSH assistance in finding methods to reduce solvent vapor exposures. NIOSH studies included the identification of the sources and relative magnitude of solvent emissions from the printing process, the design of controls for solvent emissions from the printing process, and the development of substitute inks using nonphotochemically reactive (as defined by the OEPA) solvents. Controls included the enclosure of the movable printer units to suppress evaporation of solvents from the printing screen. The NIOSH-developed ink used lower evaporation-rate solvents, having TLV values >100 ppm. Their nonphotochemically reactive status allowed OEPA removal of the requirement for the incineration of discharged air. This allowed substantial increases in dilution ventilation, enabling a reduction in worker exposures to less than one-third TLV additive levels, and a consequential removal of requirements for respirator usage. The solution was the result of a comprehensive review of all facets of the problem, including OEPA regulations. It also

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