

strategies take hold in the environmental field, industrial hygienists may find themselves "out-moded" in continuing to facilitate controlled use of dangerous substances or processes. Traditional industrial hygiene strategies may potentially shift risks to the environment or miss opportunities to reduce risks to both workers and the environment. To assess the extent to which industrial hygiene practice has incorporated preventive strategies, the presenters conducted a critical assessment of 92 peer-reviewed articles from the industrial hygiene literature circa 1994-2000. In that review, the presenters found that while there are excellent examples of innovative source reduction strategies in industrial hygiene practice, greater consideration and institutionalization of preventive control strategies is clearly needed. Additionally, to further investigate the barriers and opportunities for source reduction as a control strategy, the presenters surveyed over 30 industrial hygienists from a variety of settings. Based on these findings, the presenters developed a theoretical model for a preventive approach and practical integration of workplace and environmental protection.

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EXPERIENCES GAINED FROM USING AN EXPOSURE CONTROL MATRIX. S. Lewis, SmithKline Beecham, Worthing, West Sussex, United Kingdom; M. Abramovitz, SmithKline Beecham, Philadelphia, PA.

SmithKline Beecham (SB) has developed an Exposure Control Matrix (ECM) which is similar to those produced by other pharmaceutical companies. Its purpose is to enable recommendations on requirements for engineering and administrative exposure controls to be made as early as possible during the design or modification of facilities and the development and introduction of new products. The ECM was also used to create standard recommendations on exposure control measures for inclusion in the SB Material Safety Data Sheets. The ECM has been extended to provide a tool that can be used for assessing the exposure control measures in place at existing facilities. Assessments are carried by answering a number of simple questions that lead to an assignment of the exposure control capability of specific areas. This presentation will outline the development of the SB ECM, how the ECM evolved into a self assessment tool for the non-expert to evaluate exposure control, how the ECM can be used to establish the resource implications for improvements and the experience gained from the use of the ECM at a number of different locations. The ECM focuses on a key area of industrial hygiene, i.e., exposure control as well as contributing to the understanding of health hazards. It is a cost effective method of assessing exposure controls, can be used to prioritise and estimate the costs of upgrades. The questionnaire can also be used to record supporting data for air sampling surveys.

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BLASTING ABRASIVES' HAZARD COMPARISON USING IN VIVO TOXICITY DATA & DUST GENERATING CHARACTERISTICS FROM ENVIRONMENTALLY-CONTROLLED LABORATORY & FIELD STUDIES. M. Greskevitch, V. Castranova, NIOSH, Morgantown, WV; H. Ahlers, NIOSH, Cincinnati, OH.

Abrasive blasting, a process of bombarding surfaces with a media of small abrasive particles carried

in a high velocity air stream, is used for cleaning and etching various surfaces. Historically the most common form of abrasive blasting, sand blasting, generates respirable silica dust, which can lead to the development of silicosis, a potentially deadly lung disease. Several substitutes for silica sand have been suggested, but little data exist on the relative risks of these alternative media in abrasive blasting applications. This study compares the in vivo toxicity and dust generation characteristics of several blasting abrasives including silica sand, coal slag, copper slag, nickel slag, garnet, staurolite, steel grit, olivine, specular hematite, and crushed glass. An abrasive blasting laboratory and field study was conducted in a controlled environment to compare concentrations of respirable dust and various toxic contaminants for each of the alternative abrasives relative to silica sand. The relative in vivo toxicity of these materials has been reported by NIOSH investigators using intratracheal instillation of equal respirable dust concentrations of each abrasive in male rats. Steel grit and specular hematite were the only alternative abrasives that had lower in vivo toxicity than blast sands. These two abrasives also had substantially lower respirable dust concentrations than blast sands. Olivine and coal slag were the only alternative abrasives that had higher in vivo toxicity than blast sands. Olivine also had substantially higher respirable dust concentrations than blast sands. The airborne respirable dust concentrations of the abrasive blasting environmentally-controlled laboratory and field studies are combined with the intratracheal instillation toxicity studies' results to present a hazard comparison. Using this dust comparison indicates that steel grit and specular hematite have a lower hazard ranking relative to silica sand; while olivine and coal slag have a substantially higher hazard ranking.

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AN EVALUATION OF RETROFIT ENGINEERING CONTROL INTERVENTIONS TO REDUCE PERCHLOROETHYLENE EXPOSURES IN COMMERCIAL DRY-CLEANING SHOPS. G. Earnest, L. Ewers, A. Ruder, M. Petersen, R. Kovein, NIOSH, Cincinnati, OH.

Air sampling and real-time monitoring were used to evaluate the ability of engineering controls retrofitted on two existing dry-cleaning machines to reduce worker exposures to perchloroethylene. In one dry-cleaning shop, a refrigerated condenser was installed on a machine having a water-cooled condenser to further reduce the machine air temperature, improve vapor recovery, and lower exposures. In a second shop, a carbon adsorber was retrofitted on a machine to adsorb residual perchloroethylene not collected by the existing refrigerated condenser to improve vapor recovery and reduce exposures. Both controls reduced the perchloroethylene exposures of the dry-cleaning machine operator. Real-time monitoring was performed to evaluate how the engineering controls affected exposures during loading and unloading the dry-cleaning machine, a task generally considered to account for the highest exposures. The real-time monitoring showed that dramatic reductions occurred in exposures during loading and unloading of the dry-cleaning machine due to the engineering controls. Peak operator exposures during loading and unloading were reduced by 60 percent (1,139.3 ppm to 456.4 ppm) in the shop that had a refrigerated condenser installed on the dry-cleaning machine and 92 percent (352.9 ppm to 29.4 ppm) in the shop that had a carbon adsorber installed on a machine with an already existing refrigerated

condenser. Although loading and unloading exposures were dramatically reduced, drops in full-shift time-weighted average exposures were less dramatic. Time-weighted average exposures to perchloroethylene, measured by conventional air sampling, showed smaller reductions in operator exposures of 28 percent or less for both controls. Differences between exposure results from real-time and conventional air sampling likely resulted from other uncontrolled sources of exposure, differences in shop general ventilation before and after the control was installed, relatively small sample sizes, and experimental variability inherent in field research. This study showed that retrofit controls may be a feasible option for some shops to reduce perchloroethylene exposures, and bring machine operators into compliance with OSHA peak exposure limits.

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UV DISINFECTION OF SOLUBLE OIL METALWORKING FLUID CONTAMINATED WITH BACILLUS SUBTILIS. T. Havel, University of Oklahoma Health Sciences Center, Oklahoma City, OK.

Microbial infestation of water-based industrial metalworking fluids (MWF) presents both worker health and process quality problems. Chemical biocidal agents often added to MWF have limited effectiveness, and though disinfection by UV irradiation has been proposed, little work has been reported regarding its effectiveness. In this project, a bench-scale model treatment system was used to evaluate the effectiveness of a new type of UV lamp for disinfection of bacteria in an opaque soluble oil MWF. In the first of an experimental series, UV disinfection was effective against Gram negative *P. fluorescens* with kill in opaque MWF within 60 minutes. In following experiments, a mixture of soluble oil MWF in sterile water was inoculated with the Gram-positive bacteria *B. subtilis* and exposed to UV radiation in a circulating system for up to 1 hr. Aliquots were withdrawn at intervals, diluted with sterile deionized water, and surface plated on tryptic soy agar. Colony forming units were counted after incubating the plates overnight at 35C. Control experiments were run under identical conditions except that the UV lamp was not turned on. *B. subtilis* showed a linear reduction in culturability to approximately 50 percent of the initial culturable concentration over the 60-min period even in the absence of UV irradiation. This was in contrast to previous results with the Gram-negative bacteria *P. fluorescens*, which showed no similar intolerance for the MWF. With UV, a 2-log reduction in culturable concentration was seen in 60 minutes. Also in contrast to *P. fluorescens*, the decay in *B. subtilis* culturable concentration under UV irradiation was approximately linear rather than first order. These results further support that UV control of microbial infestation is effective in opaque water-soluble oil MWF, but suggest that different or multiple inhibitory mechanisms may be involved for these two organisms.

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EFFECT OF BIOCIDES USE AND ENCLOSURES ON WORKERS' EXPOSURE TO CONTAMINANTS OF METAL-WORKING FLUIDS. M. Linnainmaa, J. Laitinen, S. Laitinen, J. Liesivuori, Finnish Institute of Occupational Health, Kuopio, Finland; H. Kiviranta, National Public Health Institute, Kuopio, Finland.

The aims of this study were to evaluate the effects

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ABSTRACTS