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METALWORKING FLUID EXPOSURES IN SEVERAL METAL MACHINING INDUSTRIES. J.M. Whitehouse, Adirondack Environmental Services, Inc., Saratoga Springs, NY

This study summarizes the findings of metalworking fluid (MWF) exposure assessments conducted in several industries. The purpose of the assessment was to evaluate personal exposures to MWF for comparison with the February 1996 NIOSH draft document, "Criteria For a Recommended Standard Occupational Exposures to Metalworking Fluids," which established a recommended exposure limit (REL) of 0.5 mg/m$^3$. A secondary objective of the assessments was to compare two analytical methodologies of MWF: the NIOSH 0500 method for total particulate and the NIOSH 5026 method for mineral oil.

More than 60 personal air samples were collected among 8 facilities, including manufacturers of industrial tools, medical devices, turbines, and industrial equipment. Several types of machinery and MWF were evaluated. Air samples were collected/analyzed by both the NIOSH 0500 and 5026 methods.

Analysis of the data indicates the mean exposure to MWF is below the draft REL of 0.5 mg/m$^3$. A comparison of the two analytical methodologies found that the NIOSH 0500 method consistently produced higher results for MWF than the NIOSH 5026 method. Other conclusions from the studies indicate the following general trends: (1) Grinders are more likely to generate operator exposure to MWF than other types of machines; (2) enclosed CNC and milling machines are not likely to generate exposures to MWF; (3) complete machine enclosure appears to be more important in preventing exposure to MWF than local exhaust ventilation; (4) measurable MWF exposures are more likely to be obtained on operators of more than one machine or who are required to frequently handle the machined pieces.

In conclusion, the majority of exposures evaluated were in compliance with the NIOSH draft REL for MWF. The NIOSH 0500 method for nuisance particulates is an acceptable screening method for MWF; however, exposure may be overestimated depending on the type of MWF in use.

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EXPOSURES TO METALWORKING FLUIDS IN SMALL-SIZE MACHINE SHOPS. G.M. Piacitelli, R. Hughes, W. Sieber, R. Glaser, NIOSH, Cincinnati, OH; J. Catalano, Prezant Associates, Inc., Seattle, WA; M. Kent, OSHA, Washington, DC

This paper presents results from an industrywide study of occupational exposures to metalworking fluids (MWFs) in small-size (less than 500 employees) machine shops. This is a joint project between the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) that is intended to assess the range of current occupational exposures to MWFs. In addition to being used for potential rulemaking, this information will help determine industrywide needs for future evaluation and control MWF exposures.

Survey sites were selected that represent a range of sizes, machining operations, machine age, fluid types, and engineering controls. A total of 80 field surveys were conducted between January 1997 and March 1998; 1 day of exposure sampling was conducted at each survey site. Full-shift personal and area samples for total and thoracic particulates were collected and analyzed for the "total mass" and the "MWF-mass" concentrations; the MWF-mass was determined using a solvent extraction procedure developed by NIOSH and the American Society for Testing and Materials (ASTM). For this presentation, data were analyzed for the initial 28 surveys. Results indicate that 70% of all total mass concentrations and 86% of MWF-mass concentrations were below 0.5 mg/m$^3$. Differences were observed in the total and MWF-mass concentrations by operation type and fluid type. In general, the highest concentrations were associated with straight fluids (geometric mean [GM] =0.50 mg/m$^3$). Grinding operations were associated with the highest average total mass concentrations (GM=0.45 mg/m$^3$) while turning operations had the highest MWF-mass concentrations (0.27 mg/m$^3$). For most samples collected, the MWF-mass contribution was about 50% of the total mass.

These results are similar to those reported in studies involving MWF-exposures in large-size machine shops in the automotive industry. Together, these data indicate that worker exposures to MWFs have declined over the past 20 years and indicate that current exposures are significantly lower than the current permissible exposure limit of 5.0 mg/m$^3$.

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VALIDATION AND OPTIMIZATION OF A SOLID SORBENT DYNAMIC PERSONAL AIR SAMPLING METHOD FOR ALDEHYDES. Y. Shen, S. Que Hee, University of California, Los Angeles, CA

A solid sorbent personal dynamic air sampling method for aldehydes using chemisorption through reaction with O-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine hydrochloride (PFBHA) has been developed and several aldehydes validated. The aim of this study was to validate this method for formaldehyde, to test the influence of temperature on sampling efficiency, and also to optimize desorption efficiency. Formaldehyde is an animal carcinogen and a suspected human carcinogen. There is need for a sensitive sampling method. Vapors of known concentrations were generated in Tedlar gas bags by syringe injection of known volumes of formalin of measured formaldehyde content. Chemisorption through reaction with 20% (w/w) PFBHA on Tenax TA solid sorbent (200 mg) in a Pyrex tube (7-cm long, 7-mm OD, and 5-mm ID) occurred during collection with a personal sampling pump operated at 10 or 50 mL/min. The oxime derivative was desorbed quantitatively (>75%) with hexane and an aliquot injected for gas chromatographic analysis on a nonpolar capillary column with $^{63}$Ni electron capture detection. Formaldehyde at 8 ppm-hours relative to the TLV-TWA concentration can be successfully sampled with a recovery of 94 ± 4%. Valeraldehyde and acrolein at their TLV-TWAs H 8 hours showed no significant differences ($P<0.05$) between the recoveries at different relative humidities (1 and 90%) and sampling temperatures (1, 25, and 401C). The critical time for desorption was 30 minutes with occasional shaking or 2 minutes for vigorous manual shaking. The desorption efficiency for valeraldehyde is 88 ± 2%, and the desorption efficiency for acrolein is 100 ± 3%.

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NEAR REAL-TIME AMBIENT AIR MONITORING IN A CHEMICAL PLANT USING EXTRACTIVE FTIR. P.W. Logan, 3M Co. Specialty Materials Division, Decatur, AL

Several EPA (Environmental Protection Agency) field analytical methods have been recently developed for the use of extractive FTIR (Fourier transform infrared) instruments in environmental monitoring. To help begin to study the feasibility of a portable extractive FTIR for ambient air monitoring and industrial hygiene applications, field tests with a commercial FTIR using extractive sampling techniques on several different chemical processes were conducted. The FTIR unit, computer, and support sampling equipment were secured on a cart and transported to the different sampling locations. Interchangeable cells with path lengths of 10 centimeters and 10 meters for the FTIR were used, respectively, in source and ambient sampling of several different chemicals. The FTIR was calibrated successfully ( ± 5%) before and after field sampling events using a 20.13, 19.8, and 2067 ppm ethylene calibration standards. The chemical agents sampled in this field study were fluoromonomers, ethylene oxide, and formaldehyde. Ambient air samples of formaldehyde taken with the FTIR and compared with a STEL (short term exposure limit) sample taken simultaneously in the same location using formaldehyde passive monitoring badge with encouraging results. Many chemicals used in the chemical industry currently do not have NIOSH-approved sampling and analytical methods for 8-hour time-weighted average, STEL, and/or ceiling samples due to poor absorption or poor sample media interaction characteristics. The FTIR equipment setup used in this field study was able to consistently provide near real-time data for several of the above listed chemicals simultaneously on processes containing more than one of the above listed chemicals. Although more rigorous field study and laboratory research is required, this preliminary field study indicates that portable extractive FTIR will become a very powerful tool for industrial hygiene in the near future.

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MULTI-BEAM SEGMENTATION STRATEGY: A NEW BEAM GEOMETRY FOR OPEN-PATH FOURIER TRANSFORMED (OP-FTIR) EXPOSURE ASSESSMENT IN WORKPLACES. R.A. Hashmonay, M. Yost, University of Washington, Seattle, WA

Exposure assessment is an essential practice for industrial hygienists in order to protect workers from gaseous contaminants. Currently, workplace personal and area exposure assessment technologies for gases and vapors have several limitations: they are costly, labor-intensive, and may not produce timely representative samples. Recently, open-path Fourier transform infrared (OP-FTIR) spectroscopy has been proposed for workplace monitoring using complex

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