Applied Occupational and Environmental Hygiene

ISSN: 1047-322X (Print) 1521-0898 (Online) Journal homepage: https://www.tandfonline.com/loi/uaoh20

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Dawn Tharr Column Editor

To cite this article: Dawn Tharr Column Editor (1993) Case Studies, Applied Occupational and Environmental Hygiene, 8:1, 13-14, DOI: 10.1080/1047322X.1993.10388108

To link to this article: https://doi.org/10.1080/1047322X.1993.10388108

Published online: 25 Feb 2011.

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Dawn Tharr, Column Editor

Case Reported by Kathryn Hoffman

Introduction

Municipal operators of street-sweeping equipment have the potential for exposure to excessive concentrations of a variety of airborne contaminants, including dusts that may contain respirable silica and asbestos fibers. Medical surveillance has shown that long-term exposure to elevated concentrations of silica dust and asbestos fibers can produce adverse health effects. The purpose of this study was to determine the level of exposure of sweeper operators to silica and asbestos.

Methods

The sweepers chosen for this study were selected randomly from several municipalities. Sweeper types included the Elgin Pelican, the FMC Vanguard, and the Elgin Whirlwind Sweepers. Air samples were collected by mounting personal air sampling pumps inside the sweeper cabs. Air samples for respirable dust and silica were collected on preweighed, 5-micron pore size, polyvinyl chloride (PVC) filters using Sensidyne Respirable Mass Samplers, or cyclone separators, calibrated to 1.7 L/min of air flow.

All weighing and laboratory analyses were performed by an accredited laboratory. Each PVC filter was desiccated and preweighed prior to shipment from the laboratory. After sampling and upon receipt at the laboratory, the filters were again desiccated and weight gain determined.

Each PVC filter was then analyzed for three forms of crystalline silica: quartz, cristobalite, and tridymite. This method does not identify noncrystalline forms of silica, including glass, amorphous silica, or vitreous silica. Each PVC filter was dissolved in tetrahydrofuran, and the suspension was filtered onto a silver membrane filter. The residue on the filter was analyzed for quartz, cristobalite, and tridymite by X-ray diffraction, and the silica content was quantified by comparison to known standards. The reported values for crystalline silica included both quartz and cristobalite. Tridymite, if present, was also reported.

NIOSH Analytical Method 7400 was used for the collection and determination of asbestos fiber concentration. The sampling method involved the collection of fibers on a 25-mm diameter, cellulose ester, open-faced filter with a 0.8-micron pore size. The fiber concentration on each filter sample was determined following Method 7400 (A rules). Wedges from each filter were examined at 400 power using phase contrast microscopy. All fibers longer than 5 microns with a length-to-width ratio of 3:1 or more were counted. These results were then compared to blanks for correction.

Results and Discussion

The air samples taken during the summer for respirable dust, silica, and asbestos fibers are presented in Table I. A review of the data shows respirable dust concentration ranging from the limit of detection (LOD) to 0.4 mg/m³. The permissible exposure limit (PEL) for respirable dust set by the Occupational Safety and Health Administration (OSHA) is 5 mg/m³. Quartz concentrations ranged from LOD to 0.05 mg/m³. The OSHA PEL for quartz is 0.1 mg/m³. Trace levels of cristobalite were detected.

Table II contains sample results from the winter-time sweeping. Respirable dust concentrations were measured as high as 2.7 mg/m³, with quartz concentrations ranging from LOD to 0.2 mg/m³. All quartz concentrations measured on the one sweeper type exceeded the OSHA PEL. Asbestos concentrations could not be determined due to the dust loading on the filters.

In reviewing the data, it should be noted that the study was severely limited because of the small sample size resulting from machine breakdown, scheduling, and an exceptionally mild winter. Other factors, which were not taken into account, include the age of the sweeper, how often the brushes were replaced, the general condition of the sweeper, and individual operator use.

The data, however, do show that exposure levels increased during the

TABLE I. Summary of Samples Collected by Sweeper Type, Summer Only

Sweeper Type (#)	Range of Air Conc. (mg/m³)	Range of Fibers (fibers/cc)
Elgin Pelican (7)	Dust: LOD(0.1)–0.4 Quartz: LOD(0.03)–LOD(0.05) Cristobalite: LOD(0.03)–LOD(0.05)	LOD(0.01)
FMC Vanguard (1)	Dust: LOD(0.01) Quartz: LOD(0.03) Cristobalite: LOD(0.03)	LOD(0.01)
Elgin Whirlwind (1)	Dust: LOD(0.2) Quartz: LOD(0.05) Cristobalite: LOD(0.05)	LOD(0.01)

LOD = Limit of detection.

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TABLE II. Summary of Samples Collected by Sweeper Type, Winter Only

Sweeper Type (#)	Range of Air Conc. (mg/m³)	Range of Fibers (fibers/cc)
Elgin Pelican (2)	Dust: 1.0–2.7 Quartz: 0.1–0.2 Cristobalite: LOD(0.04)–LOD(0.05)	Not tested, filters too dirty
FMC Vanguard	Dust: 0.1 Quartz: LOD(0.05) Cristobalite: LOD(0.05)	Not tested, filters too dirty
Elgin Whirlwind	Dust: NA Quartz: NA Cristobalite: NA	NA

LOD = Limit of detection.

winter-time sweeping and that some sweeper operators were exposed to significant amounts of silica after sanding operations. Additional sampling should be completed so that appropriate controls or personal protective equipment can be recommended.

Editorial Note: Kathryn Hoffman was formerly with the Colorado Intergovernmental Risk Sharing Agency in Denver, Colorado. More detailed information regarding this evaluation can be obtained by contacting the author at the Bureau of Land Management, Building 50, SC-672, Denver Federal Center, Denver CO, 80225, or telephone (303) 236-4186.