Bull. Environ. Contam. Toxicol. (2004) 72:542–546

DOI: 10.1007/s00128-004-0278-3

Environmental Contamination and Toxicology

Asbestos Abatement of Pipe and Floor Tile/Mastic and Comparison of Critical Plastic Barrier Controls

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Received: 2 November 2003/Accepted: 4 December 2003

Asbestos abatement has become a major industry in the United States (Hoskins, 2001) and other countries. Little information has been published on exposure during different removal practices and even less on integrated work practices (Lange et al., 2002; Lange and Thomulka, 2003). The purpose of asbestos abatement control measures is to reduce exposure concentrations below that which is likely to result in disease (Lange et al., 2002). Few studies have been published on actual asbestos abatement practices and exposure.

This study reports on airborne asbestos exposure during abatement of pipe insulation and floor tile/mastic. A comparative analysis of exposure was performed during removal of pipe insulation with and without critical barriers.

MATERIALS AND METHODS

Personal samples were collected from the breathing zone of workers during abatement of pipe insulation and floor tile/mastic (Lange and Thomulka, 2003). Abatement was conducted in an exhibition facility located in Pennsylvania, USA, during summer of 2002. Asbestos-containing material (ACM) percent, for pipe and floor tile/mastic was determined as 30-45% and 3-5%, chrysotile asbestos, respectively, by polarized light microscopy (National Institute for Occupational Safety and Health – NIOSH, 1997). Perimeter air samples for asbestos were also collected during removal of pipe insulation (Lange et al., 1996). No other ACM existed within the work areas reported in this study.

Removal of floor tile was by scraping and lifting tile using ice scrappers (manual removal) with little water applied and mastic by a solvent method with these activities occurring within a full containment (Lange et al., 1996). Pipe insulation was removed by glovebag procedure with and without critical barriers, although a multi-stage (three) decontamination station was available for both types of work (US Environmental Protection Agency-EPA 1987). Critical barriers were constructed out of 6-mill polyethylene plastic and sealed doors, windows and other openings.

These barriers did not cover all the surfaces as would be associated with a "full" containment structure (Lange et al., 2003). Negative pressure was employed using High Efficiency Particulate Air filtered negative air machines (at least four air exchanges per hour) (EPA 1987). Work areas for pipe insulation were both approximately 10,000 square feet (SF) with each having about 700 liner feet of insulation removed. All floor tile removed was 9"X9" and was about 2,000 SF. Time of actual removal for pipe insulation in each location was about 7 days and involved 3-6 workers per day and floor tile/mastic approximately 2 days using 4 workers.

Samples were collected using 25-mm diameter electrically conductive extension cowl cassettes consisting of mixed cellulose ester filters with a flow rate (nominal) of 2 liters per minute as previously described (Lange and Thomulka, 2003). Filters were analyzed using the NIOSH 7400 method employing phase contrast microscopy (PCM) (NIOSH 1997). Samples were collected as individual exposure measurements were reported as a task-length average (TLA) (Lange and Thomulka, 2003). Sampling time ranged from around 100 minutes to 400 minutes. Perimeter samples were collected for the entire work period (around 8 hours) in various locations outside the work area. Summary results were determined using the actual values provided from analysis (Lange et al., 2002) and these results were reported using three decimal places with a lower reportable value of 0.002 fibers per cubic centimeter (f/cc). If the reported exposure value was below the laboratory detection limit for that sample this measurement was included in calculations at one-half of the reported concentration (Oehlert et al. 1995). Blank samples were included with exposure cassettes submitted to the laboratory. Sample values reported were not corrected for blank values. All blank samples reported a fiber load of <3 fibers per 100 fields.

Exposure results are reported by summarized measures of central tendency (Lange et al., 2003). Comparison for critical barriers was performed using the Wilcoxin Rank Test. All statistical analysis was conducted at a 95% level.

Probability (confidence coefficient) of at least 5% of workers exceeding the occupational exposure limit (permissible exposure limit – PEL) as established by OSHA for airborne asbestos was determined using a graphic method (Leidel et al. 1977). The PEL value employed in these calculations was 0.1 f/cc. These calculations were performed using summary TLA values.

RESULTS AND DISCUSSION

All personal samples during this project were below the OSHA PEL for airborne asbestos (table). Perimeter samples, which were collected outside the regulated area, were below the PCM final clearance criterion

Table 1. Summary statistics for air samples, in f/cc, abating pipe insulation using glovebags with and without critical barriers, and floor tile and mastic at an exhibition building.

Type of Sample	Nos. of Samples	AM	GM	SD	GSD	Range
Glovebag without criticals (pipe)*	11	0.013	0.010	0.009	2.0	<0.008-0.031
Perimeter (pipe)+	14	<0.006				<0.006
Glovebag with with criticals (pipe)*	15	0.011	0.007	0.019	2.3	<0.004-0.08 [<0.022]
Perimeter (pipe)+	14	<0.005				<0.003-<0.006
floor tile/mastic*	3 (4)	0.005 (0.004)	0.004 (0.003)	0.004 (0.004)	2.2 (2.7)	<0.004-0.010 (<0.002-0.010)

arithmetic mean – AM, geometric mean - GM, geometric standard deviation – GSD, standard deviation – SD; * personal samples; [] highest value reported that was identified as below detection limit; () samples and results include one value that was collected while mastic was not being removed; + perimeter samples are for the glovebag above these data

of <0.01 f/cc. Summary values with and without criticals are similar to the final clearance level for asbestos. Probability of overexposure using the AM for with and without barriers was around 7% for both. This suggests that there is a very low likelihood of overexposure to these asbestos workers, supporting that the highest value was below the PEL.

Exposure levels from pipe insulation abatement with and without critical barriers were not significantly different. AM and GM were descriptively smaller with critical barriers when compared to without critical barriers. GSD was similar, although different when evaluated by the SD. The difference for SD's is likely a result of these data exhibiting a non-normal distribution (logarithmic) (Lange et al. 2003), a single "elevated" value of 0.08 f/cc and the large GSD for with critical barriers.

All floor tile and mastic air samples were below the PCM final clearance limit. AM was descriptively lower than pipe samples, although the range reported is similar to that of pipe samples for glovebags with criticals. This suggests that these samples may not be asbestos fibers, but rather non-asbestos fiber material representing normal background concentrations.

Historically, asbestos PCM samples greatly overestimate the actual asbestos fiber concentrations. It has been suggested that using an estimate of 50% or less of the PCM value will provide a better estimate of the actual asbestos airborne concentration (Lange, 2003). During the World Trade Center (WTC) event, OSHA suggested a modified method for counting asbestos fibers by the PCM (Wallingford and Synder, 2001). This method counted only clearly identifiable asbestos fibers and did not include Obvious Non-Asbestos Fibers in the final reported concentration. Using this method for samples at the WTC event PCM "counts" was reduced by more than 90%.

These results as suggested by other studies (Lange et al., 2002; Lange et al., 2003) of work practices and engineering controls indicate that incorporation of critical barriers when performing glovebagging of asbestos pipe insulation does not provide a benefit in reducing exposure to workers or the public. Requiring critical barriers only increases cost to the building owner, uses additional supplies and does not provide any exposure benefit. A previous study (Lange et al., 2002) suggested that no benefit is gained from using full containments as well. This investigation along with other studies (Lange et al., 2003) question the scientific value of barrier containment systems when employing glovebags.

Exposure levels associated with removal of floor tile/mastic are similar to that previously reported in other studies (Lange et al., 1996). Based on exposure levels for the pipe insulation and floor tile/mastic, there appears to be a very low probably for occupational or environmental disease. The probability of overexposure for those removing floor tile/mastic is less than 5%. Thus, personnel performing work on pipe insulation and floor tile/mastic and related types of materials, most notability ACM containing chrysotile (Ilgren, 2002), even for long periods of time, are at low risk for respiratory diseases from this type of asbestos exposure (Lange and Thomulka, 2003). A recent report (Lange, 2003) suggests that any increase in "respiratory" disease (e.g. lung cancer) in this population of workers is due to environmental tobacco smoke exposure in combination with asbestos and not asbestos alone.

Regulatory requirements of engineering controls must be sufficiently scientifically tested as to determine efficiency and effectiveness. This investigation demonstrates that use of critical barriers does not provide benefit regarding release and exposure to asbestos. Previous studies (Lange et al., 2002) have suggested that combining controls (e.g. glovebag and criticals) does not result in increased protection to workers, public or the environment. It is also suggested that those involved in limited ACM activities as well as abatement using glovebags are at low risk from asbestos related diseases. Data presented for floor tile/mastic, although limited, further suggest that this "ACM" does not warrant regulation. As reported in previous studies (Lange and Thomulka, 2003), there is little likelihood of asbestos exposure beyond that associated with background levels.

Stringent regulation of these activities is suggested to be a form of legislating science (Lange, 2002). Re-evaluation of regulated work practices involving asbestos abatement is needed so as to align the costs and activities in establishing a risk-benefit association and in establishing health-based standards (Langer and Morse, 2002; Lange, 2003). Required regulated work practices do not appear to be related to the potential exposure of asbestos and the likelihood of disease, but to imaginary risks (Lange, 2002). Additional evaluation of work practices and engineering controls are needed to better quantify the appropriate controls for this industry.

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