Bull. Environ. Contam. Toxicol. (2001) 66:146–149

DOI: 10.1007/s001280000217

Bulletin of Environmental Contamination and Toxicology

Occupational Exposure During Removal of Windows with Lead-Based Paint and Asbestos Caulking

J. H. Lange

Envirosafe Training and Consultants, Post Office Box 114022, Pittsburgh, PA 15239, USA

Received: 2 July 2000/Accepted: 11 October 2000

This study reports on personal airborne lead exposure levels of workers removing windows painted with lead-based paint (LBP) and having asbestos caulking. Abatement/Removal of windows with LBP and asbestos caulking is becoming a common practice in the United States by environmental firms. As a result of both asbestos and lead regulations, many state regulatory agencies are categorizing this type of work as abatement and specification requirements are being issued for such work (Pennsylvania Department of Labor and Industry – PDLI, 1991; 1998; Lange and Thomulka, 1995). However, little information has been published (Lange, 2000; 1992; Lange and Thomulka; 2000; 2000a; Health Effects Institute - Asbestos Research, 1991; US Department of Housing and Urban Development – HUD, 1995) on exposure levels to asbestos and lead during various work practices. Exposure results presented in this study provide some historical (objective) data for abatement of windows with asbestos-containing materials (ACM) and LBP.

MATERIALS AND METHODS

This study investigated exposure from airborne asbestos and lead during abatement of windows. ACM on windows was located in the caulking and LBP was associated with the frame. This project was located in western Pennsylvania. Abatement was undertaken in the spring of 2000. Workers had received training in lead abatement and were certified as either workers or supervisors by the PDLI.

LBP and asbestos on windows were reported to be greater than 0.5% lead and greater than one-percent asbestos, respectively. These windows were being abated/removed as part of a building renovation project. Abatement was conducted by physically removing the window with its frame. This required under some conditions cutting part of the frame and/or window into sections. Approximately 3 to 6 windows were removed per day and the project consisted of about 12 days. Number of personnel at the site during abatement ranged from three to four per day. Neither wetting nor pre-cleaning of surfaces was conducted before or during abatement. The area was restricted and asbestos and lead signs were placed for notification. Plastic was placed on the ground and inside the building before windows were removed. Waste was collected for disposal and analyzed for lead by the Toxicity Characteristic Leaching Procedure (TCLP) (HUD, 1995).

Air samples were collected as previously described (Lange and Thomulka, 2000; 2000a; Lange, 2000). Analysis for asbestos and lead samples was performed using the National Institute of Occupational Safety and Health (NIOSH) 7400 and 7082 methods, respectively (NIOSH, 1994). Flow rate for personal samples was 2 lpm (nominal) and for area samples was 5 to 15 lpm (nominal) as determined using a calibrated rotometer. Sample results were reported as a time-weighted average (TWA) for personal and non-TWA for area. Personnel performing abatement were not aware that these data were being collected for a study.

Summary occupational exposure data are reported as statistics of location (arithmetic mean - AM, geometric mean – GM) and variability (standard deviation – SD, geometric standard deviation – GSD, range) as has been described previously (Lange and Thomulka, 2000). Shapiro-Wilk (W test) and Grubbs tests were employed for determination of distribution and presence of outliers (Lange et al. 1997). Transformation of exposure data was performed using natural logarithms (Lange et al. 1997; Lange and Thomulka, 2000). Confidence interval (CI) for AM was determined using a technique for non-normal populations and employed non-transformed data (Daniel, 1991). Confidence coefficient (probability) of exceeding at least 5% "of the true daily exposure averages" was determined using a graphic method (Leidel et al. 1977; Lange et al. 1997). All statistical calculations were at the 95% level. Sample data were included in calculations at the value reported (Lange et al. 1997).

RESULTS AND DISCUSSION

Occupational (personal) exposure during abatement/removal of windows is suggested to be well below the OSHA action level (AL) (30 ug/m^3-TWA) for lead and permissible exposure limit (PEL) (0.1 f/cc-TWA) for asbestos (Table 1). The highest value reported for both asbestos and lead exposure did not exceed either the PEL or AL. CIs for asbestos and lead were 0.01 and 2.7, respectively. Based on these exposure levels, medical surveillance and PPE would not be required for those conducting abatement/removal of windows (Lange, 2000; 2000a; Lange and Thomulka, 2000; 2000a). However, reported exposure does not account for uptake of lead that may result from ingestion through a hand-to-mouth route, although this can be minimized by hand washing.

Area samples during work activities for lead and asbestos were below 15 mg/m^3 and 0.07f/cc, respectively. A single measurement for both removal

Table 1. Summary statistics for personal sample concentrations for asbestos(+) and lead(*), in f/cc and ug/m3 (TWA), for window abatement.

Number of Samples	Arithmetic Mean	Geometric Mean	Standard Deviation	Geometric Standard	Range
7+	0.01	0.006	0.013	2.5	<0.0028 - 0.0394
11*	4.2	2.8	4.5	2.3	1.2 – 15.2

of doors/door frames and stripping of LBP with a caustic stripper ("Peel Away"™) was collected. Exposure results for door/frame removal and the stripper were 5.7 and 3.2 mg/m^3, respectively.

Asbestos and lead airborne exposure data were non-normally distributed and appear to best fit a logrithmetic function (Lange et al. 1997; 1998; Burstyn and Teschke, 1999; Lange, 2000). The GSD supports these data being non-normally distributed (Lange et al. 1998). Previous studies have reported that airborne asbestos and lead are non-normally distributed and best fit a logrithmetic distribution (Lange et al. 1997; Lange, 2000). The highest lead value was an outlier at 5%, but not 1% for non-transformed data. No values for asbestos (tranformed or non-transformed) or lead were outliers when these data were transformed.

Based on GSD and SD, data for both asbestos and lead exhibit variability commonly associated with occupational exposure samples (Leidel et al. 1977; Lange et al. 1997; 1998; Lange and Thomulka, 2000). A GSD of around 2.3 represents about 75% variability among samples (Leidel et al. 1977). Graphic determination of the confidence coefficient for at least 5% or greater of personal exposure averages exceeding the AL for lead and PEL for asbestos is below 20%. As reported previously, the confidence coefficient is primarily a function of the day-to-day variation as represented by the GSD (Leidel et al. 1977; Lange and Thomulka, 2000).

TCLP results were <0.1 ppm lead. This value suggests that the leechable lead concentration is below the criterion of 5 ppm lead for defining this debris as a hazardous waste (HUD, 1995).

These results suggest that exposure to both airborne lead and asbestos during abatement of windows were well below compared occupational exposure criteria (AL, PEL). Such measurements support employment of work practices described in this study. Exposure results suggest that employment of respiratory devices are not warranted (Lange and Thomulka, 2000). Several publications (Lange and Thomulka, 2000; Lange, 2000; 2000a) have recommended that use of respirators for exposure concentrations below the substance's PEL may constitute a greater hazard than from the substance they were employed to protect against. Although caution must be applied in extrapolating these data to other projects, low exposure levels of both asbestos and lead in this study do provide descriptive data, which are historical of nature. Additional studies on exposure are warranted for varying types of asbestos and lead abatement.

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