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Personal Exposure During Abatement of Various Asbestos-Containing Materials in the Same Work Area

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Asbestos abatement is a major industry in various countries and has become highly regulated (Ilgren, 2001; Skinner, 2003). However, there remains limited information on exposure during abatement of different types of asbestos-containing materials (ACM) (Lange et al., 2003). Most asbestos abatement studies report exposure results for a single category of material that is being remediated (Lange and Thomulka, 2000).

This study reports on personal exposure concentrations from three different projects that involved removal of two or more different types of ACM and two projects involving removal of asbestos-containing floor tile only. Results provide information on exposure during abatement of combined building materials.

MATERIALS AND METHODS

Personal air samples were collected during asbestos abatement of five different projects (studies) that were performed in 2004. Samples were collected from the breathing zone as previously described (Lange et al., 2003). These projects involved time periods of three days to about four weeks and included setup and tear down. Abatement in three of the projects involved removal of more than one type of ACM in the same area and generally during the same time. Percent of asbestos in each building material was determined using polarized light microscopy. Phase contrast microscopy (PCM) was used to determine the asbestos concentration in air and is reported as fibers/cubic centimeter (f/cc). Exposure data were calculated as a task-length average (TLA) (Lange, 2004).

Airborne exposure concentrations are reported as measures of central tendency (arithmetic mean, AM, geometric mena, GM) and dispersion (standard deviation, SD, geometric standard deviation, GSD, range) (Lange and Thomulka, 2000). Values below the detection limit were used in calculations as one-half the reported concentration (Oehlert et al., 1995). The Grubbs and Shapiro-Wilk/Shapiro-Francia tests were used to evaluate samples for outliers and distribution, respectively. Outliers and distribution were evaluated at the 5% level. The probability of

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overexposure (POE) - that at least 5% of actual daily employee exposure exceeded the US Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) (0.1 f/cc-time-weighted average) - was determined using a graphic method (Leidel et al., 1977). These calculations were performed using GM and GSD for TLA values.

RESULTS AND DISCUSSION

Exposure results shown in table 1 suggest that none of the exposures exceed the OSHA PEL as indicated by the highest value reported for range as well as the POE. Both AM and GM were all well below the OSHA PEL. All distributions were non-normal. The highest SD and GSD were associated with floor tile (in study 5) that also had the highest number of samples collected. The percent asbestos in floor tile is similar to that reported in other studies (Lange, 2004) while insulation is higher than at least another previous report (Lange et al., 2003). Exposure concentrations during removal of multiple ACMs (Lange et al., 2003) and floor tile only (Lange and Thomulka, 2000) were similar to that previously reported.

These results suggest that work practices employed were effective in maintaining exposure levels below the OSHA PEL. With a low likelihood of over exposure occurring, it has been previously suggested (Lange and Thomulka, 2000) that use of respirators for protection against airborne asbestos as related to this type of work is inappropriate. Some (Lange and Thomulka, 2000) have suggested that using respirators at low level concentrations may result in greater long-term harm than benefit as a result of increased stress on the cardio-respiratory system. It has been suggested (Lange, 1993; Lange and Thomulka, 2000) that the medical surveillance examination given to workers using respirators does not provide protection against these stresses and is nothing more than a form of a regulatory work permit. These examinations are at best a gross estimation of the general physical health of the individual; thus, is not a substitute in protecting against additional physiological stress to any individual.

Thus, under current conditions associated with ACM there is little if any exposure resulting from these materials. Exposure under controlled practices is suggested to be similar regardless of the type of ACM being abated. This is supported in this study when examining exposure from individual components such as floor tile, mastic (shot blasting) and window caulking. Since these samples were collected during abatement it could be anticipated that exposure levels would be the highest under these conditions. Since the counting method used in this investigation includes all fibers, as has been previously suggested, the exposure levels reported are probably much higher than the actual airborne concentration of asbestos (Lange, 2002; Wallingford and Synder, 2001). When using the NIOSH 7400 method, some have suggested that the obvious non-asbestos fibers not be included in determination of airborne levels (Lange

Table 1. Summary statistics of asbestos exposure (f/cc) for projects

Study	No of Samples	AM	GM	SD	GSD	Range	Outlier+	POE
1	13	0.007	0.006	0.004	1.6	<0.005-<0.015	High	<5%
2	8	0.006	0.005	0.002	1.5	<0.006-<0.015	None	<5%
3	4	0.011	0.008	0.008	2.3	<0.007-<0.045	None	6%
4	6	0.004	0.004	0.001	1.3	<0.006-<0.009	None	<5%
5	63	0.014	0.009	0.013	2.4	<0.006- 0.065	High	10%

+ Only high values were outliers; POE – Probability of overexposure
Type of materials abated and percent as representing the mineralogical form chrysotile unless otherwise mentioned.
1. Floor tile (FT) – 5%, mastic (M) negative, plaster 3%, pipe insulation (PI) 65%, fitting insulation (FI) 70%;
2. boiler insulation 65% (<1% amosite), FT 65%, and PI 65%;
3&4. FT 10% and M negative;
5. PI, caulking, FT 10% and mastic (M was removed by shot blasting with 4 samples collected for a AM of 0.006, caulking had 5 samples collected with an AM of 0.005)

et al., 2003). Thus, exposure to asbestos in most buildings under reasonable conditions is unlikely to not carry any practical risk for disease and does not warrant current stringency of regulation (Lange, 2002).

REFERENCES

Ilgren EB (2001) Health risks from exposures to asbestos and inorganic metals due to collapse of the world trade center: an environmental residential survey. Indoor Built Environ 10: 361-383.

Lange JH (2004) A study on the type and amount of asbestos in floor tile and mastic. Bull Environ Contamination Toxicol (in press).

Lange JH, Thomulka KW, Sites SLM (2003) Airborne concentrations of asbestos during removal of pipe/boiler insulation using glovebags with and without containments. Fresenius Environ Bull 12: 431-434.

Lange JH (2002) How do you interpret regulations: through science or agency rules? Toxicol Ind Hlth 18: 107-108.

Lange JH, Thomulka KW (2000) An evaluation of personal airborne asbestos exposure measurements during abatement of drywall and floor tile/mastic. Int J Environ Health Res 10: 5-19.

Lange, JH (1993) A questionnaire survey during asbestos abatement refresher training for frequency of respirator use, respirator fit testing and medical surveillance. J Occup Med Toxicol 2: 65-74.

Leidel NA, Busch KA, Lynch JR (1977) Occupational Exposure Sampling Strategy Manual. DEHW (NIOSH) Publication Number 77-173, National Technical Information Service Number PB-274-792. National Institute for Occupational Safety and Health, Cincinnati, Ohio

Oehlert GW, Lee RJ, Van Orden DR (1995) Statistical analysis of fiber counts. Environmentrics 6: 115-126.

Skinner HCW (2003) Mineralogy of asbestos minerals. Indoor Built Environ 12: 385-389.

Wallingford KM, Synder EM (2001) Occupational exposures during the World Trade Center disaster response. Toxicol Ind Hlth 17:247-243.