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Personal Airborne Asbestos Exposure Levels Associated with Various Types of Abatement

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Exposure to asbestos has been associated with a number of occupational diseases (Hoskins, 2001). This has resulted in asbestos abatement of various building materials in the United States and many other countries as well as its discontinued use and installation. Currently, there is limited information on exposure levels to workers conducting various types of asbestos abatement (Lange, 2004). Information on exposure will assist epidemiologists and others in predicting future rates, appropriate levels of protection, work practices and methods in preventing occupational disease. We here provide historical – objective - data on exposure levels during abatement of various asbestos-containing materials (ACM).

MATERIALS AND METHODS

Personal air samples were colleted and analyzed as previously described (Lange, 2004). Analysis was conducted using phase contrast microscopy (PCM) with results reported as task-length average (TLA) (Lange, 2004a). Any value reported below the detection limit was included in calculations at one-half this value (Oehlert et al., 1995). Asbestos abatement was performed in various schools located in the eastern part of the United States. The time periods of these projects were summer, 2005. Abatement was performed within the general guidelines of the Occupational Safety and Health Administration (OSHA) and the US Environmental Protection Agency regulations. Materials abated contained more than 1% asbestos, which by regulatory definition is characterized as ACM. Determination of asbestos in a building material was preformed by polarized light microscopy.

Exposure results of air samples, expressed in fibers/cc (f/cc), are summarized as: measures of central tendency, arithmetic and geometric means (AM, GM); standard and geometric deviations (SD, GSD); and range. Probability of overexposure was determined for at least 5% of employees' that may be exposed above OSHA's occupational exposure limit (permissible exposure limit – PEL - 0.1 f/cc-TWA]. A graphic method was used in performing computations (Lange, 2004).

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RESULTS AND DISCUSSION

Table 1 shows that exposure concentrations for each of the projects were below the PEL. Most of the samples were below detection limits. The highest exposure levels were associated with pipe and boiler insulation (insul), which are more likely to be in a friable condition when removed. Exposure results reported here are similar to that in previous studies of similar types of building materials.

A previous study of pipe insulation abatement (Lange, 2004a), that reported results with and without using a glovebag, found AM values of 0.013 (without) and 0.011 (with) f/cc which is similar to that observed in this investigation. Similar findings appear for floor tile (FT) and mastic when compared to other studies (Lange, 2004). Two previous studies reported on exposure levels during abatement of caulking and those results (AM - 0.008 and 0.006 f/cc) (Lange and Thomulka, 2001; Lange 2004) were slightly numerically higher than that reported here. However, this difference is likely mathematical and not of any true concentration difference since both are well below the PEL and the method used, PCM, counts all fibers equally. This is one of the few studies that provide exposure data on abatement of ceiling tile, transite, roofing, and mastic without involvement of other types of ACM.

Probability of overexposure for all types of samples is below 5% except for pipe insulation which is about 27%. This value (27%) indicates the probability that at least 5% of the employees will experience exposure over the PEL (Leidel et al., 1977). The larger probability for pipe insulation is related to the high day-to-day variation represented by the GSD, which is around 77%. If the GM is used instead the probability of overexposure becomes much lower to about 10%. These results indicate that there can be a great degree of difference in likelihood of exposure depending on the mean (AM verse GM) that is applied in determining the probability. Since these are TLA values, if converted to TWA values a lower concentration would be observed along with a lower probability. This high variation for pipe insulation would suggest that a single sample is not likely to represent the true average exposure. Day-to-day variation associated with other GSD's are lower (GSD of 1.5 represents of percent probably of 47%) than that of pipe insulation.

Based on suggested threshold levels for causation of asbestos-related disease (Ilgren, 2001), it is unlikely that these workers are at risk even if they are employed in the industry for 40 years. This suggests that in many cases abatement of ACM is over regulated and can be considered a classic example of overextension of the precautionary principle. However, the high percent of smokers reported in these workers (Lange et al., 2004) suggests that preventative measures for cessation of this habit is of the greatest priority, and this would be a more effective and efficient means of disease prevention.

Table 1. Summary statistics for air samples, in f/cc, involving abatement of various types of materials.

Type of Sample	Nos. of Samples	AM	GM	SD	GSD	Range
FT/mastic	30	0.004	0.004	0.003	1.5	<0.005-0.015
Pipe insul	30	0.014	0.010	0.012	2.5	<0.005-0.053
Ceiling tile	21	0.005	0.005	0.002	1.5	<0.003-0.011
Pipe/boiler insul	19	0.010	0.009	0.003	1.4	<0.003-0.015
FT/fittings/caulking	2	0.006	0.005	0.004	2.0	<0.006-0.008
Window caulking^	5	0.003	0.003	0.007	1.3	<0.004-<0.007
Roofing^	4	0.003	0.003	0.008	1.3	<0.004-<0.007
FT/mastic^	3	0.006	0.006	0.0+	1.0+	0.006+
Transite pipe^	3	0.005	0.004	0.002	1.8	0.002-0.006
Mastic^	2	0.006	0.006	0.0+	1.0+	0.006+

range represents actual values reported; ^ same project; + all samples were the same concentration and do not allow calculation of a SD or GSD.

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