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A DUST SURVEY CARRIED OUT IN BUILDINGS INCORPORATING ASBESTOS-BASED MATERIALS IN THEIR CONSTRUCTION

J. C. BYROM, A. A. HODGSON and S. HOLMES

Asbestosis Research Council, Rochdale, Lancs.

Abstract—An assessment has been made of the amount of asbestos dust in the respirable size range present in typical situations where the principal types of asbestos-based building materials have been used. More than 60 buildings of various types have been included in the survey. In over 90 per cent of the locations sampled, the asbestos dust concentrations present in the atmosphere of the completed buildings do not exceed one-tenth of the level regarded as acceptable for occupational exposure. More than 40 per cent of the concentrations are of the same order as the level in buildings where no asbestos has been used.

INTRODUCTION

IT HAS been known for many years that prolonged exposure to high concentrations of asbestos dust could result in a progressive fibrosis of the lungs known as asbestosis. It appears that all commercial types of asbestos are involved, but it has been shown within the asbestos industry that improvements in working conditions have been accompanied by a reduction in the incidence of the disease and it has recently been possible for a Committee of the British Occupational Hygiene Society to draw up *Hygiene Standards for Chrysotile Asbestos Dust* (1968) based on occupational exposure data. It has also been recognised that asbestosis can lead to lung cancer, but where dust control has been established, the asbestosis has been reduced to such a low level that the risk of cancer is no greater than in the general population. (KNOX *et al.*, 1968).

In recent years the health problems within the industry have been complicated by the discovery that certain asbestos exposure appears to be associated with the occurrence of a very rare form of cancer known as mesothelioma, although it must be emphasised that it has not been possible to establish a connection with asbestos in all cases of this disease. The association seemed to be strongest with crocidolite (blue) asbestos, the other types (chrysotile and amosite) being implicated to a much lesser extent, amosite perhaps not at all. This new hazard has been widely publicised, because it has been suggested that minimal exposure, not necessarily occupational, was sufficient to lead to the disease (WAGNER, SLEGGS and MARCHAND, 1960; NEWHOUSE and THOMPSON, 1965). Responsible medical opinion, however, now believes that there is a dose-response relationship, not yet determined, but probably different from that for asbestosis.

The above situation has led to speculation regarding possible health risks attending many uses of asbestos and it has even been suggested that there is danger to the occupants of buildings incorporating asbestos in their construction. Although there is no evidence whatever to support this suggestion, the Asbestosis Research Council decided to carry out a dust survey, believed to be the first of its kind in the environments concerned.

DETAILS OF SURVEY

The survey comprised dust tests in 73 different locations in over 60 buildings known to incorporate asbestos or asbestos products in their construction. The buildings sampled included hospitals, schools, factories, offices, shops, places of assembly and residences. The asbestos products encountered embraced insulation boards, asbestos-cement sheeting, sprayed asbestos and other building materials, incorporating either chrysotile or amosite asbestos.

METHOD OF SAMPLING AND ASSESSMENT

The membrane filter method of sampling and evaluation (HOLMES, 1965) was used throughout the survey, the results being expressed in terms of fibres/cm³ air. White Millipore gridded membrane filters (type DAWG 025) were used. They were held in 1 in. dia. Gelman open sampling heads and Austen-Dymax diaphragm pumps were used to draw the sample air through them. The flow rate was measured with a suitable Rotameter flow meter.

The sampling heads were washed thoroughly and other sampling apparatus was also cleaned carefully. Using clean tweezers, the membrane filters were charged into the sampling heads in a 'clean' room or cabinet. They were then covered immediately with either a dust cap or adhesive tape for transport to the sampling site. The volume of air sampled was approximately 120 l. for all tests, equivalent to about 40 l. through each cm² area of filter in the 1 in. dia. Gelman heads. This gave a satisfactory deposit of dust on most samples. Pumping rates of around 2 l/min were employed, the sampling period therefore being approximately 1 hr.

The samples were fixed in the environment under test by carefully applying a 0·025% solution of polymethyl methacrylate in chloroform to the filter whilst air was drawn through it for a few seconds at the end of the sampling time. The samples were then mounted in a dust-free room or cabinet by the following technique. Several drops of filtered glycerol triacetate were placed on a clean 3 × 1 in. microscope slide (0·8–1·0 mm thick). The filter was removed by means of clean tweezers from the sampling head and placed on the glycerol triacetate, dust side uppermost. A further drop or two was then added on top of the filter. The filter was then covered with a clean cover slip (1 in. dia., No. 1½) and left for about 30 min to clear.

The cleared samples were observed in transmitted light under phase contrast conditions at a magnification of approximately 500 ×. As the density of the asbestos deposit was nearly always very low, it was necessary to count a relatively large area of the sample, 100–200 random fields of view or, if the dust was evenly distributed, several complete filter grids. A Patterson Globe and Circle eyepiece graticule was used to ascertain the size of the fibres. The optical system was exactly as that used for the occupational survey on which the recommendations given in the BRITISH OCCUPATIONAL HYGIENE SOCIETY Report (1968) were based, and the fibres counted were in the same size range, 5 and 100 μ in length with a length/dia. ratio of at least 3:1.

The fibre concentration is given by the following expression:

$$\frac{D^2N}{d^2nv}$$

where

D = Diameter of dust deposit on filter.
d = Diameter of each field of view.
v = Volume of air sample (cm³).
N = No. of fibres counted.
n = No. of fields observed.

If gridded filters are used the fibre concentration is

$$\frac{\pi D^2N}{4Anv}$$

where

A = Area of each grid unit.
n = No. of units observed.

When evaluating low concentrations such as encountered in this survey, it is necessary to assess the background contamination on the filters by means of control samples. The control membrane filters were charged into sampling heads at the same time as the filters on which test samples were to be collected. They were taken to the site of the test and fixed along with the sample membranes in an identical manner. They were mounted and counted at the same time as the samples and if the background count was found to be significant, it was subtracted from the relevant sample fibre count.

RESULTS AND CONCLUSIONS

The results of the survey are shown in Tables 1 and 2. In Table 1 the results are classified by type of asbestos product and in Table 2 by type of building. In the British Occupational Hygiene Society Report, the asbestos concentration regarded

TABLE 1. ASBESTOS DUST CONCENTRATIONS ACCORDING TO MATERIALS USED

Concentration (fibre/cm³)	Type of Material				Total	
	Insulation board	Asbestos cement sheeting	Sprayed asbestos	Others*	(No.)	(%)
0–0·005	17	2	7	8	34	46
>0·005–0·010	8	3	5	0	16	22
>0·010–0·020	6	2	2	0	10	14
>0·020–0·030	2	1	3	0	6	8
>0·030–0·040	2	0	0	0	2	3
>0·040–0·050	2	0	0	0	2	3
>0·050–0·080	2	0	1	0	3	4

*Includes fully compressed flat sheets, partition board and low density rigid panels.

TABLE 2. ASBESTOS DUST CONCENTRATIONS ACCORDING TO TYPE OF BUILDING

Concentrations (fibre/cm³)	Type of building								Total	
	Hospital	Education	Factory or storage	Office	Shop	Place of assembly	Residential	Miscellaneous	(No.)	(%)
0-0·005	4	15	3	6	1	2	3	0	34	46
>0·005-0·010	1	3	2	2	4	2	1	1	16	22
>0·010-0·020	1	0	4	0	1	1	2	1	10	14
>0·020-0·030	2	0	2	0	0	0	2	0	6	8
>0·030-0·040	0	1	0	1	0	0	0	0	2	3
>0·040-0·050	0	0	0	1	0	0	1	0	2	3
>0·050-0·080	0	0	0	2	0	0	0	1	3	4

as presenting a negligible hazard for a life-time's occupational exposure is 0·4 fibre/cm³; this leads to a non-occupational limit of 0·04 fibre/cm³, as such limits are often set at one-tenth the value adopted for occupational exposure. It will be seen that 93 per cent of the results fall within this limit and in the remaining 7 per cent (5 locations) where the level was in the range > 0·40–0·080 fibre/cm³, work was in some cases still in progress and in the others there was evidence of failure to clean up properly after completion. In order to obtain an estimate of the general environmental level of asbestos dust, a number of tests were taken in buildings which did not incorporate asbestos in their construction. The figures fell within the range 0–0·004 fibre/cm³, which is similar to 46 per cent of the cases shown in Tables 1 and 2, where the dust levels were in the range 0–0·005 fibre/cm³. Furthermore, most of the buildings sampled were built within the last two or three years and the dust levels are likely to decline further with age. It is intended that this will be checked by further tests at a later date.

In our present state of knowledge, the dust concentrations found in completed buildings incorporating asbestos-based products in their construction are not considered likely to constitute a hazard to the health of the occupants.

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