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Asbestos Exposure in the Motor Vehicle Repair and Servicing Industry in Hong Kong

INSTITUT DE L'AMIANTE
1117 OUEST, RUE SHERBROOKE — BUREAU 410
MONTRÉAL, QUÉBEC, CANADA H3A 2M8

V. K. I. CHENG and F. J. O'KELLY
Occupational Health Division, Labour Department, Hong Kong

Summary

Twelve garages representing the local motor vehicle repair and servicing industry were surveyed to assess the asbestos exposure of workers as a basis for determining health protection strategy. Chrysotile fibres arising from brake dust or machining asbestos containing friction material were present in air samples from all workplaces. With maximum levels in personal sampling averaging 0·13 fibre/ml and static sampling averaging 0·05 fibre/ml exposure appeared to be well within the accepted hygiene standards for occupational exposure. Although dust concentrations were low and the hazard of pulmonary fibrosis negligible, uncertainty about the relationship between fibre levels and carcinogenic risk indicated the need to alert local industry to possible health hazard and preventive measures by publication of an appropriate code of practice.

Introduction

Asbestos related diseases have attracted considerable attention in recent years. Much is known about the hazard of occupational exposure to raw fibres in mining, milling and manufacturing and guidelines for health protection are well established. The picture is less clear in work with asbestos-containing material where the potential for fibre escape and associated airborne pollution is relatively low, as for example in motor vehicle repair and servicing. Friction materials commonly found in brake and clutch systems contain about 50 per cent chrysotile asbestos (together with phenolic type resins as binder and various other additives to affect performance) and wear and tear may cause fibre release. Recognition of an associated health hazard is increasing and advice on prevention has been promulgated by countries such as Australia and America but control practices are not yet universal. With general assessment of occupational hazards from asbestos in Hong Kong progressing associated with review of the relevant legislation it was opportune to investigate conditions in local garages. A sample survey was undertaken to get some measures of asbestos exposure as a basis for determining health protection strategy.

Method

Excluding very small concerns with less than 5 employees where brake and clutch work was unlikely to be regular, 12 garages were chosen at random from a list of establishments registered with the local Factory Inspectorate. The largest was a bus servicing depot with 119 employees while the rest provided the usual repair and servicing facilities for a variety of vehicles. Of these, three had between 50 and 100 and the remainder less than 50 employees.

Visits were made to each garage to observe work involving friction material and measure airborne dust levels. The membrane filter sampling method associated with phase contrast optical microscopy (PCM) recommended by the Asbestos Research Council (ARC) 1971 was used. Dust samples were collected on millipore filters of diameter 25 mm and pore size 0·8 μm using Casella pumps. Filter sections were cleared with triacetin and examined at 400× magnification by PCM. Fibres with aspect ratio exceeding 3 with length greater than 5 μm and diameter under 3 μm were counted to a minimum of 200 fibres or 100 random fields and dust concentrations were determined by the standard ARC formula.

Some 25 10-minute personal samples at 1 litre per minute flow rate and 46 4-hour static samples at 2 litres per minute flow rate were collected. The personal samples were taken when the operator was either cleaning brake housing or machining friction material as representing maximum dust emission circumstances and ceiling airborne dust levels. The static samples were taken at breathing level within 5 metres of the work centre as portraying average exposure levels.

Findings

Asbestos material in clutch repairing was not encountered in any garage and it was explained that because of long life and the growing popularity of automatic fluid transmission gear systems its use was seldom necessary. On the other hand brake work was a common activity in all establishments and attention was therefore focussed on this as likely to be the main source of possible asbestos exposure.

Processes in brake work included cleaning dust from the assembly, removing old brake shoes, separating worn brake linings and fitting new ones to shoes, with possibly rivetting and bevelling the lining and reassembling. All processes were observed in bus servicing, but in the other garages the use of factory made pads with lining already fitted to new shoes reduced the need for further machining.

Dust arising from the work was obviously a possible source of asbestos. It accumulated in the brake housing and was usually cleaned out by blowing with high pressure air jet or brushing either of which methods could produce a visible dust cloud. Sawing, filing, rivetting or other machining of the friction material was another potential source of dust.

In the largest establishment a compartment was allocated to brake system maintenance and an extract fan was window-mounted behind the work bench. In the smaller garages there was no demarcation of working spaces and no arrangement for dust control.

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Table I. Air sample details

Establishment	Air Sample Type	Work Activity*	No. of Samples	Asbestos fibres per millilitre	
				Range	Mean
A	Personal	M	3	0-04–0-83	0-55
	Static		9	0-02–0-54	0-14
B	Personal	CB	2	0-01–0-01	0-01
	Static		7	0-00–0-01	0-008
C	Personal	CA	2	0-20–0-24	0-22
	Static		3	0-01–0-02	0-015
D	Personal	CA	2	0-01–0-02	0-015
	Static		3	0-00–0-02	0-01
E	Personal	CA	2	0-05–0-05	0-05
	Static		3	0-01–0-03	0-02
F	Personal	CB	2	0-08–0-08	0-08
	Static		4	0-01–0-03	0-02
G	Personal	CA	2	0-20–0-24	0-22
	Static		3	0-01–0-03	0-02
H	Personal	CB	2	0-08–0-12	0-10
	Static		3	0-00–0-01	0-005
I	Personal	CA	2	0-10–0-10	0-08
	Static		2	0-01–0-02	0-015
J	Personal	CA	2	0-04–0-12	0-08
	Static		2	0-03–0-03	0-03
K	Personal	CA	2	0-16–0-28	0-22
	Static		2	0-00–0-01	0-005
L	Personal	CA	2	0-08–0-12	0-10
	Static		4	0-02–0-09	0-06

*CA, brake cleaned by air jet; CB, brake cleaned by brushing; M, brake pad machining.

Sampling results

Details of the number of samples taken in each garage, the type of sample, the work activity in the case of personal samples and the asbestos fibre count are presented in *Table I*. In many cases the fibre concentration was less than 0·1 per millilitre and the limitations of the sampling method in giving meaningful information at dust levels below this level was appreciated. For the purposes of this survey, however, confirmation of the presence of fibres was more significant than exact quantification at low levels, and recordings below 0·1 fibre/ml were interpreted accordingly.

Asbestos was presented in the air samples from all garages. The highest levels were found in the largest establishment, Garage A, and may be taken as an index of work activity and the machining of the friction material. The high pressure air jet method of cleaning brakes was associated with above average dust recordings in Garages C, G and K, and as expected this method generally produced more airborne dust than brake brushing.

Table II. Type of sample and asbestos levels

Type of Sample	Number of Sample	Asbestos fibres per millilitre	
		Range	Mean
Personal	25	0·01–0·83	0·13
Static	46	0·00–0·54	0·05

Table II summarizes the asbestos levels in the various samples and shows a range of 0·01 to 0·83 fibres/ml with a mean of 0·13 fibre/ml in personal samples and a range of 0·00 to 0·54 fibre/ml with a mean of 0·05 in the static samples.

Discussion

Chrysotile can undergo thermal degradation to forsterite or a non-fibrous silicate phase (Lynch, 1968) and it was originally doubted that any fibres survived the high temperature generated in braking. In addition to heat, however, abrasion and other shear processes play a part in the wear and tear of friction material and free chrysotile asbestos can be liberated as confirmed by various studies (Hickish and Knight, 1970; Jacko et al., 1973; Rohl et al., 1976). The dust remaining in the brake assembly contains some of these fibres. Another source of unaltered fibres is drilling, filing or other machining of the friction material which is necessary in some brake fitting processes.

Concentrations of asbestos fibres in ambient air in Hong Kong are relatively low as shown by a recent study (Tromp, 1985) when using scanning electronic microscopy technique in combination with energy dispersion X-ray analysis the maximum level recorded was 3·3 $\mu g/m^3$ or ranging under 0·0001 fibre/ml by conversion on the basis of one nanogram to 30 fibres. These low readings may be explained by the absence of mining or major manufacturing of asbestos products in the area. Against this background the fibre levels recorded in the various garages can be accepted as rising from the work processes and a direct relationship is supported by the variation of dust concentration with work activity.

By occupational exposure standards these fibre concentrations were comparatively low. The highest average level of 0·13 fibre/ml in personal samples and the static sample average of 0·05 fibre/ml indicated the time weighed average exposure to be well within the occupational hygiene standard for chrysotile of 0·5 fibre/ml.

Exposure at such levels was unlikely to be associated with a serious risk of pulmonary fibrosis and there

appeared to be no record of such cases occurring in the industry. While asbestosis could be discounted as an occupational hazard the same did not apply to the carcinogenic risks. The relationship of Threshold Limit Values to diseases other than fibrosis is uncertain and low levels of exposure do not necessarily guarantee protection. It was also for consideration that brake debris is likely to contain an amount of small and broken fibres where disease potential is not necessarily reflected in fibre levels determined by standard counting methods. A link between garage work and cancer has not as yet been established by epidemiological study but a recently reported case of mesothelioma (Langer and McCaughey, 1982) strikes a warning note.

In answer to the pertinent question of what action was necessary in the circumstances, it seemed prudent to alert local industry to possible health hazard and advise on preventive measures. To this end a Code of Practice for control of asbestos in motor vehicle servicing and repair was published. Aspects covered by the code included the advantage of using asbestos free friction material when possible, the education of exposed persons on the hazard, the need to isolate asbestos work and control by ventilation and the personal protection and good housekeeping measures necessary to reduce the inhalation of dust.

Conclusion

The survey confirmed exposure to asbestos in commercial garages in Hong Kong. Although airborne fibre levels were low health protection consideration merited the publication of an appropriate Code of Practice.

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Requests for reprints should be addressed to: V. K. L. Cheng, Occupational Health Division, Labour Department, Harbour Building, 38 Pier Road, 15/F. Central, Hong Kong.