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INDUSTRIAL HYGIENE REPORT
ASBESTOS

READING BRAKE AND ALIGNMENT SERVICE
Reading, Ohio

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BACKGROUND

A major objective of the National Institute for Occupational Safety and Health (NIOSH) is to determine environmental exposures of working populations through research, surveys, and industrywide studies. Accordingly, NIOSH has conducted research to characterize dust exposures resulting from vehicle brake servicing operations. Of particular interest are the small diameter, potentially respirable asbestos fibers generated by these operations. Limited studies have suggested that such emissions may be associated with asbestos-induced diseases.[1]

An estimated workforce of 900,000 brake mechanics and garage workers in the U.S. are potentially exposed to asbestos.[2] An estimated 118 million pounds of asbestos are used annually in the U.S. for the production of brake friction materials.[3] In addition to asbestos, other materials which are used in the manufacture of brake linings such as lead, zinc, copper, and iron pose other potentials for exposure.

The purpose of the study was to investigate and characterize dust exposures resulting from vehicle brake maintenance and repair operations taking into account the work practices utilized.

SURVEY METHODS

Personal and general area air samples were collected at the shop during the course of the work shift. Personal air samples were collected in the breathing zone of the brake mechanic using Millipore* type AA, 37 mm diameter, 0.8 µm pore size, membrane filters at a sampling flow rate of 2.0 liters per minute (lpm). The filters were changed periodically during the work shift to prevent overloading of the collection media. The peak brake wear dust exposure during the compressed air blow-off of the right rear brake assembly of a 1971 Vega was determined by using a Gast pump calibrated at 7.48 lpm. This sample was collected on identical media as above but only during the time the mechanic was blowing dust from the brake assembly.

Hi-Volume general area samples were also collected during the work shift. These samples were collected at 10 lpm on the east and west sides of the shop and were used for trace metal analysis.

ANALYTICAL METHODS

Analysis of the membrane filters for asbestos fibers was conducted in accordance with the procedures outlined by the Occupational Safety and Health Administration[4] and the NIOSH Manual of Analytical Methods P&CAM #239.[5] These procedures require the counting of fibers greater

*Mention of manufacturer's name does not constitute a NIOSH endorsement.

than 5 micrometers in length and with at least a 3 to 1 length to width aspect ratio (fibers/cc) using phase contrast optical microscopy at a magnification of 400-450X. These samples were also analyzed on a transmission electron microscope utilizing selected area electron diffraction (SAED) and an energy dispersive X-ray analyzer (EDAX). Sample preparation and analysis were performed in the manner described in the NIOSH Technical Report, "Review and Evaluation of Analytical Methods for Environmental Studies of Fibrous Particulate Exposure".[6]

Airborne, Hi-Volume samples collected at the shop were analyzed for trace metals by atomic absorption spectrophotometry in accordance with the NIOSH Manual of Analytical Methods, Volumes 1 and 3.[5,7] the samples were analyzed for lead, zinc, copper, iron, manganese, and chromium.

RESULTS AND CONCLUSIONS

The results of the survey are shown in Tables 1, 2, and 3. A time-weighted average (TWA) concentration of 0.04 fibers/cc was found for the mechanic sampled. General area sample concentrations ranged from 0.007 to 0.014 fibers/cc for samples collected at various locations within the shop. As shown in Table 2 the trace metals were found in concentration well below the current OSHA standards[4] as well as the NIOSH recommended standards.

Also, the personal and general area samples were sized by length and diameter, and fiber concentrations (fibers/cc) determined for total fibers and fibers >5 μm in length by transmission electron microscopy (TEM). These concentrations were compared to those found by optical microscopy and are reported in Table 3. In six of the eight samples, fiber concentrations (>5 μm) determined by phase contrast optical microscopy were somewhat higher than those determined by TEM. This difference could have been caused by particulate loss during the preparation of samples for TEM and by the small number of fibers observed on each sample. Small differences in the number of fibers counted by both methods would produce significant differences in concentrations. The TEM results also indicate that the majority of the airborne fiber exposure consisted of small fibers (<5 μm in length and <1 μm in diameter).

Air samples were also collected by NIOSH at this facility in 1977. At that time sample results indicated a personal TWA exposure of 0.12 fibers/cc for the mechanic and exposures of 0.09 and 0.13 fibers/cc for general area samples. The exposures during the 1977 survey were obviously higher than those found during the 1979 survey. This difference is probably due to the fact that only two wheels of one vehicle were serviced during the sampling period in 1979.

Airborne asbestos sample results for samples collected during the survey on March 7, 1979 are within the current OSHA[4] asbestos standard, as well as the NIOSH recommended standard. The NIOSH standard recommends that the 8-hour TWA exposure to asbestos should not exceed 0.1 fibers >5 μm/cc with a ceiling exposure of 0.5 fibers >5 μm/cc for any 15 minute sampling period.

However, there was very little actual brake service activity on the day of the survey. If there would have been a greater amount of time spent in brake servicing the fibrous dust exposures would probably have been higher.

REFERENCES

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6. Zumwalde, R.D., and Dement, J.M., (1977). Review and Evaluation of Analytical Methods for Environmental Studies of Fibrous Particulate Exposures. DHEW (NIOSH) Publication No. 77-204.

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Table 1

Reading Brake
Fiber Air Sample Results
Optical Microscopy

Sample Description	Sample #	Volume (liters)	Time (min)	Concentration Fibers > 5 µm/cc
Personal - Brake Mechanic	RD-1	178	89	0.005
Personal - Brake Mechanic	RD-2	342	171	0.06
				TWA = 0.04
Peak Sample - During compressed air blow-off of right rear brakes of '71 Vega	RD-3	7.48	1	0.33
Area Sample - On tool box near service bay	RDGA-1	858	429	0.009
Area Sample - On work bench	RDGA-2	854	427	0.014
Area Sample - Next to service bay	RDGA-3	846	423	0.004
Area Sample - In office	RDGA-4	846	423	0.007
Area Sample - Next to turn down lathe	RDGA-5	828	414	0.01

TWA - Time-Weighted Average exposure for period of time sampled

Table 2

Reading Brake
Air Sample Results
Trace Metal Analysis

Sample Time (military)	Sample Volume (cubic meters) m^3	Sample Location	Trace Metals $\mu g/m^3$*					
			Pb	Zn	Cu	Fe	Mn	Cr
0922-1600	103.9	East Side of Shop	0.7	<0.1	0.1	1.3	0.03	0.06
0952-1605	112.2	West Side of Shop	0.7	0.4	0.3	23.2	0.2	0.2
		OSHA exposure standards[3] ($\mu g/m^3$)						
			50	5000	1000	10,000	5,000	N/A
		NIOSH recommended standards ($\mu g/m^3$)						
			50	5000	1000	10,000	5,000	N/A

* $\mu g/m^3$ = micrograms per cubic meter

Table 3

Reading Brake
Fiber Air Sample Results
Comparison Between TEM and Optical Microscopy Analysis

Sampling Number	Optical Microscopy	Transmission Electron Microscopy		% Fibers
	> 5 μ in length fibers/cc	> 5 μm in length fibers/cc	Total fibers fibers/cc	> 5 μm in length (TEM)
RD-1	0.005	0.0	0.0	0
RD-2	0.06	0.0	0.20	0
RD-3	0.33	0.73	1.46	50
RDGA-1	0.009	0.0	0.11	0
RDGA-2	0.014	0.0	0.08	0
RDGA-3	0.004	0.0	0.11	0
RDGA-4	0.007	0.0	0.05	0
RDGA-5	0.01	0.04	0.19	23