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EVALUATION OF AIRBORNE ASBESTOS FIBER LEVELS DURING REMOVAL AND INSTALLATION OF VALVE GASKETS AND PACKING

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This project was designed to evaluate airborne asbestos fiber levels generated during dry installation and removal of asbestos-containing gaskets and packing materials. Every effort was made to simulate work practices commonly utilized by pipefitters and maintenance personnel in the past when asbestos exposures were not a concern.

The study was conducted under a set of controlled conditions. All work was conducted in an isolated room constructed in a manner similar to an asbestos abatement project. Construction was conducted by an Illinois-licensed asbestos abatement firm.

BACKGROUND

Research Conditions

A slight negative pressure was maintained in the work area for protecting adjacent areas of the building. All personnel entered and exited the work area through a decontamination unit. All personnel in the work area wore supplied-air respirators. An Illinois-licensed asbestos worker conducted the removal and installation of the asbestos-containing materials. Removal/installation work was conducted under the supervision of an experienced union pipefitter familiar with asbestos removal work practices.

Materials Researched

Old valves with asbestos-containing gaskets and packing materials were obtained from a scrapyard that bought materials from industrial facilities. New asbestos-containing sheet gasket and packing materials were obtained directly from distributors. All researched materials were sampled and analyzed by polarized light microscopy (PLM) for asbestos content by the Chem-Bio Corporation, which is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) and by the National Institute for Occupational Safety and Health's (NIOSH's) Proficiency Analytical Testing (PAT) program. PLM results showed an asbestos content of 50% to 60% chrysotile in the gasketing materials and 30% to 50% chrysotile in the packing materials.

Work Practices

Every effort was made to make these experiments representative of past work practices involving gasket and packing material installation and removal. Work practices were utilized that simulated those normally used by trained pipefitters when there was little concern about asbestos exposure. An experienced pipefitter was on site during all testing to provide consultation and advice on how to perform specific tasks necessary to complete an operation. Tools of the trade and other tools normally available to maintenance personnel performing these tasks were utilized.

Operations of a similar type were conducted in sequence without cleaning the work area between operations except to maintain a satisfactory work space. Each type of operation was repeated five or more times. The gasket removal operations had an average duration of 32 min; gasket installation, an average duration of 31 min; packing removal, an average duration of 46 min; and packing installation, an average duration of 26 min.

The work area was wet-wiped or vacuumed free of debris and dirt following the gasket removal and installation phase and prior to the packing operations. Air monitoring (under aggressive conditions with a leaf blower) was completed prior to initiation of packing experiments to ensure work area fiber levels were reduced to background values and no cross-contamination would occur between experiments.

Air-Sampling Techniques

A high-volume vacuum pump was used to collect air samples. The pump was connected via Tygon® tubing (6-mm ID) to a manifold connected to six to nine filter cassettes placed at various locations inside the work area. Each cassette's flow was controlled with a needle valve. Airflow through each cassette was measured at the beginning and end of each run with a precision rotameter that was calibrated daily.

Two to three of the filter cassettes were positioned on the worker's left lapel for evaluating breathing zone fiber levels. One to two filter cassettes were positioned within 18 in. of the work being performed. Two to four filter cassettes were positioned in the opposite corner of the room approximately 4 ft from the work being performed. All area samples were collected approximately 5 ft from the floor and 18 in. above the worktable used to hold

TABLE I. Gasket and Valve Packing Removal and Installation

Location	Flow Rates (L/min)	Volume (L)
Personals	0.6-3.6	20, 70, 120
Center	1.4-2.8	40, 80
Corners	2.0-4.0	60, 120

the valve that was being evaluated. A fibrous aerosol monitor was also used to obtain real-time information on fiber levels.

Airflow rates and volumes were adjusted according to the type of work being conducted and the anticipated fiber levels. Multiple samples (each with a different volume) were collected at each location to minimize the impact of filter overloading and underloading. Table I lists typical airflow rates and sampling durations associated with these operations.

All samples were collected on 0.45- μ cellulose ester filters loaded in 25-mm cassettes with 50-mm nonconductive cowl.

LABORATORY ANALYSIS

General

All air samples were analyzed by using phase contrast microscopy (PCM) by the Chem-Bio Corporation, which is accredited by the American Industrial Hygiene Association (AIHA), NVLAP (for both transmission electron microscopy [TEM] and PCM analysis), and NIOSH's PAT program. All samples were further analyzed by using TEM by the same laboratory.

TABLE II. PCM and TEM Data for Gasket Removal and Installation

PCM Data					
Location	No.	Fibers/cc		GM ^A	GSD ^B
		min.	max.		
Center-R ^C	23	0.09	0.59	0.19	1.62
Center-IN ^D	12	0.11	0.35	0.19	1.35
Personal-R	23	0.05	0.44	0.16	1.91
Personal-IN	12	0.13	0.29	0.20	1.28
Northeast-R	13	0.03	0.32	0.08	1.95
Northeast-IN	6	0.13	0.19	0.16	1.16
Southwest-R	13	0.00	0.17	0.05	4.62
Southwest-IN	6	0.11	0.16	0.14	1.21
TEM Data					
Location	No.	Structures/cc		GM	GSD
		min.	max.		
Center-R	23	0.29	26.22	3.32	3.44
Center-IN	12	0.86	3.52	1.05	1.83
Personal-R	26	0.86	18.45	4.58	2.73
Personal-IN	12	0.40	74.32	2.97	3.40
Northeast-R	13	0.69	15.36	3.92	3.53
Northeast-IN	6	0.93	3.23	1.73	1.56
Southwest-R	6	0.52	12.74	2.74	3.48
Southwest-IN	6	0.91	3.53	1.66	2.00

^AGM = geometric mean.

^BGSD = geometric standard deviation.

^CR = removal.

^DIN = installation.

Gasketing Operations

PCM analysis of air samples collected during gasket removal and installation showed personal fiber levels ranging from 0.049 to 0.44 fibers/cc for removal and 0.131 to 0.29 fibers/cc for installation.

TEM analysis of air samples collected during gasket removal and installation showed asbestos fiber levels ranging from 0.86 to 18.44 structures/cc for removal and 0.40 to 74.32 structures/cc for installation. Table II shows specific sample locations and results.

Packing Materials Operations

PCM analysis of air samples collected during packing materials removal and installation showed fiber levels ranging from 0.04 to 1.01 fibers/cc for removal and 0.03 to 0.75 fibers/cc for installation.

TEM analysis of air samples collected during packing materials removal and installation showed asbestos fiber levels ranging from 0.39 to 19.57 structures/cc for removal and 0.03 to 10.88 structures/cc for installation.

Table III shows specific sample locations and results.

PRELIMINARY CONCLUSIONS

Comparison of PCM results with TEM results suggest that under these simulated working conditions, airborne asbestos levels reported by TEM analysis are 5 to 10 times higher than those reported by PCM analysis. Numerous times, PCM levels were observed to be higher than the current permissible exposure limit (0.2 fibers/cc).

Further data analysis is being conducted.

TABLE III. PCM and TEM Data for Packing Removal and Installation

PCM Data					
Location	No.	Fibers/cc		GM ^A	GSD ^B
		min.	max.		
Center-R ^C	14	0.06	0.60	0.25	2.05
Center-IN ^D	12	0.03	0.75	0.09	2.73
Personal-R	21	0.05	1.01	0.29	2.28
Personal-IN	18	0.04	0.52	0.10	2.21
Northeast-R	14	0.04	0.46	0.22	1.94
Northeast-IN	12	0.03	0.43	0.09	2.48
Southwest-R	14	0.04	0.34	0.19	1.87
Southwest-IN	12	0.03	0.46	0.09	2.26
TEM Data					
Location	No.	Structures/cc		GM	GSD
		min.	max.		
Center-R	7	0.39	18.88	5.38	3.49
Center-IN	6	0.03	10.88	0.38	7.81
Personal-R	7	0.52	19.57	4.37	3.09
Personal-IN	6	0.07	4.05	0.42	5.80

^AGM = geometric mean.

^BGSD = geometric standard deviation.

^CR = removal.

^DIN = installation.