

R & D REPORT

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DEPARTMENT

HER Industrial Hygiene

TITLE

EVALUATION OF ASBESTOS EXPOSURES TO UTILITY MEN OPERATING
THE CHLORINE CELL DIAPHRAGM DEPOSITION PROCESS, CELL
MANUFACTURING, 853 BUILDING, MIDLAND

AUTHOR'S SIGNATURE(S)

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REVIEWER'S SIGNATURE

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DESCRIPTIVE SUMMARY
WITH CONCLUSIONS:

(Include in this space references to data books, and to earlier related reports, patents and publications.)

Exposures to asbestos fibers by utility men working in 853 Building, Michigan Division, were evaluated while pulling chlorine cell diaphragms. Work area samples were also taken to estimate exposures to other personnel in the building. Measured concentrations were well within OSHA and the more stringent Dow time-weighted average exposure limits. Peak concentrations were within ceiling limits. Ventilation and work practice changes are recommended to further reduce contamination.

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PLAINTIFF'S EXHIBIT

DOW-2966

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PROBLEM

The Industrial Hygiene Laboratory was asked to re-evaluate asbestos exposures of workers in 853 Building, Michigan Division (Chlorine Cell Manufacturing Department). The operation involves drawing chlorine cell diaphragms by vacuum deposition from an asbestos slurry.

CONCLUSIONS

1. Employees with the utility man classification, who work as the pulling tank operator, the helper and the crane operator, had asbestos exposures well within acceptable time-weighted average (TWA) limits for an eight hour day.
2. Air samples taken in work areas adjacent to the pulling tank indicate that exposures to all other personnel in the building were well within limits.
3. Ceiling limits were not exceeded during the dumping of dry fibers into the diaphragm slurry.
4. Housekeeping was good and the control of dust and loose fiber on the floor, in the gratings, and on equipment

was noticeably improved. Improvements in ventilation and work practices would further reduce dust dispersion.

5. Monogoggles, rubber gloves and protective clothing are worn to prevent exposure from accidental splashes or contact with the caustic slurry. Outer clothing is changed each day.

RECOMMENDATIONS

1. The local exhaust hood should be redesigned to improve the capture of airborne fiber at the points where the dust is generated.
2. Employees near the tank should continue to wear respiratory protection during the dumping of the bags. Although ceiling limits were not exceeded in this study, the possibility of overexposure is avoided by using the mask. All other personnel should continue to stay away from the tank during this period unless protected by an approved respirator.
3. Empty bags should be carried, not thrown, to the waste pile to stop causing this source of airborne dust.

4. Loose fiber should be removed from the floor by vacuum cleaning after each cycle to reduce tracking fiber in the building.
5. An industrial hygiene survey should be carried out once every six months to help assure adequate monitoring and strict compliance to current and proposed OSHA (Occupational Safety and Health Administration) regulations and standards.

STANDARDS

The current asbestos exposure limit under OSHA regulations for an eight hour TWA basis is five fibers (over 5 microns in length) per cc of air sampled. The maximum peak concentration allowed is 10 fibers per cc of air. In July, 1976, the OSHA TWA standard will be reduced to 2 fibers per cc of air. The current Dow TWA standard is 2 fibers per cc air limit. A limit of 0.5 fibers per cc has been proposed by OSHA to replace the 1976 standard. OSHA requires a sampling interval of no greater than every six months for employees whose exposures to asbestos may reasonably be foreseen to exceed exposure limits.

DISCUSSION

Although exposures did not exceed TWA limits during recent surveys, we should monitor every six months to evaluate process changes, to assure strict compliance with current limits, and prepare us to meet the more stringent standards being proposed. Technical changes made since the last survey (HEH34.21-21-3(6)) have not changed the basic process. As before, the asbestos is received in plastic lined burlap bags and stored near the pulling tank into which the dry pulp is slurried with caustic solution. The bags are slit open by the pulling tank operator, carried to the edge of the tank and dumped in on top of the slurry surface about three feet down from the tank side. The recipe weight calls for a partial bag of asbestos which is manually weighed into a fiber pak and dumped into the tank. Visible dust rises above the tank as the dry asbestos is dumped. The operators attempted to minimize the dust and a local exhaust hood was used to capture some of the dust. This hood was only partially effective and modifications were recommended to increase the dust capture. The tank operators are required to, and do wear, approved respiratory protection during the handling of dry fiber and during the slurry preparation. Although exposure levels were within

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acceptable limits, the continued use of respirators is recommended to assure no overexposure to possible short term peak concentrations.

The deposition of the diaphragm onto the cathode assembly is essentially the same as described before. The slurry is controlled at a lower density and the deposition is done by vacuum pulling the slurry through the perforated steel cathode assembly three times instead of once, as before, to improve the quality. This has extended the cycle for one diaphragm from about 1 hour to 1 1/2-2 hours. The extra time does not increase exposure time to dry asbestos. The main exposure period to dry fibers is the beginning 5 to 15 minutes while weighing and dumping. Monogoggles, aprons and rubber gloves are used to avoid injury from any caustic that might splash out when smoothing down the diaphragm.

OBSERVATIONS

Appropriate protective clothing is available and was used. Disposable work clothing is provided for a daily change to avoid spreading contamination. Disposable clothing along with empty bags and debris are accumulated during the day and placed in plastic bags for disposal. At the end of the shift, the loose fiber around the tank is swept by vacuum using a flexible hose extension to the exhaust hood system.

There is some tracking of fiber during the day and the loose fibers should be vacuumed as soon as possible during each diaphragm cycle. During this survey, two men alternated between the pulling tank operator and the helper jobs. Normally, these jobs are not switched during a given day. Only minor variability between operators was observed. Both operators on the pulling tank threw the empty bags to an open disposal area about 10 feet away. This created observable airborne dust. Empty bags should be carried rather than thrown and placed inside a plastic disposal bag to reduce airborne contamination.

Housekeeping was very good and noticeably improved since the last survey.

VENTILATION

A local exhaust hood was used to help control dust and the exhaust from this hood is vented into the atmosphere through a filter. Figure 1 summarizes an evaluation of this hood using smoke tubes to observe the capture of airborne contamination. When placed cone face down, capture within 6 inches of the hood is reasonably effective. Capture underneath the hood appears to be effected to 18 inches down. The bags are dumped outside of this profile and much of the airborne fiber escapes to the work area. Measurements

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indicate blower capacity and duct transport velocity are adequate, but the hood configuration (conical) is poor, and should be replaced with a packaging type hood where air flow is limited to the direction where the dust is generated. A specific design will be worked out with plant supervision and installed to improve the dust capture.

SAMPLING AND ANALYTICAL

Breathing zone air samples were collected on 37 mm diameter, 0.8 micron pore size, membrane filters (in cassettes with open face). Three MSA, 8 hour (Monitaire) pumps were calibrated with these filters and were operated at 1.3 to 2.1 liters of air per minute. A Gast vacuum pump calibrated at 16.7 liters per minute was used to take breathing zone samples of the tank operator during the dusty part of the job. Work area samples were also taken with this pump to check airborne fiber concentrations away from the tank area and at the tank area during the wet part of the cycle. The MSA pumps, with tubing and filter, were worn by the operators during each diaphragm cycle. Fibers (over 5 microns in length and with a minimum 3 to 1 length to width ratio) on the filter were counted by the standard phase contrast microscopy technique at 430 magnification. Slide specimens

of the filters were prepared by the author under the supervision of H. L. Garrett of the Analytical Laboratories, Michigan Division. Counting was done by the author and by J. A. Jacoby both of the Industrial Hygiene Laboratory. Current analytical procedure for counting asbestos requires double counting. Gross differences in count are to be refereed by a trained microscopist. Both counts in this case were within 10% of each other in all but two samples and these were within 20%. The counts were averaged for the calculation of exposures. The data is filed with the original data for industrial hygiene report number HEH34.21-21-3(9).

RESULTS

Table 1 shows the breathing zone and work area asbestos levels found. The highest levels did not exceed ceiling limits. As before, the highest airborne concentrations were found next to the tank during the handling of the dry fibers. Although current ceiling limits were not exceeded, ventilation and work practices should be improved where possible to further reduce dust escape. If the OSHA standard is lowered to 0.5 fiber per cc, the ceiling values will become more stringent. Table 3 shows the highest level found was next to the tank operator and was well under the excursion ceiling of 10 fibers per cc. This was only a potential exposure in that the operator

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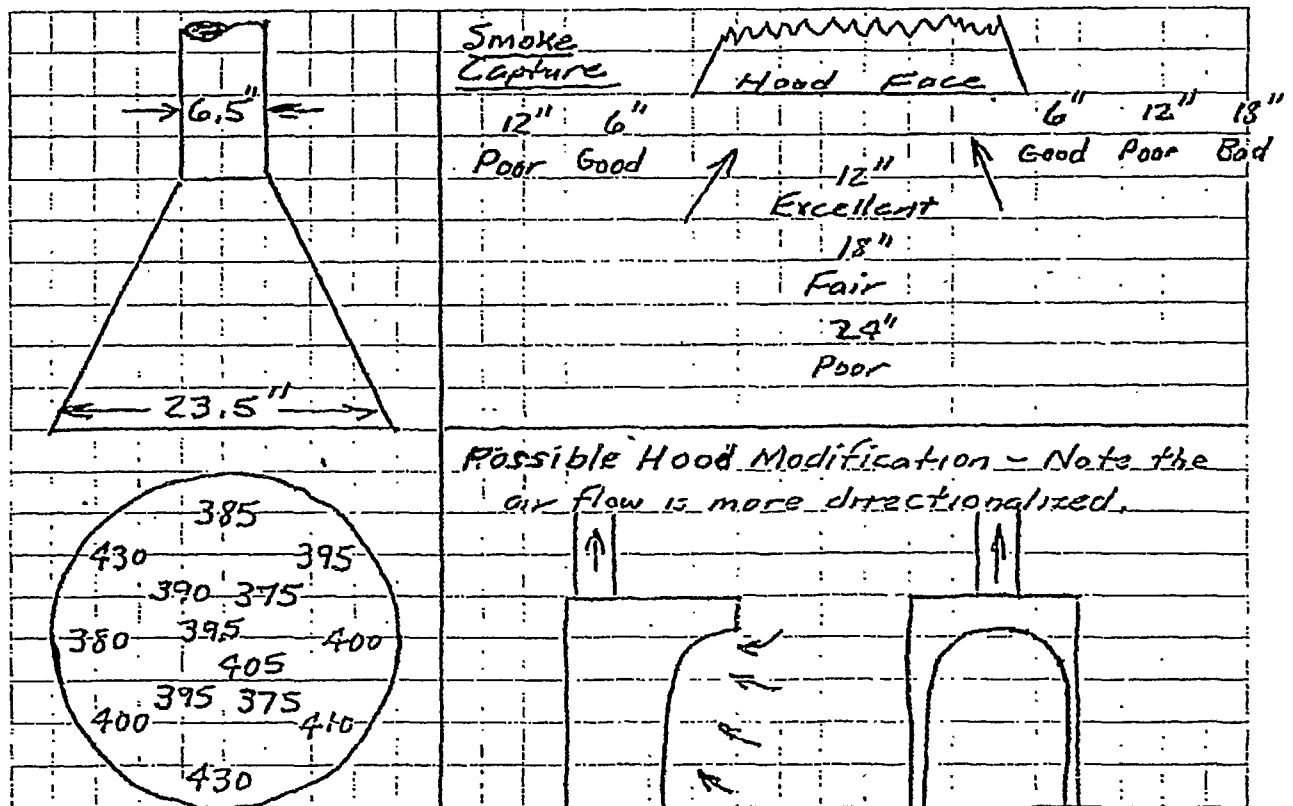
wore a respirator. Table 2 shows the TWA exposures for the three utility men who work on this process. All were well below the 2.0 fiber per cc air Dow Industrial Hygiene Guide (IHG). The calculations assume each job is covered by the same man for 8 hours. The pulling tank job shows the high exposure at 0.7 fibers per cc. OSHA is currently looking at 0.5 fibers per cc as a possible standard. Should this standard become effective, administrative control, i.e. alternating the 3 jobs between the three (or more) men, would provide a method of meeting this 0.5 fiber per cc limit. Table 4 shows a possible TWA exposure if the jobs are alternated.

Figure 1

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HOOD SURVEY DATA

FILE NUMBER <u>34.21-21-3 (9)</u>	BUILDING NUMBER <u>853</u>	DATE <u>10/10/75</u>	TYPE OF HOOD <u>Exhaust - Local</u>
HOOD LOCATION, DESIGNATION <u>Movable to area where dry asbestos fiber is being handled.</u>			
INTERNAL BAFFLE? <u>—</u>	EXTERNAL BAFFLE? <u>—</u>	CHEMICALS HANDLED IN THIS HOOD <u>Asbestos Fiber</u>	
OTHER HOODS CONNECTED TO THE SAME EXHAUST SYSTEM <u>None</u>			
SOURCES OF AIR DISTURBANCE EXTERNAL TO THIS HOOD <u>Normal air circulation & Doors nearby are usually open in good weather.</u>			
STATIC PRESSURE <u>—</u>		REMARKS <u>Hood design is poor.</u>	
<u>The hood should be revised to present a hooded enclosure facing the area where dry asbestos fibers are airborne.</u>			

RECOMMENDED MEAN FACE VELOCITY FOR THIS HOOD 100 - 150 F. P. M., DOOR OPEN — IN.RECOMMENDED EXHAUST RATE FOR THIS HOOD — C. F. M.

HOOD CONDITIONS DURING THE SURVEY

	MAXIMUM	MINIMUM	MEAN	VARIANCE (s^2)
ACTUAL FACE VELOCITIES	<u>375</u> F.P.M.	<u>430</u> F.P.M.	<u>400</u> F.P.M.	
HOOD FACE AREA DURING SURVEY	<u>3.0</u> SQ. FT.	Minimum Transport Velocity = 3000 FPM		
EXHAUST RATE DURING SURVEY	<u>1200</u> C.F.M.	Actual Transport Velocity = 25200 FPM		
MAXIMUM OPENING: HEIGHT <u>—</u> IN., WIDTH <u>—</u> IN.	MAXIMUM HOOD FACE AREA <u>—</u> SQ. FT.			

INSTRUMENT USED FOR AIR VELOCITY MEASUREMENTS

Alnor Thermoanemometer

SERIAL NUMBER

H-4

SURVEYOR

R.W. Bohl

and Standard Smoke Generating Tubes

FORM C-1250 PRINTED IN U.S.A. 8-1955

Table 1. ASBESTOS IN AIR SAMPLES TAKEN AT CELL MANUFACTURING, 853 BUILDING,
OCTOBER 10, 1975

<u>Sample</u>	<u>Description</u>	<u>Asbestos in air fibers/ml air*</u>
1	Breathing zone of utility man operating the pulling tank during one cycle (131 minutes), operator wears respirator first 30 minutes.	0.90
2	Breathing zone of utility man acting as helper during one cycle (127 minutes), no mask worn.	0.11
3	Breathing zone of utility man acting as crane operator during one cycle (58 minutes), no mask worn.	0.24
4	Breathing zone (potential exposure) of utility man operating pulling tank when weighing out and dumping the asbestos into the tank (5 minutes), sample taken outside of the respirator being worn by the man.	3.01
5	Work area, 50 feet southeast of pulling tank where workers assemble chlorine cells, 59 minutes during diaphragm pulling cycle.	0.01
6	Same as sample 1 but with a different operator, (103 minutes).	0.80

*Fibers over 5 microns in length

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Table 1. CONTINUED

<u>Sample</u>	<u>Description</u>	<u>Asbestos in air Fibers/ml air</u>
7	Same as sample 2 but with a different man, (98 minutes).	0.38
8	Same as sample 4 including unlacing the bags (11 minutes), respirator was worn.	4.25
9	Work area, 50 feet northeast in cell assembly area, 35 minutes during first part of diaphragm pulling cycle, (man working in area).	0.04
10	Work area next to pulling tank after dry pulp has been added to tank slurry, (45 minutes).	0.02
	Dow Industrial Hygiene Guide, TWA exposure limit for an eight hour day.	2.0
	Dow and OSHA ceiling exposure limit	10.0

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Table 2. TWA EXPOSURE TO ASBESTOS BY THE UTILITY MEN ON THE CHLORINE CELL CATHODE DIAPHRAGMING OPERATION, 853 BUILDING

NOTE: Three utility men perform this operation. One man operates as pulling tank operator, one as helper and the third as crane driver. Three diaphragms are deposited during the 8 hour day shift. The operators can alternate between jobs but normally do not, and the calculations assume the men do not switch jobs.

A. Utility man as diaphragm pulling tank operator

<u>Activity</u>	<u>Time during day</u>	<u>Exposure* fiber/cc</u>	<u>Time x exposure</u>
Pulling tank operation	360	0.90	324
Other work and misc.	<u>120</u>	~0	<u>0</u>
	480		324

$$\text{TWA exposure} = \frac{324}{480} = 0.7 \text{ fibers/cc air sampled}$$

Dow IHG = 2.0

B. Utility man as helper

Helper on pulling job	360	0.38	137
Other work and misc.	<u>120</u>	~0	<u>0</u>
	480		137

$$\text{TWA exposure} = \frac{137}{480} = 0.3 \text{ fibers/cc air sampled}$$

Dow IHG = 2.0

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Table 2. CONTINUED

C. Utility man as crane operator

<u>Activity</u>	<u>Time during day</u>	<u>Exposure fiber/cc</u>	<u>Time x exposure</u>
Operating crane and helping during cycles	360	0.24	86
Other work and misc.	<u>120</u>	~0	<u>0</u>
	480		86

TWA exposure = $\frac{86}{480} = 0.2$ fibers/cc air sampled

Dow IHG = 2.0

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Table 3. PEAK EXPOSURE TO ASBESTOS BY THE UTILITY MAN ON THE CELL CATHODE DIAPHRAGMING OPERATION, 853 BUILDING

NOTE: In this study and in past studies, the utility man working as the pulling tank operator has the greatest exposure potential. He wears approved respiratory protection during the time dry asbestos is being handled to assure safety.

<u>Activity</u>	<u>Exposure, fibers/ml air</u>
Weighing dry asbestos fiber into a fiber pak and dumping this fiber pak plus several bags of fiber into the pulling tank. (This operation takes about 10 minutes.)	4.25
Dow ceiling exposure limit	10.0

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Table 4. POSSIBLE TWA EXPOSURES BY UTILITY MEN IF THEY ALTERNATE JOBS DURING THE SHIFT*

<u>Activity</u>	<u>Maximum time</u>	<u>Exposure</u>	<u>Time x exposure</u>
Pulling tank job	120	0.90	108
Helper	120	0.38	46
Crane operator	120	0.24	29
Other	<u>120</u>	~0	<u>0</u>
	480		183

TWA exposure possible = $\frac{183}{480} = 0.4$ fibers/cc

Current Dow IHG and OSHA standard as of July 1976 = 2.0

Proposed NIOSH criteria (not yet approved) = 0.5

- *1. Assume no respirator worn at pulling tank.
2. This administrative control may be advisable if government TWA standards are dropped to 0.5 fibers per cc of air.