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Biochemical Research Laboratory

The Dow Chemical Company

2100

EXPOSURE TO FINE DUSTS ENCOUNTERED BY WORKERS CUTTING VARIOUS TYPES OF PIPE COVERING MATERIAL

File: T2.1-3-1
Date: July 21, 1965
By: E. J. Schneider

Signed E J Schneider Date 7/22/65

Checked H R Hoyle Date 7-22-65

DOW CONFIDENTIAL

PROBLEM

A question was raised by shop personnel after reading an article of the health hazards associated with exposure to asbestos. Is there a health hazard from asbestos in cutting various types of pipe covering material used at Dow Corning? The Environmental Research Laboratory was asked to evaluate the exposures to the fine dusts encountered by workers cutting the pipe covering material and to determine the possible health hazard.

CONCLUSIONS

1. Concentrations of total dust in excess of acceptable levels can be encountered by workers cutting pipe covering material both by hand and in using a table saw.

2. A total dust count or the number of particles per million cubic feet of air also exceeds acceptable levels at times.

3. The amount of asbestos fibers of significant length found within the dust exceeds 25 per cent of the fiber content,

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however, fibers constitute only 10 per cent of the total dust. The possibility that Dow Corning workers are being exposed to excessive amounts of asbestos fibers within the important fiber lengths (20-50 microns) is unlikely, however, it is advisable and prudent to have workers wear respiratory protection while cutting pipe covering material. This is especially true when using a table saw.

4. No one type of pipe covering material was found to have a significantly greater amount of asbestos fibers than the others. The Phillip Carey Fibercel material does produce considerable more fine dust than the others when cut.

ASBESTOS

In reviewing the literature[1] it is learned that the most common form of asbestos is known as chrysotile, a hydrous magnesium silicate containing from 12.5 to 14 per cent water of crystallization. There is another form of asbestos derived from amphibole which occurs as a variety of minerals consisting of iron, calcium and magnesium silicates with little water of constitution. This latter type of asbestos consists of shorter fibers but is more stable chemically than chrysotile and more resistant to acids and heat.

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[1] Industrial Toxicology - L. T. Fairhall, pp. 19-21, 1957.

It is this latter type of asbestos which is thought to be used in the various pipe covering material tested because x-ray diffraction analysis of the materials showed them to contain tobermorite, a calcium silicate form of asbestos.

The inhalation of asbestos dust produces a condition known as asbestosis. Asbestos is the only silicate apart from talc and mica which does not contain free silica and yet produces pulmonary lung fibrotic changes. The fibrogenic action differs from silica in that the effects are produced only by long asbestos fibers. Very short fibers appear to have little or no effect. The long fibers apparently block the finer bronchioles of the lungs and produce fibrotic changes as a result of irritation.

The literature[1] states that in the case of asbestosis unlike silicosis fibrosis does not progress indefinitely after cessation of exposure. It further states that in order to produce asbestosis in workers exposures must be in excess of 5 millions particles cubic foot for extended periods (greater than 10 years) and the fibers in the range of 10-250 μ in length. Some authorities[2] indicated that only those asbestos fibers in the 20-50 μ range are significant for producing asbestosis.

The present Industrial Hygiene Standards state that for control the number of particles of asbestos dust be kept below

[2] Industrial Hygiene and Toxicology - Frank A. Patty, Vol. I, pp. 398-399, 1958.

5 mpcf and that for nusiance dusts of any type the number of particles must be below 50 mpcf or 15 mgs total dust per cubic foot of air.

PRESENTATION OF DATA

Early in 1965 a visit was made to Dow Corning to make measurements of the dust exposures encountered by workers cutting pipe covering material. In a small room (approximately 10' x 15') adjacent to the carpenter shop building 409 a worker was asked to hand saw several pieces of the various types of pipe covering material used at Dow Corning. Air samples were collected in his breathing zone while sawing the materials. Analyses were made for both total dust and the number of particles of dust in the contaminated air

In another small room (approximately 8' x 8') part of the pipe shop building 316 tests were repeated for two different pipe covering materials while a worker used a table saw to cut the materials.

At both locations only general ventilation was used with no local exhaust system for dust collection.

The air samples collected for total dust load were later sent to Dow laboratories for x-ray diffraction analysis and then microscopic evaluation.

Table 1 shows a summary of the results obtained for the air samples by the various analytical techniques.

Table I

EXPOSURE TO FINE DUSTS ENCOUNTERED BY WORKERS CUTTING VARIOUS TYPES OF PIPE COVERING MATERIALS

Industrial Hygiene Standard, Nuisance Dusts . . . . 15 mg/m^3
Industrial Hygiene Standard, Asbestos Fibers . . . 5 M.P.C.P.

Operation	(Total Dust Exposure) mg/m^3	(Dust Count) M.P.C.P.	X-Ray Diffraction Analysis	Electron Microscope Analysis) Particle Size		(Fibers 10% of Total Dust) Fiber	Size	Other
Breathing zone of worker hand sawing Baldwin Ehret Hill [illegible] curved block 2" thick	0.45	3.2 6.4 8.5 44.6	Tobermorite (0.8-1.5) CaO . SiO_2 . (0.5-2.0) H_2O	35% 95%	<10 μ <20 μ	1% 5% 70%	<10 μ <20 μ >50 μ	25%
Repeat same material	0.09	12.6	Tobermorite (0.8-1.5) CaO . SiO_2 . (0.5-2.0) H_2O	45% 90%	<10 μ <20 μ	5% 10% 45%	<10 μ <20 μ >50 μ	45%
		Avg. 14.5						
Hand sawing Owens-Corning Kaylo flat block 2" thick	3.60	17.3 22.2	Tobermorite (0.8-1.5) CaO . SiO_2 . (0.5-2.0) H_2O	45% 90%	<10 μ <20 μ	1% 5% 70%	<10 μ <20 μ >50 μ	25%
		Avg. 19.8						
Hand sawing Phillip Carey Fiberous curved block 2" thick	17.90	7.9 12.1	Tobermorite (0.8-1.5) CaO . SiO_2 . (0.5-2.0) H_2O	45% 90%	<10 μ <20 μ	5% 10% 45%	<10 μ <20 μ >50 μ	45%
		Avg. 10.0						
Hand sawing Phillip Carey 85% flat curved block 2" thick	7.20	11.0	$3MgCO_3 . Mg(OH)_2 . 3H_2O$	35% 95%	<10 μ <20 μ	1% 5% 70%	<10 μ <20 μ >50 μ	25%
Hand sawing Baldwin Ehret Hill Thibestos flat block 2" thick	0.09	13.5	Tobermorite (0.8-1.5) CaO . SiO_2 . (0.5-2.0) H_2O	35% 95%	<10 μ <20 μ	5% 10% 45%	<10 μ <20 μ >50 μ	45%
Breathing zone of worker using table saw to cut Owens-Corning Kaylo flat block 2" thick	77.90	--	Tobermorite (0.8-1.5) CaO . SiO_2 . (0.5-2.0)H_2O	45% 90%	<10 μ <20 μ	1% 2% 80%	<10 μ <20 μ >50 μ	5%
Using table saw to cut Baldwin Ehret Hill Thibestos flat block 2" thick	53.90	58.6	Tobermorite (0.8-1.5) CaO . SiO_2 . (0.5-2.0) H_2O	35% 95%	<10 μ <20 μ	1% 5% 70%	<10 μ <20 μ >50 μ	25%

The total dust exposure is not excessive in hand sawing most of the types of pipe covering material, however, sawing the Phillip Carey Fibercel® material does produce a very fine dust and does produce excessive concentrations of dust.

The use of the table saw as would be expected produces very large quantities of dust even for a not too dusty material such as the Baldwin Ehret Hill Unibestos®.

The dust count in millions of particles per cubic foot did exceed in all cases the 5 mpcf Industrial Hygiene Standard for asbestos. However, because asbestos fibers represent approximately 10% of the total dust and because only approximately 25% of the fibers are considered of significant size, it is doubtful that workers encounter a health hazard in their normal work load of cutting pipe covering material.

The practice of using a table saw either within a shop building or out in the field should not be continued without adequate control of the dust or the use of respiratory devices. It also seems advisable to encourage workers to wear respiratory protection when hand sawing material. Any Bureau of Standards approved dust respirator should prove adequate to filter out the asbestos fibers.

UNIT INDEX

Measurements were made of the dust exposures encountered by workers cutting pipe covering material, Pipe Shop Department, Dow Corning Corporation, Midland, Michigan. Concentrations of total dust in excess of acceptable levels can be produced both in hand sawing and in the use of a table saw. The amount of asbestos fibers found did not constitute a health hazard. Respiratory protection is recommended to be worn when cutting pipe covering material.

DISTRIBUTION

Jack Quinn, Safety Department, Dow Corning Corporation (4)
H. H. Gay, M.D., Medical Department, 607 Building
A. W. Wilson, Safety Department, 401 Building
R. C. Middleton, Safety Department, Ludington Division
W. Snodgrass, Maint. Service Admin., 49 Building (7/9/71)

TO: E. J. Schneider

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

ANALYTICAL LABORATORIES

REPORT

DATE 20 May 1965 CHARGE 700-4400-003

AL NUMBER S 57-945 PROBLEM

YOUR NUMBER

DESCRIPTION HYDRATED CALCIUM SILICATE ON LATEX FILTERS

MICROSCOPY

Particle size determination

About 65%	< 10 μ
About 90%	< 20 μ
0	> 50 μ

Filters 1.5, 6, 8

About 85%	< 10 μ
About 95%	< 20 μ

Filters 2, 3, 4, 7

About 45%	< 10 μ
About 90%	< 20 μ

Fiber size determination

About 1%	< 10 μ
About 10 %	< 20 μ
About 65%	> 50 μ

Filters 7

About 1%	< 10 μ
About 2%	< 20 μ
About 90 %	> 50 μ

Filters 2,4,6

About 5%	< 10 μ
About 10 %	< 20 μ
About 45%	> 750 μ

Filters 1,3,5,8

About 1%	< 10 μ
About 5%	< 20 μ
About 70 %	> 50 μ

Fibers would account for about 10 % of the residue

SPLE. 8 REL. 12 DET. 20

BY R. Lape
bb

SIGNED P. A. Traylor

PHONE NO. 2351 BLDG. 574

PHOTOMICROGRAPHY

ALS 57-945

Photomicrographs were prepared employing Bright field y

Phase Contrast _____ Oblique Transmitted Light _____

Dark field _____ Polarized Light _____ Oblique Reflected Light _____ technique

to show particles and fibers

Label Data for 8 x 10 prints x
contact prints _____

Negative #	Sample	Microscopy	Magnif.
L5-525	Latex Filter # 2	B. F.	300X
L5-526	Latex Filter # 8	B. F.	300X

THE DOW CHEMICAL COMPANY REPORT NUMBER 168499

CHEMICAL PHYSICS RESEARCH LABORATORY

TO E. J. Schneider

DEPARTMENT Biochem Res. Lab.

BUILDING NUMBER 1701

SUBJECT X-ray Diffraction Analysis of dust samples from cutting pipe covering at Dow Corning

CHARGE NO. 1219-26

SIGNED H. W. Rinn

DATE RECEIVED 2-2-65

DATE 2-11-65

#1 (.0001 g)	Tobermorite - $XCaO \cdot SiO_2 \cdot yH_2O$ where x varies between 0.8 and 1.5 and y between 0.5 and 2.0
#2 (>.0001 g)	Same as #1
#3 (.0004 g)	Same as #1
#4 (.0020 g)	Same as #1
#5 (.0008 g)	This sample gave a very weak pattern of hydromagnesite - $3MgCO_3 \cdot MgOH)_2 \cdot 3H_2O$. There could be amorphous material present.
#6 (<.0001 g)	Tobermorite and some calcite. Pattern quite weak, probably because of small sample.
#7 (.0052 g)	Mainly tobermorite with 10-20% calcite - $CaCO_3$.
#8 (.0036 g)	Mainly tobermorite with 5-10% calcite.

No quartz was detected in any of the samples.

Note on appearance of tobermorite - from Crystallographic Data for the Calcium Silicates by Heller and Taylor.

Natural mineral from Ballycraigy: minute, radiating agregates of fibers with distinctive silky lustre on the cleavage faces.
Natural mineral from Mull or Skye: fine geared aggregates of minute, birefringent crystals.
Synthetic material: minute irregular crystals, birefringent.

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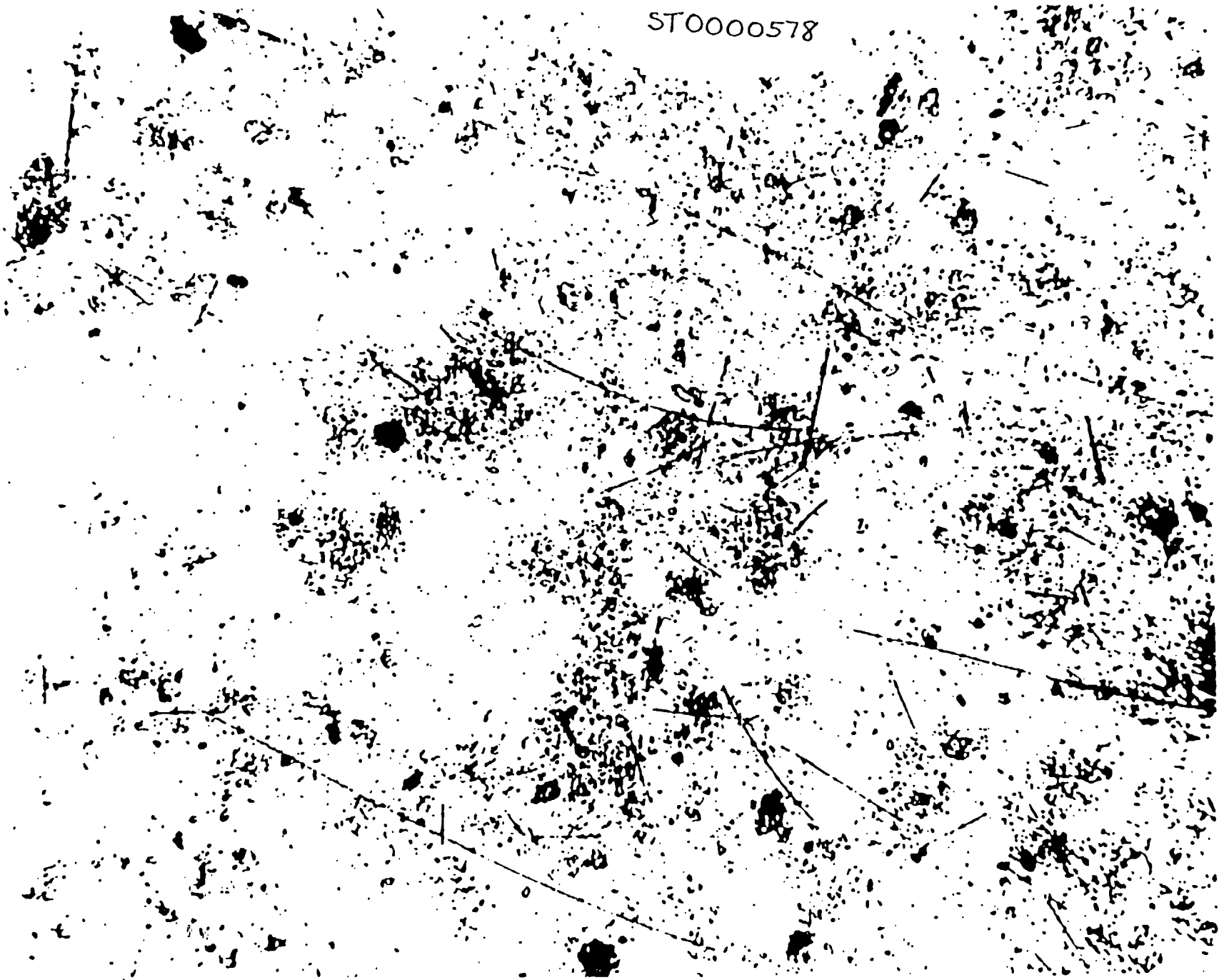

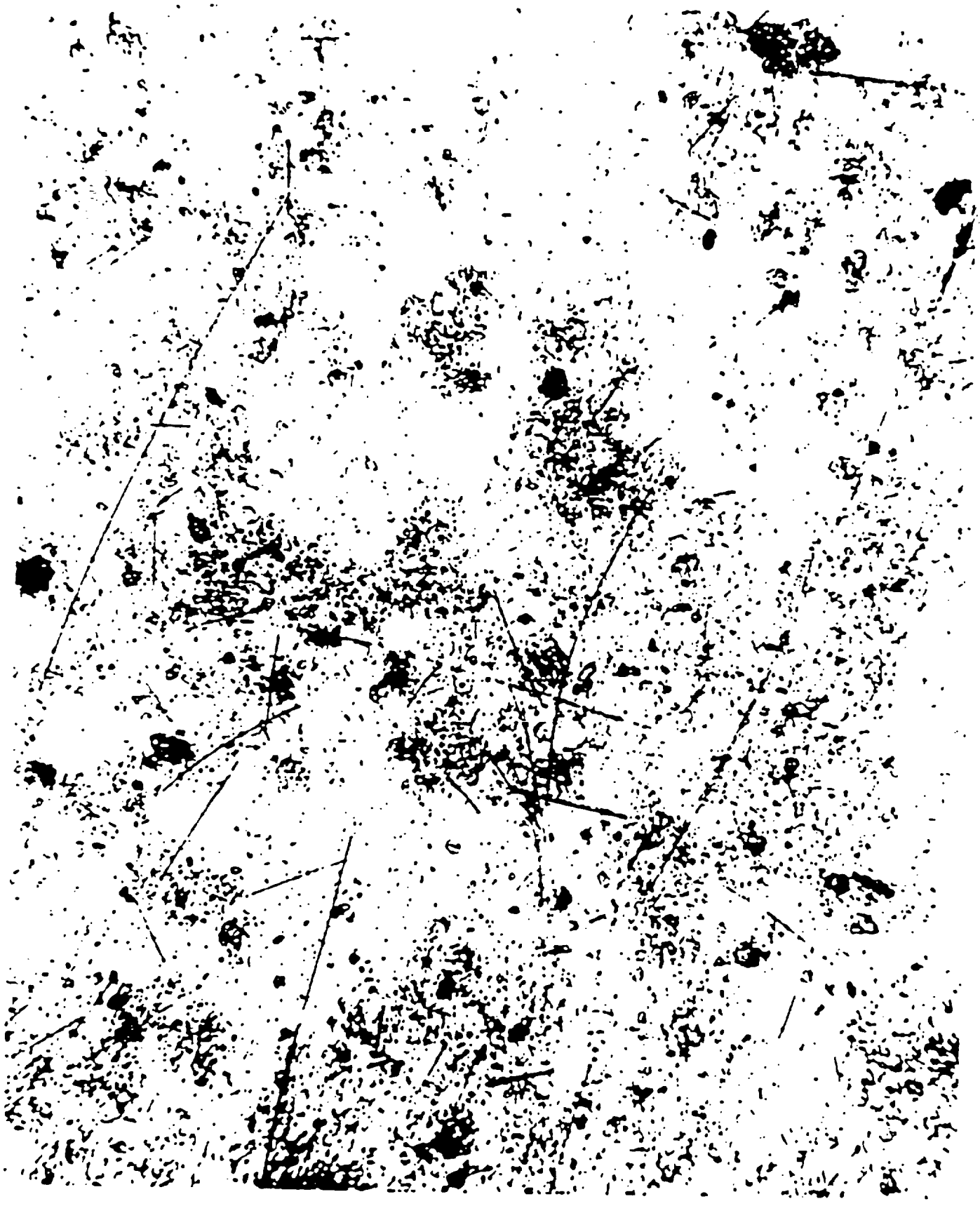

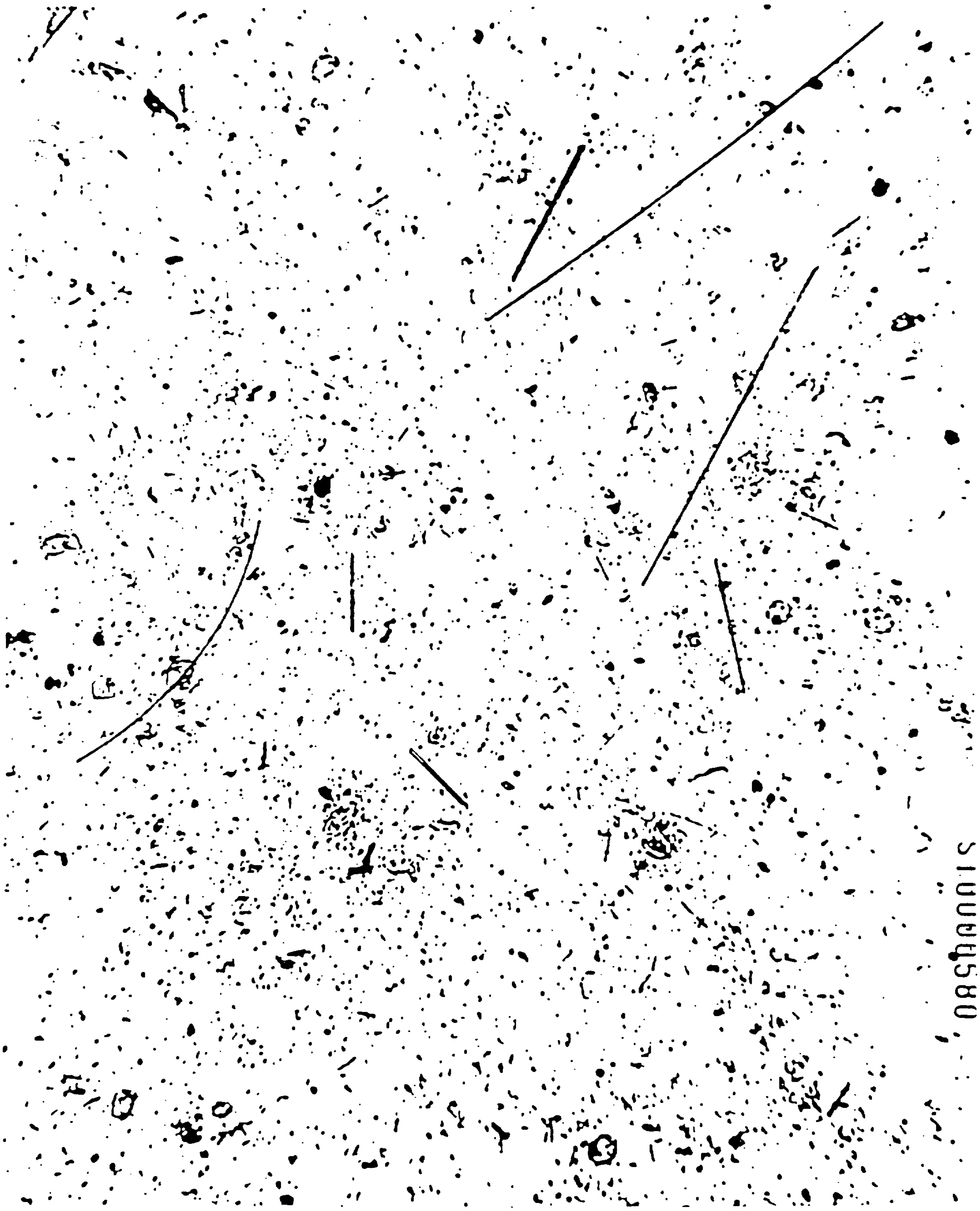

Table I

EXPOSURE TO FINE DUSTS ENCOUNTERED BY WORKERS CUTTING

Industrial Hygiene Standard, Nuisance Dust
Industrial Hygiene Standard, Asbestos Fibe

Operation	(Total Dust Exposure) mr/m³	(Dust Count) M.P.C.F.	X-Ray Diffracti
Breathing zone of worker hand sawing Baldwin Ehret Hill calcium silicate curved block 2" thick	0.45	3.2 6.4 4.8 44.6	Tobermorite (0.8-1.5) CaO . SiO
Repeat same material	0.09	12.6	Tobermorite (0.8-1.5) CaO . SiO$_2$
	Avg.	14.5	
Hand sawing Owens-Corning Kaylo flat block 2" thick	3.60	17.3 22.2	Tobermorite (0.8-1.5) CaO . SiO$_2$
	Avg.	19.8	
Hand sawing Phillip Carey Fibercel curved block 2" thick	17.90	7.9 12.1	Tobermorite (0.8-1.5) CaO . SiO$_2$
	Avg.	10.0	
Hand sawing Phillip Carey 85% MAG curved block 2" thick	7.20	11.0	$3MgCO_3 \cdot Mg(OH)_2 \cdot$
Hand sawing Baldwin Ehret Hill Unibestos flat block 2" thick	0.09	18.5	Tobermorite (0.8-1.5) CaO . SiO_2
Breathing zone of worker using table saw to cut Owens-Corning Kaylo flat block 2" thick	77.90	--	Tobermorite (0.8-1.5) CaO . SiO$_2$
Using table saw to cut Baldwin Ehret Hill Unibestos flat block 2" thick	53.90	58.0	Tobermorite (0.8-1.5) CaO . SiO$_2$

IG VARIOUS TYPES OF PIPE COVERING MATERIALS

Dusts . . . . 15 mg/m^3
Fibers . . . 5 M.P.C.F.

	Electron Microscope Analysis)		(Fibers 10% of Total Dust)		
tion Analysis	Particle Size		Fiber	Size	20-50 μ
SiO_2 . (0.5-2.0) H_2O	85% 95%	<10 μ <20 μ	1% 5% 70%	<10 μ <20 μ >50 μ	25%
SiO_2 . (0.5-2.0) H_2O	45% 90%	<10 μ <20 μ	5% 10% 45%	<10 μ <20 μ >50 μ	45%
SiO_2 . (0.5-2.0) H_2O	45% 90%	<10 μ <20 μ	1% 5% 70%	<10 μ <20 μ >50 μ	25%
SiO_2 . (0.5-2.0) H_2O	45% 90%	<10 μ <20 μ	5% 10% 45%	<10 μ <20 μ >50 μ	45%
$3H_2O$	85% 95%	<10 μ <20 μ	1% 5% 70%	<10 μ <20 μ >50 μ	25%
SiO_2 . (0.5-2.0) H_2O	85% 95%	<10 μ <20 μ	5% 10% 45%	<10 μ <20 μ >50 μ	45%
SiO_2 . (0.5-2.0)H_2O	45% 90%	<10 μ <20 μ	1% 2% 90%	<10 μ <20 μ >50 μ	8%
SiO_2 . (0.5-2.0) H_2O	85% 95%	<10 μ <20 μ	1% 5% 70%	<10 μ <20 μ >50 μ	25%

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INDUSTRIAL HYGIENE SAMPLE RECORD

SAMPLING METHOD	SAMPLE RATE	PROBLEM	BLDG.	DATE
Filter	22.3 l/min	T 2.1-3-1		1/29/65

TRAPPING MEDIUM	ROTAMETER OR ORIFICE NO.	PROCESS
Gelman Safety Filter	Pump # 1	DOW CORNING SHOPS

ROTOMETER SETTING	OUTSIDE TEMP.	INSIDE TEMP.	MATERIAL
			ASBESTOS.

VENTILATION:
Bldg 409 carpenter shop: room approx 10x15 Gen ventilation
Bldg 316 pipe shop. small room within shop. 8x8 Gen ventilation

SAMPLE	BOTTLE	DESCRIPTION	TIME START	TIME STOP	CONCENTRATION
2/31 -1	Filter #1	BZ hand sawing Baldwin Ehret Hill Calcium Silicate Curved block 2" thick	10 min.		
2/31 -2	Filter #2	Same. material.	5 min		
2/31 -3	Filter #3	BZ hand sawing Owens Corning Kaylo 2" flat block.	5 min		
2/31 -4	Filter #4	BZ hand sawing Philip Carey Fibrocel 2" ~~flat~~ curved block. very fine dust.	5 min.		
2/31 -5	Filter #5	BZ hand sawing Philip Carey 85% Mag 2" curved block	5 min		
2/31 -6	Filter #6	BZ hand sawing Baldwin Ehret Hill Unibestos 2" flat block.	5 min		
2/31 -7	Filter #7	BZ using Table saw bldg 316 to cut Owens Corning Kaylo 2" flat block very dusty	3 min		
2/31 -8	Filter #8	BZ. using table saw bldg 316 to cut BEH. Unibestos 2" flat block. very dusty	3 min		

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CALCULATIONS RECORD

PROBLEM	RATE	MATERIAL	BUILDING	DATE
T2.1-3-1	22.3 l/min	Acetone		1/24/65

MOL. WT.	CONVERSION HALOGEN TO TOTAL

ppm mg/l	PROCESS
	DOW CORNING SHOPS.

EXPLANATION OF CALCULATIONS:

SAMPLE	TIME	S. VOL.	ANALYSIS	Mg./l.	CONC.
			TOTAL WT.		Mg/M³
2131 -1	10 min	223 liters	0.1 mg	0.00045	0.45 mg
2131 -2	5 min	111.5 liters	< 0.1 mg	< .00009	< 0.09 mg
2131 -3	5 min	111.5 liters	0.4 mg	0.00364	3.6 mg
2131 -4	5 min	111.5 liters	2.0 mg.	0.0179	17.9 mg
2131 -5	5 min.	111.5 liters	0.8 mg	0.00718	7.2 mg
2131 -6	5 min	111.5 liters	< 0.1 mg	< 0.0009	< 0.09 mg
2131 -7	3 min	66.9 liters	5.2 mg.	0.0779	77.9 mg
2131 -8	3 min.	66.9 liters	3.6 mg.	0.0539	53.9 mg

INDUSTRIAL HYGIENE SAMPLE RECORD

SAMPLING METHOD	SAMPLE RATE	PROBLEM	BLDG.	DATE
B & L Dust Counter.		T2.1-3-1		1/27/65

TRAPPING MEDIUM	ROTAMETER OR ORIFICE NO.	PROCESS
		Dow Corning Shops.

ROTOMETER SETTING	OUTSIDE TEMP.	INSIDE TEMP.	MATERIAL
			Asbestos

VENTILATION:

Breathing zone of worker sawing, grinding, joint cover material

SAMPLE	BOTTLE	DESCRIPTION	[illegible]		CONCENTRATION
			No. particles $10^5/ft^3$	Size microns	Size for mics.
1		Hand sawing Baldwin Chest High Column	3.2	< 5	1-90
2		" " Suburb Block	6.4	< 5	1-5
3		" ~~" High Block~~	4.8	< 5	1-15
4		" " "	44.6	< 5	1-10
5		" " "	12.6	< 5	1-15
6		" Owens Corning Kaylo Block	17.3	< 5	1-5
7		" " "	22.2	< 5	1-100
8		" Phillip Carey Fibrecel Block	7.9	< 5	1-5
9		" " "	12.1	< 5	1-70
10		" " 85% Mag Block	11.0	< 5	1-70
11		~~Table saw~~ BCH. Unibestos	18.5	< 5	1-90
12		Table saw. BCH. Unibestos	58.6	< 5	1-70

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