1939

PLAINTIFF'S EXHIBIT

MET-792

AIR SAMPLING OF ASBESTOS DUST*

Comparison of Impinger and Electrostatic Precipitator Methods

During the past ten years, the Industrial Health Service of the Metropolitan Life Insurance Company has been studying the effect of the inhalation of asbestos dust by employees in plants in the United States and the Province of Quebec, Canada, engaged in the mining of the fiber, and the manufacture of asbestos products.

In 1929, the American asbestos industry was practically uninformed of the health hazard associated with asbestos dust, although a few British articles had been published describing cases of asbestosis contracted in English plants.

In 1927, Cooke and Hill (1) and McDonald (2) gave the first detailed description of what are known as "asbestos bodies." Asbestos fibers as long as 360 microns were described as occurring in the lung tissue of asbestos workers. We therefore made an effort to distinguish asbestos fibers in our collected air samples, and while we used the impinger method of sampling for the determination of dust counts or concentrations, we also collected a large number of samples with the electric precipitator (3) for examination of physical structure and determination of particle sizes. We were, however, unsuccessful in finding much fibrous material in the air-borne dust, and very few of length greater than 50 microns, and practically none of the 360 micron size. We found that 50% of the dust was less than 2.5 microns in the longest diameters, while 97% was less than 10 microns. These particles are of the same dimensional sizes as encountered generally in industrial plants.

Later, Fulton (4) and his associates reported that not more than 3% of the air-borne plant dust was greater than 10 microns in the longest diameter, which agrees with our findings. However, he had surveyed only one of the dozen plants and mines we had.

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*Paper given by Mr. J. Wm. Fehnel before the Twenty-Fourth Annual Meeting of the American Association of Industrial Physicians and Surgeons with American Conference on Occupational Diseases and Industrial Hygiene, Cleveland, Ohio - June 5-8, 1938.

Recently the United States Public Health Service (5) issued a comprehensive report on the asbestos textile industry, covering one of the plants we had surveyed previously, in addition to many others in other geographical locations. In their survey they took impinger samples for dust counts in order to evaluate the degree of exposure of employees engaged at various operations. On page 23, of this report, the following statement is made: "The relatively low percentage of fibers in suspended dust explains the small number of fibers observed while making dust counts of impinger samples." They determined the percentage of fibers by means of samples collected with the Owens jet dust counter, while Fulton made his fiber determinations on electric precipitator collected samples.

Recent work published by Gardner (6) indicates that chrysotile fibers less than three microns is no more active than the silicate serpentine (talc or soapstone) which has the same chemical composition but is massive rather than fibrous in structure. He states that by inhalation, chrysotile, ground to such fineness that its fibrous structure is no longer recognizable, has produced no fibrosis in guinea pigs after a year's exposure. Also, that all his observations suggest a mechanical rather than a chemical form of irritation and that the reaction to asbestos is restricted to the lungs because only these organs possess the proper structure and physiological activity to permit friction with a stiff fibrous foreign body.

Recently the electrostatic dust collector has been placed on the market. This device employs a combination of ionization and electric precipitation in entrapping dust. It is highly efficient in entrapping fine dusts and fumes.

It was therefore considered advisable to study its efficiency, as compared with the impinger, in determining asbestos dust, with the object of distinguishing fibers.

While cotton is used in the manufacture of asbestos textiles, no attempt was made to differentiate between cotton and asbestos fibers. The United States Public Health

Service [5] in their study were unsuccessful in distinguishing individual types of fibers.

The standard impinger method of sampling was used, with an air ejector to provide suction, and samples were taken simultaneously, and at the same locations, and at the same elevation, with an electrostatic precipitator.

The impinger samples were diluted to the required volume, and the electrostatic precipitator samples, washed into a standard volumetric flask, and diluted to an equal volume in preparation for counting. In some instances, further dilution on one or both duplicate samples was necessary where too heavy a concentration was encountered.

Counting was done by the light field method both for total dust and for particles distinguishable as fibers, and both factors recorded. Counts were made immediately after sampling, in order to avoid clumping and solution of particles in the case of the impinger samples.

Samples were taken at representative operations, throughout the plant, and the following tables enumerate the findings.

PREPARATION DEPARTMENT

	IMPINGER SAMPLING				ELECTROSTATIC PRECIPITATOR SAMPLING			
		Million Particles Per Cubic Foot				Million Particles Per Cubic Foot		
Sample #	Cubic Foot Air Sampled	Total Dust	Fibers	% of Fibers	Cubic Foot Air Sampled	Total Dust	Fibers	% of Fibers
1	58	8	.40	5.0	180	4	.40	10.
2	46	5	.10	2.0	144	4	.30	8.0
3	45	3	.08	3.0	180	3	.30	10.
4	56	4	.4	10.0	144	4	.30	8
5	44	2	.03	2	129	5	.40	8
6	56	5	.07	1	225	6	.50	8
7	38	3	.20	7	135	6	.50	8
8	36	3	.70	21	135	4	.50	12
Average	47	4	.30	6	159	5	.40	9

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CARDING ROOM

IMPINGER SAMPLING

Sample #	Cubic Foot Air Sampled	Million Particles Per Cubic Foot: Total Dust	Fibers	% of Fibers
1	42	2	.1	5
2	42	2	.1	5
3	44	2	.2	10
4	42	3	.1	3
5	44	3	.1	3
6	44	2	.3	15
7	44	2	.1	5
8	37	2	.2	10
9	36	2	.1	5
10	52	1	.1	10
11	45	3	.3	10
Average	43	2	.2	7

ELECTROSTATIC PRECIPITATOR SAMPLING

	Cubic Foot Air Sampled	Million Particles Per Cubic Foot: Total Dust	Fibers	% of Fibers
	135	2	.1	5
	135	2	.1	5
	135	4	.4	10
	135	3	.3	10
	135	2	.1	5
	135	3	.4	13
	135	4	.3	8
	114	3	.4	13
	114	3	.2	7
	162	2	.2	10
	135	4	.3	8
	134	3	.3	9

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MULE SPINNING

	LAPINGER SAMPLING				ELECTROSTATIC PRECIPITATOR SAMPLING			
		Million Particles Per Cubic Foot				Million Particles Per Cubic Foot		
Sample #	Cubic Foot Air Sampled	Total Dust	Fibers	% of Fibers	Cubic Foot Air Sampled	Total Dust	Fibers	% of Fibers
1	29	3	.1	3	90	4	.5	13
2	34	3	.2	7	No Sample			
3	34	3	.2	7	93	4	.6	15
Average	32	3	.2	6	92	4	.6	14

SPOOLING, TWISTING, AND WINDING

1	34	3	.1	3	135	6	2.0	33
2	44	3	.1	3	135	6	2.0	33
3	36	2	.1	5	135	4	.4	10
Average	38	3	.1	4	135	5	1.5	25

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LEAVING

	IMPINGER SAMPLING				ELECTROSTATIC PRECIPITATOR SAMPLING			
		Million Particles Per Cubic Foot				Million Particles Per Cubic Foot		
Sample #	Cubic Foot Air Sampled	Total Dust	Fibers	% of Fibers	Cubic Foot Air Sampled	Total Dust	Fibers	% of Fibers
1	44	3	.1	3	135	4	.3	8.
2	34	1	.1	10	135	3	.3	10.
3	44	3	.1	3	135	4	.4	10.
5	46	3	.4	13	135	2	.3	15.
6	44	1	.1	10	135	1	.2	20.
Average	35	2	.1	5	135	2	.3	11.

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It will be noted that from three to four times the volume of air was sampled in taking electrostatic precipitator samples, as compared with duplicate impinger samples. Average total dust concentrations agree for both methods of sampling in the preparation, carding, mule spinning, and weaving departments.

Spooling and twisting are done in the same room adjacent to looms, while the winding is done in a room next to the mule spinning frames. Pollutions from these adjacent operations may account for the variation in the total dust counts in these samples. There is also the possibility of the number of samples not being sufficient to eliminate personal or other discrepancies.

It is interesting to note the increase in the number of fibers counted in going from the preparation department, then carding, spinning, twisting into the final operation of weaving.

	PERCENTAGE OF FIBERS		
	Metropolitan Findings		United States Public Health Service Findings
	IMPINGER	ELECTROSTATIC	
Preparation Department	6	9	1-8
Carding Department	7	9	7
Mule Spinning Department	6	14	
Spooling, Twisting, and Winding	4	25	5
Weaving	5	11	12-26

The United States Public Health Service gave percentage of fibers at crushing and picking operations only, in the weave room, and no figure for spinning. From our observations of the type of operation we believe more fibers may be thrown off in mule than in ring frame spinning. We found more fiber in the spooling, twisting, and

winding than the United States Public Health Service reports, although the report is on twisting only.

Again we fall close to the United States Public Health Service average of fibers in the weaving department. Of course, we must consider the three methods of sampling involved in comparing these figures.

CONCLUSIONS

Although this report is limited to a relatively small number of comparative samples, it may be concluded that in the determination of asbestos dust in asbestos textile mills:

1. The impinger and electrostatic methods of sampling agree in the determination of total dust concentrations.
2. That the electrostatic precipitator does entrap more fibers than the impinger. There is, however, the question of any hygienic significance in the increase determined.

1. Cooke, W. E., and Hill, C. F., Journal Royal Microscopical Society, Sept. 1927, Volume 47, Pge 232.

2. McDonald, S. - British Medical Journal - 1927 - Volume 2 - Page 1025

3. Drinker, P., Thomson, R. M., and Fitchet, S. M. - "Atmospheric Particulate Matter. II - The Use of Electric Precipitation for Quantitative Determinations and Microscopy" - Journal Ind. Hygiene - Volume 5, No. 5, Page 162 (1923-24)

4. Fulton, W. B., Dooley, A., Matthews, J. L., and Houts, R. L., Asbestosis Part II. The nature and amount of dust encountered in asbestos fabricating plants. Part III The Effects of exposure to dust encountered in asbestos fabricating plants on the health of a group of workers. Pennsylvania Department of Labor and Industry - Bulletin 42, 1935.

5. United States Public Health Bulletin No. 241 - A Study of Asbestosis in the Asbestos Textile Industry - 1938 - Page 126.

6. Gardner, Leroy U. - Etiology of Pneumoconiosis - Journal of the American Medical Association - Volume III - Page 1925-1936 - November 19, 1938.