REPORT OF A DUST STUDY

OF THE CHARLESTON, S.C. PLANT

OF THE GENERAL ASBESTOS & RUBBER DIVISION

OF RAYBESTOS-MANHATTAN, INC.

1930

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INTRODUCTION

The following report is a study of dust conditions in the Charleston, South Carolina plant of the General Asbestos & Rubber Division of the Raybestos-Manhattan, Inc. This study was carried on during January, 1930 by the Industrial Health Service of the Metropolitan Life Insurance Company.

It is the second unit in a series of studies being conducted in various establishments of the asbestos industry in the United States and Canada for the purpose of determining the extent and nature of atmospheric pollution to which asbestos workers are exposed and whether there can be demonstrated any harmful effects to such workers.

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APPARATUS AND METHODS OF SAMPLING

Two methods were used in the collection of dust samples: the impinger[1] which collects the dust by aspirating the air and impinging it on to a flat surface covered by a liquid in a container, and the electric precipitator,[2] an instrument designed upon the principle of a Cottrell precipitator.

The impinger was placed in close proximity to the largest groups of workmen and at a height corresponding to the breathing level of these men. The liquid used in the container of the impinger consisted of distilled water containing 50% alcohol. The alcohol was added in order to prevent the solution of any silica which might be present in the dust. Each sample collected, using the impinger method, represented a sample of dust from a volume of air amounting to from 50 to 100 cubic feet.

The electric precipitator was placed in a position similar to that of the impinger. The air is drawn through this instrument by means of a small rotary fan, run by a motor, the quantity being measured by a flow meter. Each sample collected by the electric precipitator represented a volume of air from 10 to 50 cubic feet. These samples were used for determination of particle size. All samples were shipped to the Laboratory where counts were made of all particles, irrespective of size, found in the samples.
It has been the opinion of authorities who have studied the effects of silica dust on lungs that particles larger than 10 microns in their greatest diameter do not reach the alveoli of the lungs and therefore it has been the general

(1) "Comparative Tests of Instruments for Determining Atmospheric Dusts", Public Health Bulletin, No. 144, Treasury Department, Washington, D.C.

(2) "Determination of Suspensoids by Alternating Current Precipitators", Philip Drinker and Robert M. Thomson, Journal of Industrial Hygiene, Vol. VII, No. 6, June, 1925.

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practice to count only dust particles under 10 microns. However, in view of the publication of recent English observations that asbestos fibres as long as 200 microns have been found in lung tissue, it was decided in this study to count all sizes of particles in the samples taken at the plant in Charleston. Particle size measurements of the dust counts were made and the results are recorded in graphs and plots from which the percentage of the various sizes can be determined.

PERCENTAGE FREQUENCY OF PARTICLE SIZE

All sizes of particles visible under the microscope were counted, but in order to determine the percentage of particles less than ten microns in their longest diameter, a differential count was made.

The counts were made of samples of dust collected by means of the electric precipitator, also, because by this method the dust is collected in its original dry state and the particles are unaltered.

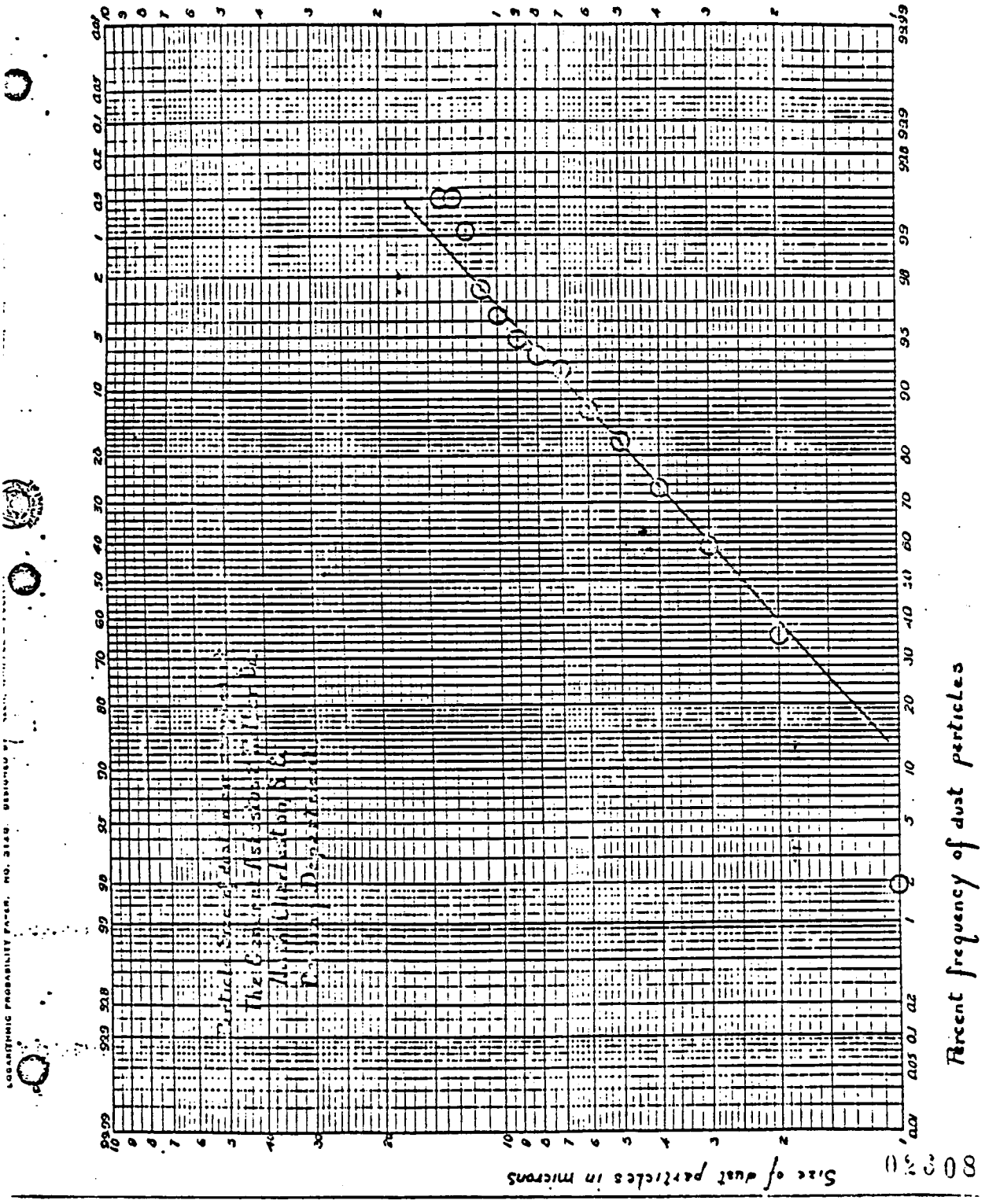
Microphotographs of these dust particles were further enlarged by being projected upon a screen by means of a lantern slide projector, the enlarged particles being measured with a ruler. Knowing the entire enlargement (by actual measurement), it was easy to calculate the original particle size. By the use of Hazen's logarithmic probability paper, the logarithms of the function to be measured - in this case microns - are plotted as ordinates against the probability of occurrence as abscissae. Since the

*Green, H. "A Photomicrographic Method for the Determination of Particle Size of Paint and Rubber Pigments", Journal Franklin Institute, 1921, 192, 627.

**Whipple, G.C. - Vital Statistics, N. Y. John Wiley & Sons, Inc., 1935, p. 451.

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Size of dust particles in microns
Percent frequency of dust particles

line is straight, extrapolation and interpolation of any desired region is facilitated.

It will be noted from these curves that 96% of the particles are less than 10 microns in their greatest diameter.

The attached floor plans indicate locations of air sampling. The numbers encircled correspond to the sample number in the table of results.

The analyses are reported in total particles per cubic foot and also in the corresponding weight of the dust in milligrams. There is no indicated relationship between the dust counts and the corresponding weights.

DESCRIPTION OF PLANT

The plant at Charleston consists of seven buildings, as follows. A two-story frame office building, the lower floor of which is used for storage purposes and the second floor for offices; two buildings of brick, one of which houses the machine shops and supply department, located on the first floor, and the second floor of this building is used for collecting dust exhausted from the manufacturing process; the other brick building houses the spinning department on the first floor and the carding department on the second; one concrete building is occupied by the rubber compounding department on the first floor and the weaving department on the second; two one-story frame buildings, the one being used for storage and the other as a packing department; and a one-story frame building covered with corrugated iron which is used as a preparation department.

PREPARATION DEPARTMENT

Asbestos is received in bags and these are emptied upon the floor and the asbestos is shoveled into pug mills and run for about five minutes in

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order to crush and open the fibres. From here the asbestos is shoveled into trucks and wheeled over to hoppers of either horizontal or vertical openers, similar to those used in the textile mills where the material is shoveled into hoppers. After passing through the opener the material is discharged into trucks. Waste manufacturing material is first run through a garnet machine and discharged into trucks which are wheeled over to the openers and the material is fed into these in the same manner as the new material. The waste material, after being discharged from the openers is put on to a vibrating or shaking screen where the long fibres are picked off by a suction hood and blown into a bin to be used again in textiles. The short fibres falling through the screen are either sold as such or used in making an asbestos cement.

The cotton is received in bales, opened, and also run through vertical openers. It is discharged into trucks. The filled trucks from the vertical and horizontal openers containing either the asbestos fibre, the cotton or the waste material are transported to separate storage bins. As needed these materials are weighed and dumped on to the floor in proportion to the mixture desired and the resulting mixed materials are then passed through a mixing picker. As this mixture is discharged from the picker, it is sprayed with a light mineral oil. The material is then passed on to a conveyor and taken to the storage bin in the card room. Two of these mixing pickers discharge on to this conveyor system, while a third machine is equipped with a suction device which conveys the material to a storage bin in the card room. The object of the two systems is to facilitate the handling of two grades of material at the same time. This third machine

is not equipped with an oil spray. The object of the oil spray is primarily to entrain the small asbestos fibres and hold them enmeshed in the cotton fibre throughout the processes of carding, spinning, and weaving. Incidentally, it is apparent that it also diminishes the amount of dust. The material is saturated with about 4% of oil at this point, but by the time it reaches the looms the oil has diminished to less than 1%.

Dust samples were collected in various sections of the preparation room, as indicated on the floor plans and the collectors were placed at the breathing level of the workmen. All particles less than 400 microns in length were counted and the results are here given.

Metropolitan Life Insurance Company, Report of a Dust Study of Raybestos-Manhattan's Charleston Plant (1930) Published by AsbestosClaims.Law
ACL Doc 11754 · Page 9 of 30 asbestosclaims.law/library/11754/9

TABLE #1

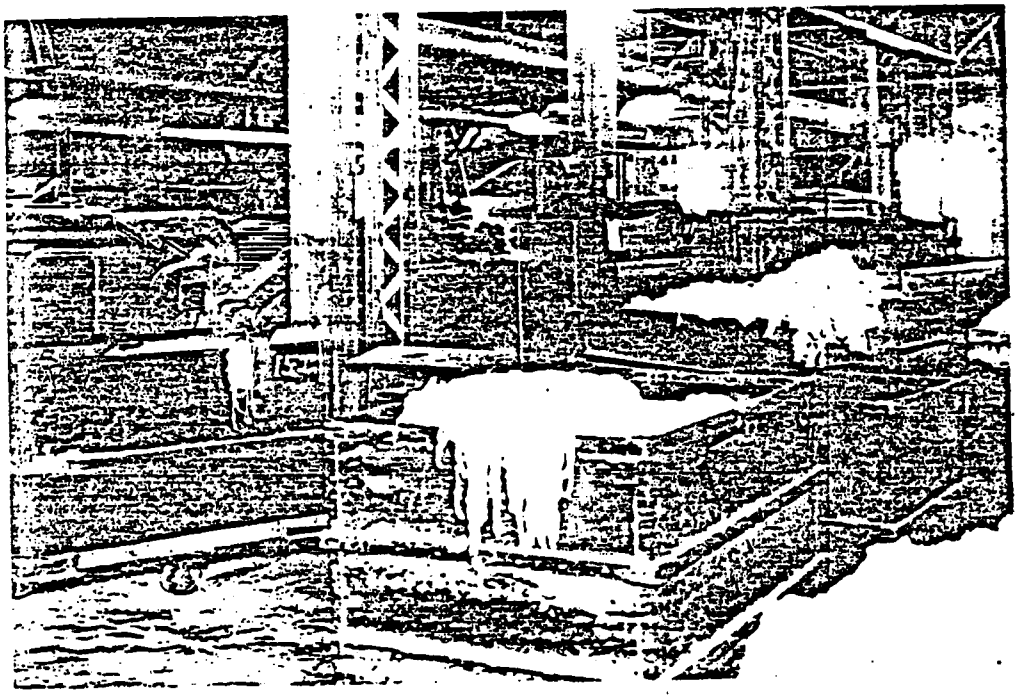
PREPARATION ROOM

Sample No.	Location	Total Count in Particles per cubic foot of air		Weight of dust in mg. per cubic foot of air
1	Garnet machine Feeder end - waste material	5,575,968	37	.74
2	Take-off end shaker sieve waste from vertical openers	4,045,780	24	1.40
3	Feed end of vertical opener asbestos fibre	2,524,534	15	10.10
4	Alongside of No. 3 chaser asbestos fibre	3,821,138	22	.45
7	Feeder end horizontal opener - asbestos fibre	7,975,421	48	1.27
8	Alongside of No. 1 chaser asbestos fibre	1,504,065	9	.64
11	Take-off end of horizontal opener	1,219,512	7	.20
12	Feeder end of No. 1 picker	5,155,038	30	1.10
13	Take off end of No. 1 picker discharging on to conveyor to card room	550,795	3	.40

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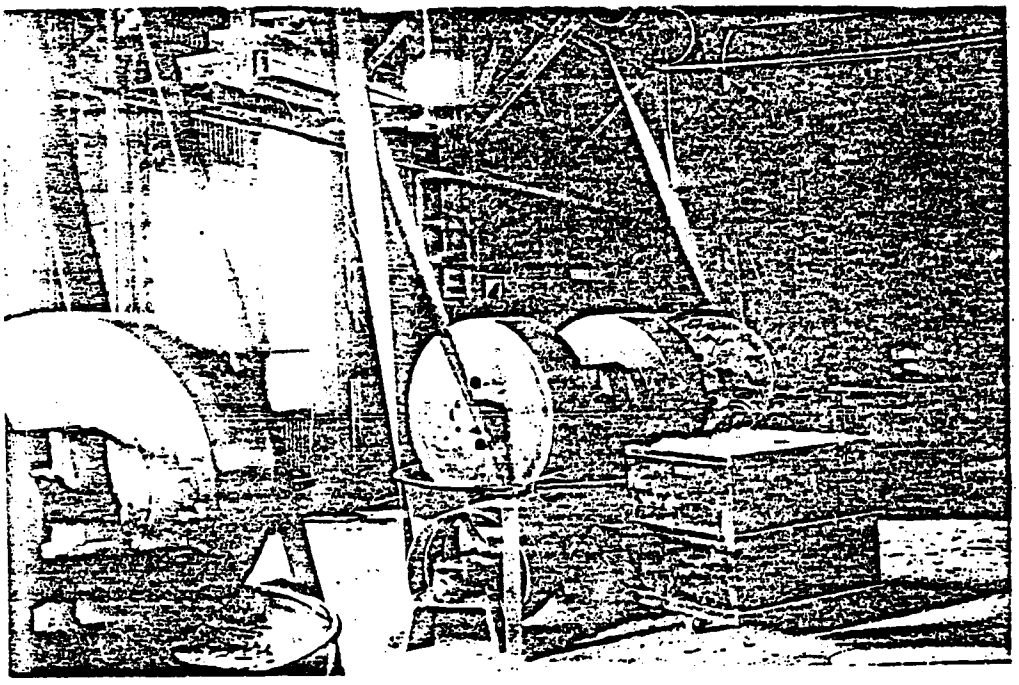
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Trucking of material in Preparation Room

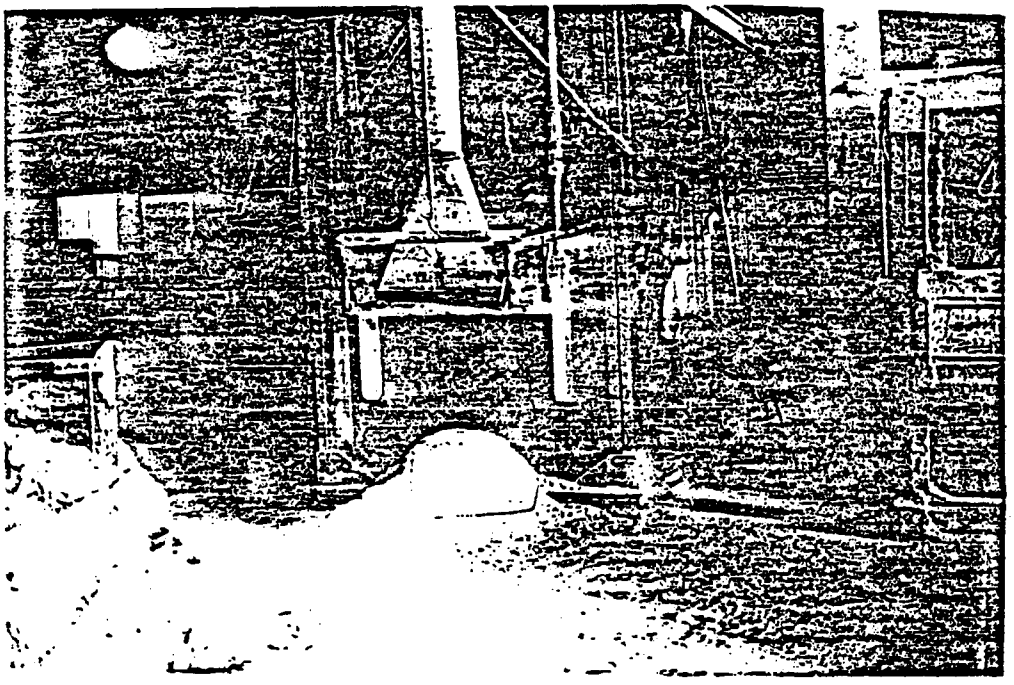
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Pug Mills

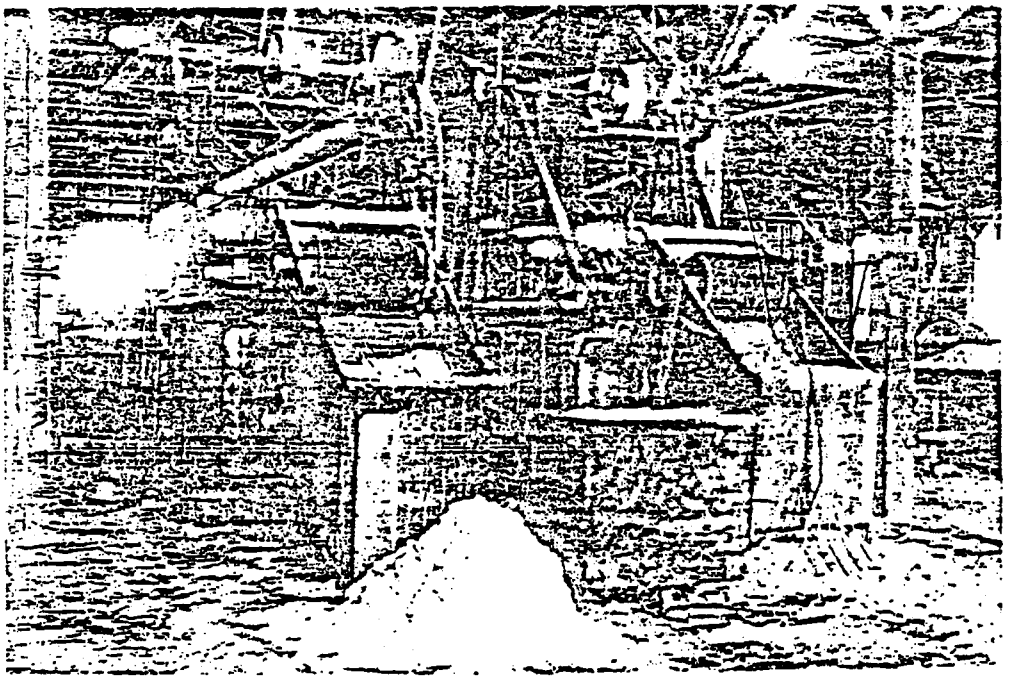
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Take-off End of Shaker Sieve

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Feeder End of Vertical Openers

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Take-off End of Garnet Machine

02317

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It will be noted that the dustiest locations are found at the feeders of openers, where the material is shoveled into the hoppers. The smallest count was found at the end of the picker machine at a position where the oiled material is discharged onto the conveyor, and no doubt is due to the fact that the oil allays the dust, because the conveyor is not covered and the material at this point has received all the picking and fluffing preparatory to carding. It is interesting to note that these total counts including all particles up to 400 microns in their greatest length or diameter are less than the accepted minimum standards (which include only particles less than 10 microns) adopted by the United States Public Health Service in their study of the granite industry.(2) This report states that on the basis of past records of dust exposure of granite workers it would appear that a safe limit lies somewhere between 9 and 10 million particles.

CARD ROOMS

The cards of the machines in this room are covered and provided with an exhaust system.

At the time of collecting samples in this room only half of the machines were in operation, and therefore samples were collected at representative positions throughout the area where machines were in operation. Five dust samples were taken at central positions of operation and at the breathing level of workers.

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(2) Public Health Bulletin No. 187 "The Health of Workers in Dusty Trades II. Exposure to Siliceous Dust (Granite Industry)" - U.S.P.H.S., Treasury Department, Washington, D.C. 1929

02318

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The material fed into the carding machines consists of various mixtures of asbestos material taken from the stored material in the enclosed bins which are situated in the center of the floor. This material is trucked to the machines and shoveled into the hoppers. Due to the variety of mixtures in use, it is not feasible to use a conveyor system in transporting the materials from the bins to the hoppers.

TABLE #2

CARD ROOM

Sample No.	Location	Total count in particles per cubic foot of air		Weight of dust in mg. per cu. ft. of air
15	Center aisle	4,742,547	24	.51
17	Side aisle	2,239,443	12	1.10
19	" "	820,795	4	.50
20	" "	4,266,123	26	1.05
22	" "	943,714	5	.78
	Average count of air of room	2,822,524	16	

It is noted that the counts in the samples from this room are for the most part smaller than those found in the preparation room and far below the standard adopted by the United States Public Health Service.

The temperature and humidity readings in the card room compared with outside readings are as follows:

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Outside Inside

Dry bulb 69° - Relative Humidity 90% Dry bulb 77° - Relative Humidity 74%

The temperature condition in this room, while a little high for comfort, is not excessive.

The humidity is sufficient for manufacturing purposes and at the same time tends to allay the dust.

Card Room

Temperature read by [illegible] page 17 attached

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Outside	Inside
Dry bulb 69° - Relative Humidity 80%	Dry bulb 77° - Relative Humidity 74%

The temperature condition in this room, while a little high for comfort, is not excessive.

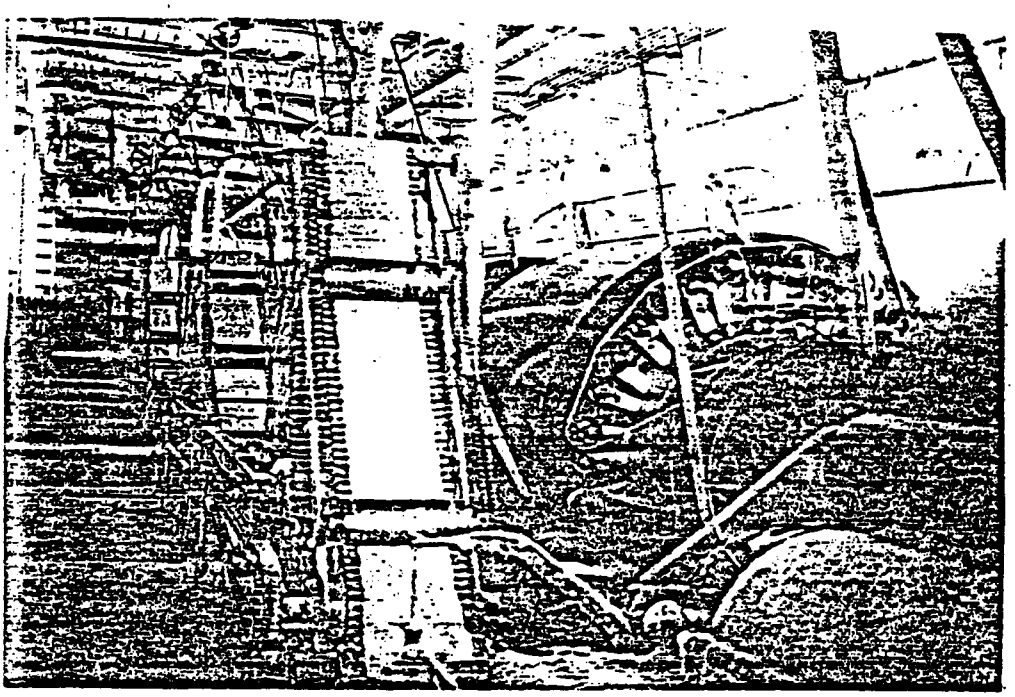
The natural humidity is sufficient for manufacturing purposes and at the same time tends to allay the dust.



Card Room

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Center Aisle of Carding Room

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SPINNING ROOM

Most of the spinning is done on mules. Some experimental work is being done on ring frames. Not all mules were in operation. Dust samples were taken in the middle aisle between the machines in operation. Twisting and spooling operations also were conducted in this same room. Dust samples were likewise taken between these machines.

TABLE #8

SPINNING ROOM

Sample No.	Location	Total Count in Particles per cubic foot of air		Weight of dust in mg. per cu. ft. of air
25	Center aisle	547,138	3	.50
26	" "	587,752	4	.25
27	" "	404,449	4	.28
29	Twisters - center aisle	1,107,419	6	.64
30	Spooling machines	571,428	3	.31
		.6 4		

It will be noted that the dust counts in this room are much smaller than the counts in the preparation and card rooms and compare favorably with those found in the weave room. The highest count was near the twisters where there is more abrasion of the material due to wrapping the asbestos thread with wire.

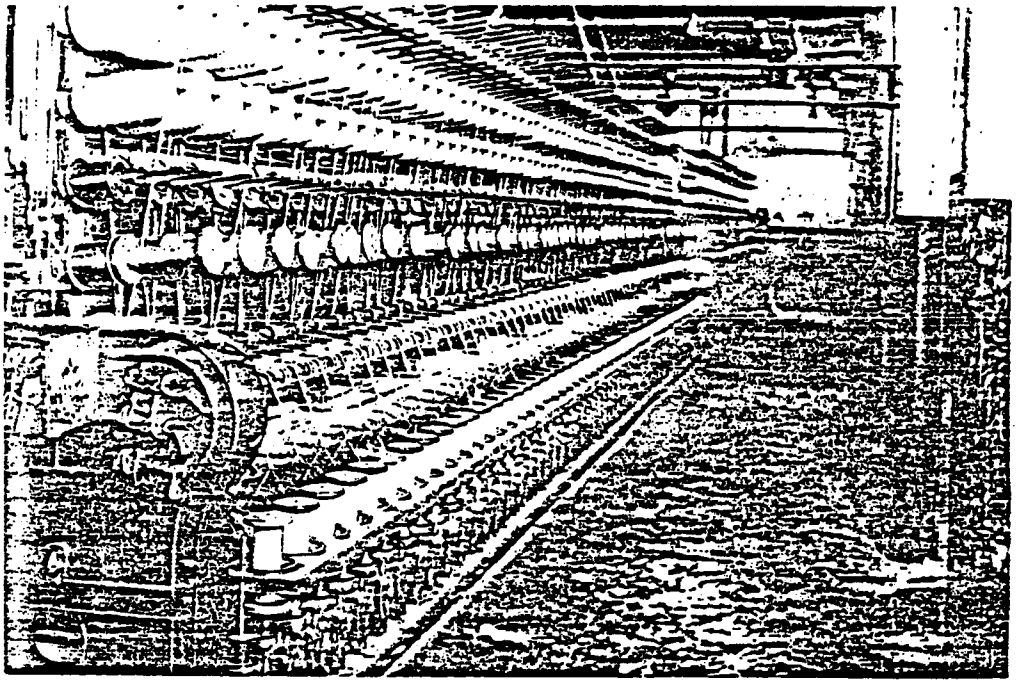
Hand control water sprays for humidifying were in use and readings taken showed the following results:

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Outside	Inside
Dry bulb 64° - Relative Humidity 95%	Dry bulb 78° - Relative humidity 78%

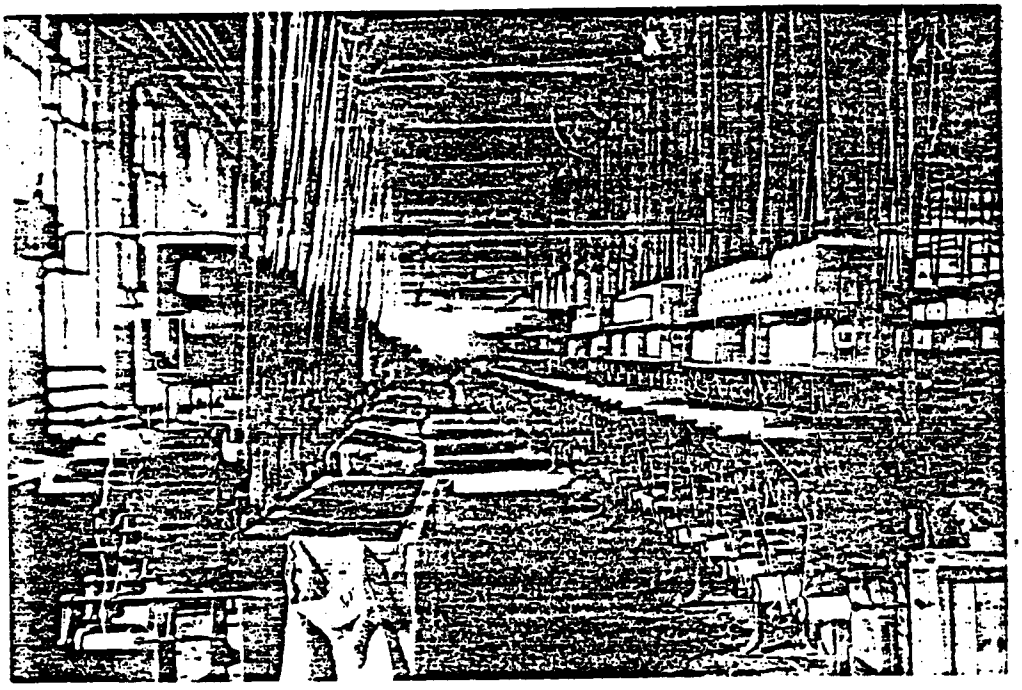
This indicates a fairly comfortable atmospheric condition in this room.



Twisting Machines
Spinning Room

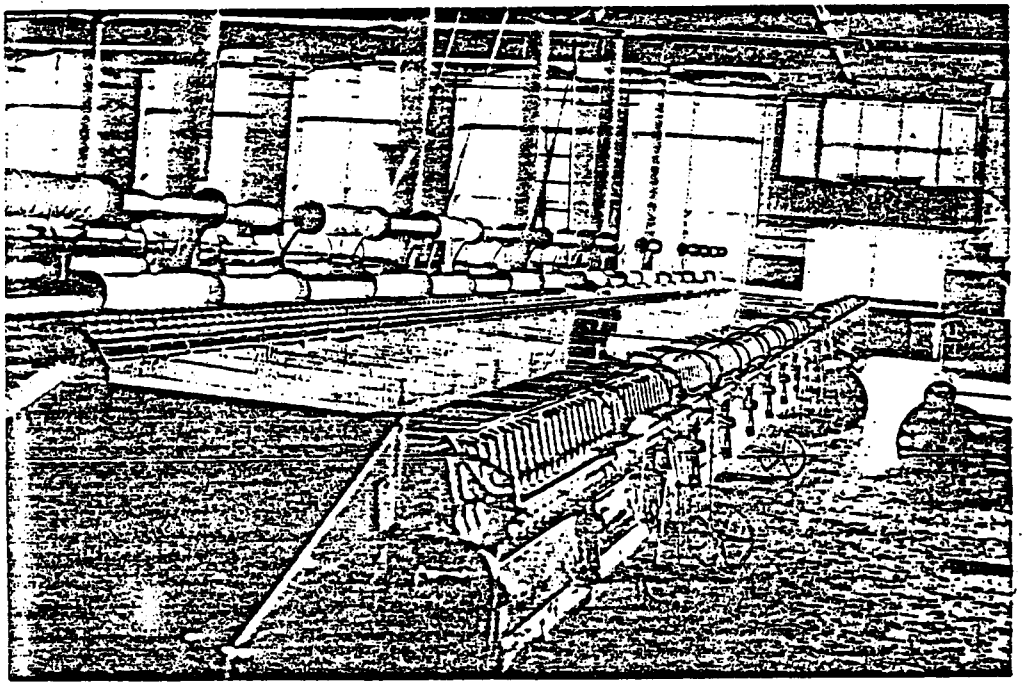
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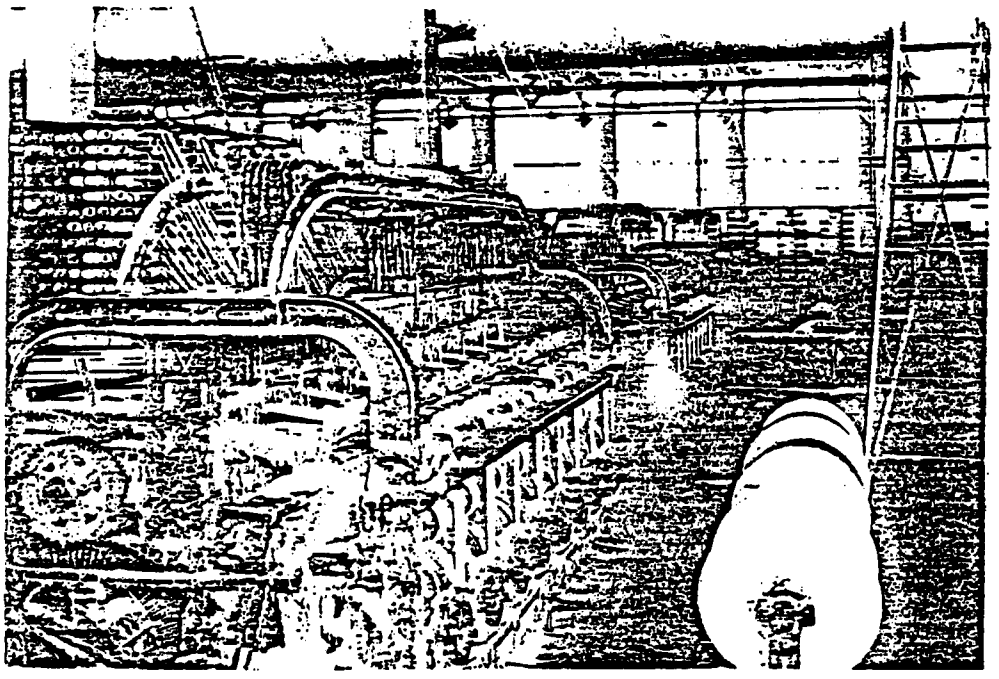
Spooling Machines
Spinning Room

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Mule Spinning

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ACL Doc 11754 · Page 24 of 30 asbestosclaims.law/library/11754/24



Weave Room

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WEAVE ROOM

This department is located on the second floor of the rubber compounding building.

At time of sampling only looms on brake band weaving were in operation. Four samples of air were taken at representative points, with the following results.

TABLE #4

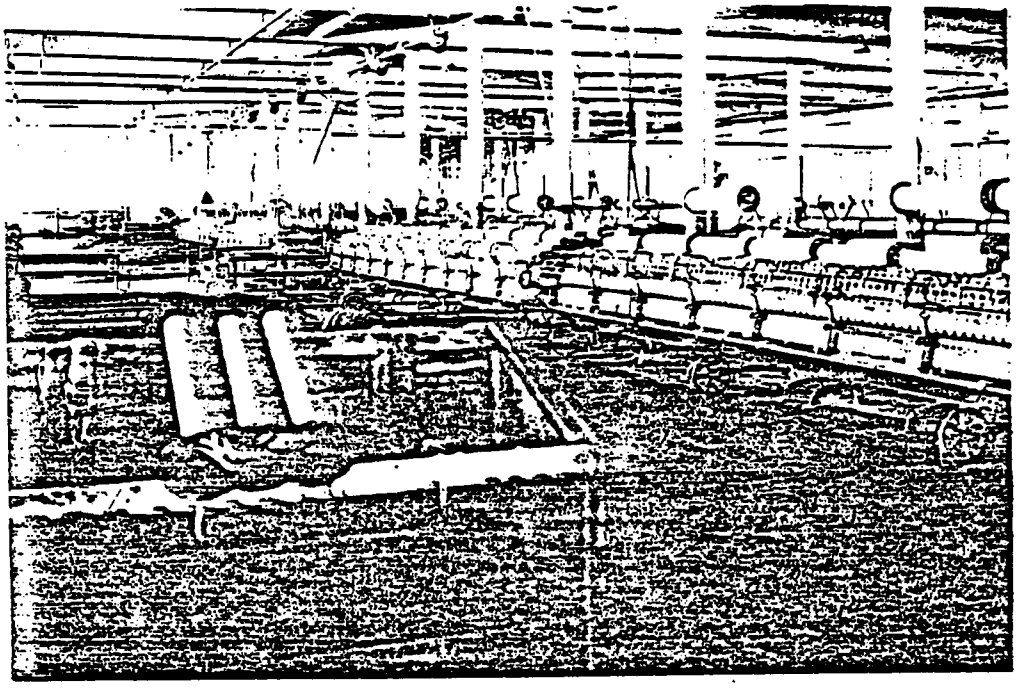
WEAVE ROOM

Sample No.	Location	Total Count in Particles per cubic foot of air	Weight of dust in mg. per cu. ft. of air
37	At loom near elevator	415,034	.18
38	First aisle - rear at loom	555,555	.73
39	Center aisle	756,756	.28
40	Center aisle rear	595,348	.12

It is noted that these counts are small.

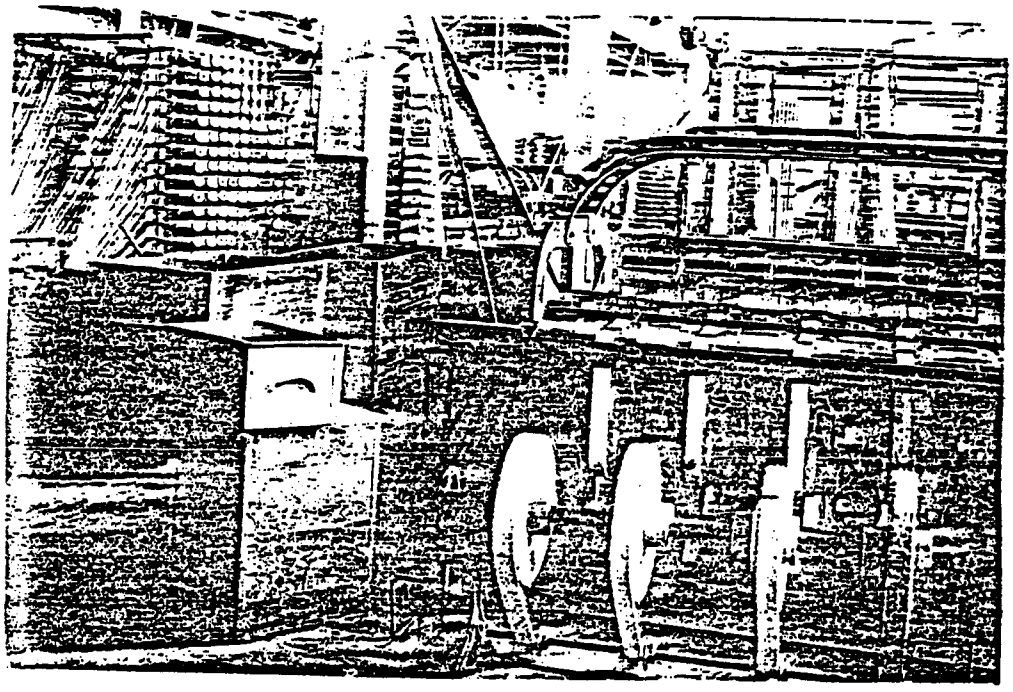
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Another View of Mule Spinning

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Heavy Room

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CLINICAL OBSERVATIONS

During the progress of these studies a careful scrutiny was maintained of the men working there the air samples were being taken. There were not detected the symptoms associated with the condition known as asbestosis, namely leaden hued complexion, cough, shortness of breath, wasting and clubbing of the fingers. The majority of the workers appeared to be robust, but in the absence of physical examination and further correlation with length of employment, the conclusions drawn from these observations must be limited.

SUMMARY

The results of these studies indicate that the number of particles of asbestos dust found in the air of the various departments, with the exception of the preparation room, is very low. This is no doubt due to the oil spray which is used to hold together the asbestos particles and also due to the efficient humidifying system, and to the exhausts which are connected with the various operations to eliminate the dust which is created in the processes. While analysis shows that over 90% of all particles are under 10 microns in size these dust counts indicate that the danger of a pulmonary health hazard is very remote.

RECOMMENDATIONS

1. That the oiling, humidifying and exhaust systems be continued and extended to every process, wherever possible.

2. That physical examinations be made yearly of all employees engaged in asbestos processes, particularly those who have been exposed over a period of years. [illegible] be [illegible].

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5. That cleaning be done by means of a vacuum system instead of the present method of blowing with compressed air.

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