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REPORT TO

UNITED STATES RUBBER COMPANY

TEXTILE DIVISION

ON

DUST CONTROL IN THE

ASBESTOS TEXTILE PLANT

HOGANSVILLE, GEORGIA

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April 7, 1950

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MARCH 13 - 15, 1950

This visit was made primarily to advise on a dust control system for the looms in the asbestos weaving plant. We were also requested to advise on dust control in any of the other operations, all of which were inspected. Particular additional attention was devoted, therefore, to the preparation room and the carding machines.

DUSTINESS IN HOGANSVILLE PLANT

In 1947 Industrial Hygiene Foundation conducted a preliminary survey for the Asbestos Textile Institute, in the course of which "dustiness" levels in various departments of the several plants were obtained.

In the following table, dust levels characterizing the industry are listed, together with those in the several departments of the Hogansville plant, the latter figures being based on measurements made by Mr. Guy during 1949 and early 1950. They show that the Hogansville preparations department requires improvement to bring it into line with the best practices in the

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industry. Dust levels in the carding room are somewhat higher than the majority of plants; recommendations for improvement are included in this report. Dust concentrations at looms are greater than in most other plants. Other departments are comparable with those in the industry generally.

TABLE I

COMPARISON OF DUSTINESS IN
VARIOUS PROCESSING DEPARTMENTS
OF THE ASBESTOS TEXTILE INDUSTRY
VERSUS THAT AT HOGANSVILLE PLANT

Operation	Range of Dust Concentrations (M.P.C.F.)* Hogansville	Typical of Good Control in the Industry	Fraction of Plants Having Indicated Degree of Control
Crusher	5 - 10	Less than 7	3/7
Willower	5 - 10	Less than 7	3/7
Pickers	5 - 8	Less than 7	3/7
Cards	2-1/2 - 5	2 - 3	6/10
Flyer Twister	2 - 4	—**	—
Spinning	3 - 5	3 - 5	5/9
Winding	2 - 4	2 - 5	5/7
Looms	5 - 10	1 - 3	2/8
		2 - 5	4/8

*M.P.C.F. = Million particles per cubic foot.
**Ordinary twisting 4-7 million particles per cubic foot.

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WEAVING DEPARTMENT

A study of dust sources at the looms was facilitated by use of a strong light, and disclosed the principal sources to be at the harness, both above and below the warp threads. In addition, some dust originates at these threads in front of the harness, between it and the lay beam, although materially less than at the former two locations.

The major sources of dust can be controlled by installation of an exhaust hood in the form of a narrow slot running the width of the loom, just behind the harness. It is estimated that control of dust above the warp would be effected by an exhaust rate of 75 cubic feet of air per minute per foot of loom width. The same exhaust rate is contemplated through a similar exhaust slot disposed below the warp threads in a position symmetrical (in relation to the plane of the warp threads) to that of the upper hood.

It appears that there will be considerable difficulty in leading a 5-inch duct into the space below the warp to communicate with the exhaust slot. This led, in discussion with Mr. Ayer, to the suggestion that a main exhaust branch 6 inches in diameter be brought to each loom with a "Y", the two branches of which will be 5 inches in diameter. One branch, for eventual communication with the hood below the warp, would be capped initially. The other branch would connect to the slot hood above the warp and exhaust the entire planned capacity of 150 cfm per foot.

This arrangement is attractive because if effective dust control could be attained with the upper exhaust hood alone, it would save the "tailoring" that would be required in extending the other branch to the space below the warp. If, on the other hand, experience with the upper hood alone indicates a need for further improvement, the lower branches and their hoods would be constructed and tailored into position, without any changes in the main exhaust system.

Recirculation of Air from Dust Collector

In connection with the problem of maintaining adequate humidity and conserving heat in this department in the winter, the question of recirculation from a dust collector was discussed. As a general rule, recirculation is not considered a good practice where the dust in question is toxic. This is based on some experiences where cloth filter collectors having basically high efficiency were not adequately maintained and leakage occurred, unnoticed by operating or maintenance personnel. This permitted discharge of dusty air back into the workroom.

In the present instance, however, we conclude that recirculation from a high-efficiency cloth tube filter collector would be feasible and, in the circumstances, is recommended. This advice is based on the following considerations:

(1) A cloth tube filter or stocking-leg type of dust collector is best suited to this application, and has adequately high efficiency.

(2) The present situation is quite different from those where serious recontamination has been noted due to poor collector maintenance. If a hypothetical dust exhaust system for the looms were to discharge back into the room without any cleaning whatever, the dust

counts would be essentially of the same order of magnitude as at present. It follows, therefore, that even though (due to some gross oversight) a major leakage developed in the dust collectors, the result in the most extreme case would still represent a material improvement over present conditions.

(3) There is in existence at present at this plant a maintenance inspection system for the carding machine exhaust system in which daily inspection is made of all parts of it. This could be extended to include the new dust collector. Moreover, the weekly dust counts now made routinely could be arranged to include one sample in the return air from the dust collector, thus providing an additional check. This would ensure good collector maintenance.

Cloth Filter Characteristics

The collection efficiency of cloth filters is extremely high, so that efficiency percentages have little meaning. This factor need not, therefore, be of concern.

A factor of major importance is in the pressure drop characteristics and "cleanability" of the filter cloth. There are differences in this respect between different designs of such collectors, the details of which were discussed with Mr. Ayer, A given type of collector, at some specific filtration velocity, has a definite basic pressure drop immediately after operation of the shaking mechanism. With ordinary mineral dusts, this varies most commonly between 0.2 inches and 1.0 inches per unit of filter velocity, in feet per minute. It is important in proper design of an exhaust system, and in particular, the selection of a fan, to know what this value is. There is no published data, nor can the collector manufacturers provide it. In our discussions with Mr. Ayer, we outlined two courses of action whereby this lack could be filled.

Two of the asbestos textile plants of the writer's acquaintance have three dust filters in operation, handling asbestos dust from carding machines. These include the Airmat, Pangborn, and the Parsons, the latter a stocking-leg cloth filter. We are communicating with these companies in an attempt to obtain pertinent pressure drop measurements.

The other plan is related to the exhaust system layout we prepared tentatively for the Hogansville loom room. It appears practical to install a system of overhead exhaust ducts, thus avoiding the necessity for concern over the absence of space below the floor of the loom room. Our layout* consists in three separate systems of three different sizes. It appeared to Mr. Ayer and the writer that the smallest of these could serve usefully as a pilot system, and a study of its operating characteristics would enable resolution not only of the question of required dust collector size, but also that concerning the importance of an exhaust hood below the warp.

On the basis of an average loom width of 3 ft., there would be provided an exhaust rate for each loom of 450 to 500 cfm, which means exhaust capacity for the entire room of 20,000 to 25,000 cfm. The dust collector size, (referred to as though a single unit were being installed), will be one having a cloth area probably not larger than 12,000 sq. ft., and possibly as small as 5,000 sq. ft. The difference in cost between these limits is

*Drawn by Mr. Ayer's department and circulated with his memorandum dated March 23, 1950, to be attached to this report.

considerable, and a resolution of the size question therefore involves material sums. It will therefore pay to proceed on the basis of an experimental unit.

Study of the effectiveness of dust control in a partial installation cannot be made very effectively by dust counts, because of dust still present in the atmosphere from adjacent looms not equipped. It will, however, be possible to draw some conclusions by close observation of the dust sources with a strong light, as was demonstrated during our visit. We have no doubt that installation of the type of exhaust system outlined will reduce dust concentrations in the room to below five million particles per cubic foot of air, and perhaps result in levels averaging three to four million.

The obtaining of data for selection of the most economical and effective size of dust collector, i.e., cloth area, can be obtained on the initial installation by procedures outlined in the appendix to this report.

CARDING MACHINES

Dust in this department is pretty well suppressed, with exceptions noted below, by good enclosure of the main machine and its auxiliary equipment.

The Bramwell feed hoppers are totally enclosed, the enclosures provided with windows, with a 4-inch branch exhaust connection. This is consistent with common practice in the industry, but the provision of a branch duct as large as 4 inches is of questionable necessity. This point is brought out here because the additional exhaust capacity required at other points noted below could be provided by reducing the flow from this unit.

The space between the weigh hopper and the main cylinder is well enclosed and exhausted by a 5-inch branch connection.

A good wooden enclosure is provided for the main cylinder of the breaker card and its auxiliary rolls. The enclosure is not exhausted. Instead, an auxiliary enclosure is attached at the doffer end and exhausted through a 3-inch branch.

The finisher card, similarly enclosed, is exhausted at an auxiliary enclosure appended to the main cylinder enclosure above the feed roll; this employs a 4-inch branch duct. A similar enclosure above the doffer roll is exhausted by a 2-inch branch duct.

The main cylinder in each card has a solid bottom imperforate tray. The space under each card is enclosed by end plates and the space exhausted through 2-inch branch ducts.

Dust Sources

The following sources of dust were noted with the aid of strong local illumination:

(a) Sifting of fly to the floor below the comb on the finisher card is apparent. A major amount of fine dust is apparent in the air directly above the comb.

(b) Some dust leaks outward from the space under the breaker cards in spite of the exhaust provided by the 2-inch duct. (It is not certain whether this same source is significant on the finisher card.)

(c) There is some leakage of dust from the exhausted box attached to the main enclosure above the doffer roll on the finisher card.

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Recommendations

In the light of these observations, the following recommendations are made. It is believed they will reduce dust concentrations in the card room to two to three million, and thus make this department comparable with best practice in the industry.

(1) Provide an exhaust slot above the comb on the finisher card. If this slot can be positioned fairly close to the comb, it should be possible to effect good dust control with air flow of about 300 cfm per comb. This would require a branch duct not less than 4 inches in diameter.

(2) Improve the enclosure under the breaker card, if possible, by extending the end plate upward another foot or so, to reduce the area of the opening. Observe the results on one machine by strong illumination. If dust still escapes, the 2-inch duct should be changed to a 3-inch duct.

(3) Increase the diameter of the dust attached to the doffer roll enclosure on the finisher card from 2 inches to 2½ inches.

(4) The increase in exhaust capacity outlined in the above paragraphs can be provided, if necessary, by reducing the 4-inch pipe on the feed hopper to 3 inches, and the 5-inch duct on the enclosure between the weigh hopper and feed roll on the breaker card to 4 inches. These changes, however, may not be required.

PREPARATION ROOM

Dust incident to fiber blending on the bedding floor was the subject of some study. We discussed with Mr. Ayer the feasibility of an enclosure consisting in curtain walls that extend from the ceiling above the bed and leave an open area at the front, adjacent to the machines, six feet high and the full eight-foot width, but on the other three sides, restricting the opening to about two feet high. The resulting open area would total about 100 sq. ft., and good dust control would result with an exhaust rate of only 7,000 to 8,000 cfm. Mr. Ayer will take this under advisement.

One of the two dry pan crushers is enclosed and exhausted. The other is in common use, and should be similarly equipped.

Carding Machine Exhaust Rates

It is of interest to compare the basic design of the carding machine exhaust in different plants with those in use in various other plants. This is best described by reference to the total rate of exhaust from carding machines, together with the average dust count, as shown in the following table.

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TABLE II

CARDS

Plant	Exhaust Rate cfm/2 Cards	Average Dust Count M.P.C.F.*
A	1500	2 - 3
B	2200	1 - 2
E	3800	1½ - 3
G	5400	2 - 3
H	2000	2 - 3
Hogansville	800	2½ - 5

*M.P.C.F. = Million particles per cubic foot of air.

It is noteworthy that the Hogansville installation should be ranked among the most efficient, inasmuch as it effects pretty good dust control with a lower exhaust rate than any of the other plants.

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General

Current practices at the Hogansville Plant are particularly meritorious in two respects. One of these is in the weekly dust count made by Mr. Guy. Other plants have good dust control records, but none are obtained by company personnel, and they are therefore less complete.

The other noteworthy practice is the daily inspection of the carding room exhaust system. This is also done in one or two of the other plants. It was recommended to Mr. Ayer in this connection that the local illumination technique demonstrated by the writer be added to the dust count inspection routine, and the resulting observations be incorporated in the weekly report.

We discussed with Mr. Ayer the inadequacy of present dust count methods in general vogue, where dust concentrations have been brought to the present levels, and of the possibility of a cooperative investigation supported by a few of the leading asbestos textile companies, aimed at a more certain evaluation of the asbestosis hazard in present conditions.

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APPENDIX

TEST PROCEDURE ON A PILOT DUST COLLECTOR FOR ESTABLISHMENT OF PRESSURE-LOSS CHARACTERISTICS

The following steps are taken, in the order indicated:

(1) At end of an operating cycle, just before shaking bags, measure:

(a) Static pressure by U-tube manometer on the clean-air side of collector, in chamber housing, not in outlet duct.

(b) Static pressure on dusty-air side of collector.

(c) Air flow through collector by Pitot tube (Q_D).

Comment:

(a) - (b) gives pressure drop loaded with dust. Air flow through collector, Q_D, is proportional to square of inlet static pressure. This relation may be used to calculate later air flow by measurement of inlet static pressure alone.

(2) Shut down fan and operate shaking mechanism. Remove dust from hopper (which should be empty before shaking) and weigh when convenient. (Weight = W lbs.)

(3) Start fan again and measure same quantities (a) (b) (c) listed under (1).

Comment:

(a) - (b) at this stage gives pressure drop with "clean" filter = R_o.

Air flow through collector $= Q_o$

Cloth area, sq. ft. $= A$

and Filtration velocity, $V_o = Q_o/A$

Then -

$$\frac{R_o}{V_o} = K_o \text{ inches drop/ at 1 fpm filtration velocity.}$$

Since pressure drop, R_o, through the cloth at start of operating cycle, varies directly with V_o, this figure enables calculation of initial pressure drop for any size of collector.

The <u>increase</u> in pressure drop (R_D inches) due to the temporary layer of dust on the cloth is

$$R_D = K_D \, w \, V$$

where, w is ounces of dust per square foot of cloth

V is Q_D/A

The total pressure drop at end of the cycle is, then

$$R = R_o + R_D$$
$$= K_o V + K_D V w$$

The value, K_o, has been found from data under (1)

V is Q_D/A, the filtration velocity given by the data obtained under (3)

w is obtained from the weight of dust, and is in ounces per square foot of cloth

R was found under (1), as (a) - (b)

Substitution in equation gives K_D

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Example of application:

Assume K_o is found to be 0.5 inches per 1 fpm

and K_D is found to be 0.2 inches per 1 fpm per 1 oz. per sq. ft.

What will be pressure drop after a collector has accumulated $1\frac{1}{2}$ oz. per square foot (equivalent to X hrs. operation). Air flow at end of cycle is 20,000 cfm and cloth area is 10,000 sq. ft.

Solution:

$$Q/A = \frac{20,000}{10,000} = 2 \text{ fpm}$$

$$R = 0.5\ (2) + 0.2\ (2)\ 1.5 = 1.6 \text{ inches.}$$