EXHIBIT
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MONTANA STATE BOARD OF HEALTH

Helena, Montana

DIVISION OF DISEASE CONTROL

A

REPORT ON AN INDUSTRIAL HYGIENE STUDY

OF THE

ZONOLITE COMPANY

OF

LIBBY, MONTANA

August 8-9, 1956

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Distribution:

This report is confidential and is not for distribution except to the management of the Zonolite Company.

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52

On August 8th and 9th, 1956, an industrial hygiene study was made of th Zonolite Company of Libby, Montana, to determine if any of the components of the operation of this company were detrimental to the health of the employee. The study was made after a discussion of industrial hygiene principles with Mr. R. A. Bleich, Division Manager, and Mr. D. Lovick, Assistant Manager. Mr. Walter Baker, Assistant Plant Manager, and Mr. Ted Wright, Repairman, acted as guides for the study.

The present study involved the conduction of an engineering investigatic to evaluate the working environment and by making a determination of the envi mental factors which might have a bearing on health. Consideration was also given to the ventilation and other protective measures already in use for the control of dust and other toxic materials.

The samples collected were analyzed and counted in accordance with accepted practice generally recommended by the U. S. Public Health Service, the American Conference of Governmental Industrial Hygienists, and other offic agencies. Samples collected for dust counts were counted a few hours after th were collected and were analyzed for free silica in the U. S. Public Health Service Laboratory in Cincinnati, Ohio.

Description of Operations

The description of the operations of this company have been adequately discussed in previous reports, but, in general, they constitute an open cut mine, a transfer point from the mine to the mill, and various milling and sizing operations done on five floors of the company's mill, a short distance from the mine.

The operation, in general, is that of reducing in size the vermiculite ore which is mined in the open cut mine to various graded sizes which are best for the product which is ultimately an insulation material. In grading and sizing, various vibrating screens are employed to obtain the sizes necessary and to reduce the amount of extraneous material from the ore.

In the mining operations, approximately 17 men are employed per shift and, since the operation is almost wholly outdoor work, no samples for dust concentrations were collected in this area. At the transfer point from the mine to the mill, one man is employed and, although there is some dustiness, it was not felt to be significant and no samples were collected at this point.

In the mill proper, operations are divided into wet mill and dry mill production. In the wet mill, dustiness is quite low; however, in the dry mill the dust from the various sizing and grinding operations is quite high, as noted in the Table I.

The approximate population in the plant at the time of this study was 1[illegible] workers, as against 34 workers in 1944, when the last study of the plant was made. The population of the plant a few days before the study was considera[illegible] higher but, due to a reduction in the demand for the product, one shift was [illegible] off.

TABLE I

DUST CONCENTRATIONS IN THE AIR

Sample No.	Location	Description	Concentration in mppcf*	Pe[illegible] Free [illegible]
1	Wet mill	General air sample.	11.6	Not d[illegible]
2	Dry mill 5th floor	General air Sample	17.9	1. (raft[illegible]
3	Dry mill 4th floor	General air sample	51.8	Not de[illegible]
4	Dry mill 3rd floor	General air sample	28.7	1.[illegible] (rafte[illegible]
5	Dry mill 2nd floor	General air sample	48.3	Not det[illegible]
6	Dry mill 1st floor	General air sample	83.0	1.2 (rafter [illegible]

Note: Composite air sample all floors provided free silica determination of [illegible]

Maximum allowable concentration:

Silica:	High - (above 50% free S_1O_2)	-	5 mppcf
	Medium - (5 to 50% free S_1O_2)	-	20 mppcf
	Low - (below 5% free S_1O_2)	-	50 mppcf
Dust	(nuisance, no free silica	-	50 mppcf

*millions of particles per cubic foot of air.

Concentrations

The concentrations of dust in the air, as determined in table I, vary consi[illegible] erably from a low of 11.6 to a high of 83 mppcf. These concentrations in relati[illegible] to free silica are not excessive, although the concentrations on the fourth, sec[illegible] and first floor were at or above the maximum allowable concentration even for a nuisance dust with no free silica. On the basis of the asbestos content, no sta[illegible] ment can be made, since at this time the asbestos content of the dust has not be[illegible] determined. However, from visual observation and from information gained at the[illegible] plant, a small percentage increase in the asbestos content of the material processed produces several times greater concentration of dust in the air. maximum allowable concentration for asbestos is 5 mppcf, and when the conc tion of asbestos in the dust samples collected has been determined, furthe ments on the concentrations will be made. At this time, however, and on t of the concentration of asbestos found in the dust, which varies from the records from 8 to 21%, it would appear that the maximum concentration of d the air should not be greater than 25 to 30 mppcf.

Toxicity

A review of the literature indicates that vermiculite or the dust fr material is not especially toxic and is generally included only as a nuisan dust. However, the asbestos dust in the dust in the air is of considerable city, and is a factor in the consideration of reducing dustiness in this pl

According to Drinker and Hatch[1], the pathologic changes produced by tos are not like those of silicosis. The asbestos fiber group about the nec the small air sacs in the lungs, and stimulate the formation of a diffuse fi There is no definite migration or transportation of the dust particles to th lymph nodes and no formation of the fibris nodules. As the fibrosis increas reduction in lung area causes a serious decrease in lung capacity, or diffic in breathing. Lanza[2] suggested that enlarged hearts noted frequently in t cases of secondary asbestosis may be the result of the increased work with t resulting from this condition. It takes more work to pump the blood through asbestotic than through the normal lung.

Maximum Allowable Concentrations

In the study of an environment from the standpoint of exposure to harm materials, the use of maximum allowable concentrations is helpful. Maximum allowable concentrations is defined as that concentration of any harmful mate in a working atmosphere below which a worker's health will not be affected adv Maximum allowable concentrations have been established upon many of the commo dustrial poisons and they have been based on the results of correlated enginee and medical studies in industries using these materials. Maximum allowable co trations now in use as a criteria for the protection for the health of the wor are subject to change as additional information is accumulated. The concentra used in this study are those recommended by the U. S. Public Health Service, t American Conference of Governmental Industrial Hygienists and the American Ind Hygiene Association. All maximum allowable concentrations recorded are for pr longed exposures or those exposures for an eight-hour working day.

In the evaluation of the worker's exposure to any harmful material, cog nizance of the amount of time spent by the worker in the contaminated atmosphe should be taken. For this reason an attempt was made to determine the amount a worker spent on all his jobs where they were not continuous. Weighted avera exposures more nearly represent a workers actual exposure over an eight-hour d

(1) Drinker, P., and Hatch, T.: Industrial Dust, McGraw-Hill Book Co, New Yor
(2) Lanza, A. J., McConnell, W. J. and Fehnel, J. W.: Effects of the inhalatio asbestos dust on the lungs of asbestos workers, "Public Health Reports", 5 of 1935.

does a single sample result representing an exposure for a short portion of a day.

$$\text{Weighted Average} = \frac{\text{concentration of material x hours exp}}{\text{hours worked}}$$

Conclusions and Recommendations

From observations made at the time of the study it would appear that exhaust mechanism for allaying dust generated by the various vibrating mach and other moving parts in the dry mill, in particular, was well designed or but under the handicap to which this exhaust mechanism is subjected it cann does not function properly. The following are several reasons why the dusti the dry mill is heavy and why the exhaust mechanism, as designed, does not f

1. Dust vibrates almost continuously off the rafters which have beco loaded and are continually loaded with dust generating from many sources.

2. Rubber connectors between the vibrating screens and the feed spou are not tight, nor are they replaced when they vibrate off or they are worn c

3. Rubber connectors between the vibrating screen and the exhaust duc are either broken, missing, or are not placed on the ducts.

4. Exhaust from some of the vibrators is insufficient to control the generated, which, in all probability, is caused by an over-load of the system fr other portions of the plant.

5. Backs are off many of the vibrators, making the exhaust mechanism p vided ineffective and, in effect, making it wholly inoperative due to the large from which the exhaust draws.

6. There are many holes in conveyor pipes in such places as stop gates, connections to vibrating screens, and dozens of other points where holes have cut into the pipes at random locations, or where the pipes have broken by vibr or worn through by friction of the moving ore.

7. Hoods over many of the vibrators are broken, have not been replaced are ineffective. It would appear that canvas or a resilient type cover over th vibrators would be more effective than rigid type hoods which have been provide

8. Many of the transfer points from one belt to another are not exhaust and contribute a great deal of dust to the atmosphere.

9. Many of the dead ends in the exhaust system were left open permittin a large volume of air to be drawn in through openings where no control was nece sary, thereby reducing the control velocity in volumes of air at more critical points.

10. In many locations it was obvious that the dust collection mechanism was full of dirt or dust and could not be expected to function satisfactorily because of many of the reasons already mentioned.

11. Many of the elevator housings and screw conveyor housings are open i

several places where holes have been cut for various reasons and the housin material removed and not replaced. These elevator housings and screw conve housings are particular offenders in production of dust.

12. It was noted during this study that holes were being cut in the e ducts at random without any previous calculation as to the volume of air req or the reduction of air volume to other locations. The junctions were often exceedingly rough increasing the frictional resistance in the collection pip

13. In some of the locations, particularly on the vibrating screens o top floor, it is obvious that a great deal of product is being withdrawn thr the exhaust system by virtue of too much air being drawn through the system. is quite probable that the reason for this pick-up of product is because of t imbalance created for the various reasons previously noted.

14. In summary, the foregoing points are illustrative of what would be poor policy in matters of maintenance and operation of this plant. The follo recommendations are based on the observations presented and on the basis of t dust counts, silica content, and asbestos content of the dust. It will be rec nized that the following recommendations are particularly broad and non-speci until such a time as the general over-all maintenance and repair of existing d work, both in the exhaust system and the ore feed pipes have been sufficiently repaired, no specific recommendations appear to be justified. General recomme tions are as follows:

1. That all of the unnecessary openings in the entire exhaust system, in the wet and dry mills be closed properly and a program of discriminatory cu of pipes be initiated. All access doors, corners, etc., should be provided wi tight seals and, of great practical importance, are so designed that they are closed and secured by quick-locking devices in place of the usual bolts and nut Access doors should be attached by hinges to avoid the frequent damage which oc when ordinarily manhole plates are removed for inspection and maintenance work. An objective in designing the access should be to make it difficult to keep the open.

2. That all of the unnecessary openings in all of the ore transport duc and in all the elevator housings and screw conveyors be tightly and completely closed and that all the broken portions of the system of the plant be adequatel repaired.

3. That all of the covers on the backs of the vibrators be replaced and made as air tight as possible and that the hoods over the vibrators be repaired and replaced with a type material that will not disintegrate subject to vibratio

4. That all of the exhaust ventilation duct work be examindd foot by foo and all holes plugged and unnecessary openings, particularly at dead ends, be adequately closed and the entire system be cleaned of dust which has deposited in any portion of any of the exhaust pipes.

5. That all of the transfer points and points where ore is being deposit into open containers be adequately enclosed and provided with exhaust ventilatio

6. That a system of vacuum cleaning or other cleaning of the rafters in the entire mill be instituted after the other measures have been adequately

accomplished so that the dust load contributed by that dust falling off raft will be eliminated. Full recognition should be given to the fact that direc control measures alone are usually not enough to insure safe working conditi The method of operations, proper maintenance of equipment and of housekeepin are equally essential to maintain healthful conditions.

7. That until such time as the repair and maintenance of both the [illegible] and ore conveying systems have been complete, all the men in the dry mill be provided with and required to wear an adequate respirator, as indicated in th accompanying list.

8. That the operators of the spray painting equipment be provided wit a respirator approved by the Bureau of Mines for such operation as indicated in the enclosed pamphlet.

9. That it be initiated as a policy of the company to be particularly discriminating in the provisions for any holes or outlets to be cut in any exhaust ventilation duct or any ore conveying duct or apparatus and that, if any ventilation must be provided for any process, the quantity of ventilation required be adequately determined before any exhaust capacity is taken from existing lines and that the result of such capacity will be ascertained on all subsequent units when such capacity has been involved.