

Pittsburgh-Corning Co. 11-10-45
Discovery T-1430

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

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REPORT OF INDUSTRIAL HYGIENE SURVEY
MADE FOR

Pittsburgh Corning Corporation

Port Allegany, Pa.

September 26, 1945

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INDUSTRIAL HYGIENE SURVEY

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PITTSBURGH CORNING CORPORATION

PORT ALLEGANY, PA.

SEPTEMBER 26, 1945

SUMMARY

Operations in the FOAMGLAS plant and the main glass plant at Port Allegany, Pa. were studied on September 26, 1945 to identify the working conditions that might be harmful to the health of workers.

The results of our investigation show that there is no silicosis hazard in either plant. We do however call attention to the gross dust exposure resulting at the spray booth in the FOAMGLAS plant when the dust collector is shaken. Our data also add weight to the need for more semi-automatic batch weighing equipment. No antimony was detected in the air-borne dust from the FOAMGLAS batch. However, a small amount of arsenic was present.

General information on the toxicities of batch ingredients and method employed in this survey are presented in the appendices.

I - FOAMGLAS PLANT

FOAMGLAS is manufactured from powdered glass and carbon with a trace of antimony. All of the silica is present as silicate and hence there is no silicosis hazard. Theoretically, there is a possibility of poisoning from the antimony. This possibility was appraised by chemical analysis of the air-borne dust collected from the breathing zone of workmen. Throughout the plant dust concentrations were measured by dust count. These latter results are a measure of the effectiveness of the plant ventilation equipment.

Mold Filling Operations

At the time of this investigation, as a temporary procedure, FOAMGLAS batch for onelehr was being weighed and handled manually in a small hand scoop. Batch for two other lehrs, however, was weighed by semi-automatic equipment. Results from analysis of air samples are presented in Table 1.

TABLE 1 - DUST CONCENTRATION AND COMPOSITION
FROM MOLD FILLING

Sample No.	Date	Time	Location and Operations	Mgs. of Arsenic Per Day	Dust Count M.P.C.F.
P.C.3	9/26	1:00P 1:56P	Sample was collected beside workman weighing batch by hand. Much visible dust. This is a temporary operation.	0.7 ⁽¹⁾	43
P.C.10	9/26	2:45P 2:55P	Sample was collected in the breathing zone of workman operating the semi-automatic mold filling machine.	--	6.3

M.P.C.F. equals Millions of particles per cubic foot of air.

(1)

Antimony was not detected by Outseift test. Controls showed characteristic arsenic reaction. Arsenic was found to be present, however, in the amount indicated in the table.

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It is of considerable interest that, whereas no antimony was detected in Sample P.C.3, arsenic was present to the extent of 0.7 milligrams per 10 cubic meters of air. This amount is slightly below the maximum allowable concentration recommended by the American Standards Association (1.0 mg. per 10 cubic meters).

Weighing of the FOAMGLAS batch by hand was nearly seven times as dusty as was the semi-automatic equipment. The installation of the latter equipment for all batch weighing is desirable. The dust exposure however is a nuisance rather than a health hazard.

Spray Booth

The FOAMGLAS batch is placed in metallic molds previously sprayed with a clay-water dispersion to prevent sticking. The molds are cleaned by an air blast and then sprayed in a spray booth. The dust exposure of the spray operator is presented in Table 2.

TABLE 2 - DUST CONCENTRATION IN THE
AIR AT SPRAY BOOTH

<u>Sample</u> <u>No.</u>	<u>Date</u>	<u>Time</u>	<u>Location and Operations</u>	<u>Dust Count</u> <u>M.P.C.F.</u>
P.C.6	9/26	1:41P 1:51P	Sample was collected in the breathing zone of workman cleaning molds with air blast and applying clay by spray-gun to clean molds. Dust collector was shaken during part of this test; hence no exhaust ventilation.	260

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During the sampling period the dust collector for the spray booth was shaken which necessitated turning off the fan and thus shutting off the spray ventilation. The resulting dust exposure during the ten minute testing period was 260 M.P.C.F. (millions of particles per cubic foot of air). Even though free silica content of the clay is low, such an exposure is excessive. We recommend that all spraying be stopped whenever the collector is shaken. Observation indicated that spray removal in the booth is effective when the ventilation system is operating.

FOAMGLAS Lehrs

Air samples were collected by the midget impinger at the feed and take off ends of the lehrs. The results appear in Table 3.

TABLE 3 - DUST CONCENTRATION AT TAKE-OFF
END OF FOAMGLAS LEHRS

Sample No.	Date	Time	Location and Operations	Dust Count M.P.C.F.
P.C.4	9/26	1:13P 1:23P	Sample was collected beside workmen removing FOAMGLAS blocks from lehrs.	3.3
P.C.5	9/26	1:27P 1:37P	Sample was collected beside workmen removing FOAMGLAS from molds and placing it in lehrs.	2.5

The dust concentrations in the breathing zone of workmen represent satisfactory working conditions.

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Cutting and Packing FOAMGLAS

One air sample was collected beside workmen who operate the power saw.
Table 1 contains the data.

TABLE 1 - DUST CONCENTRATION IN CUTTING
AND PACKING FOAMGLAS

Sample No.	Date	Time	Location and Operations	Dust Count M.P.C.F.
P.C.1	9/26	11:25A 11:35A	Sample was collected in breathing zone of workmen operating saws. Exhaust ventilation on saws is excellent. Some visible dust from handling FOAMGLAS blocks.	6.31

The ventilation provided for the power saws is excellent. Some dust
produced from handling the FOAMGLAS blocks but, as shown in Sample P.C.1, it is
not significant.

II - MAIN PLANT - BATCH HOUSE

The principal dust hazard in glass batch houses is in sand handling.
At Port Allegany dry sand is purchased in hopper cars which are unloaded into a
hopper to an elevator. The sand is conveyed into an enclosed bin without exposure
of workmen to dust.

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The batch house weighing operations are totally enclosed with the exception of the addition of minor batch ingredients. Materials feed from the bins into weigh hoppers and then are dropped onto a belt which conveys them to the mixer. Mixed batch is loaded into a hopper car in small room which is separate from the batch mixing room.

Two midget impinger samples and one I-H-F composition sample were collected in the main batch house. The results appear in Tables 5 and 6.

TABLE 5 - DUST CONCENTRATIONS IN AIR OF BATCH HOUSE

Sample No.	Date	Time	Location and Operations	Dust Count M.P.C.F.
P.C.7	9/26	2:02P 2:12P	Sample was collected while walking around the batch house. The batch handling system is totally enclosed except for the addition of minor batch ingredients.	5.3
P.C.8	9/26	2:11P 2:24P	Sample was collected while walking around the batch house. The batch handling system is totally enclosed except for the addition of minor batch ingredients.	3.3

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TABLE 6 - COMPOSITION OF RESPIRABLE DUST
 IN AIR OF BATCH HOUSE

Sample No.	Date	Time	Location and Operations	Free Silica in Respirable Dust (Port 5 microns less in Silica)
P.C.2	9/26	12:50P 2:25P	Sample was collected from breathing zone near elevator to mixer.	7%

The average dust concentration was 4.6 M.P.C.F., of which only 7% was found to be free silica. The exposure to free silica is therefore about 0.3 M.P.C.F. The maximum allowable concentration of silica dust for continuous exposure is 5 M.P.C.F.: the safety factor is therefore more than 15 to one.

MAIN PLANT - GLASS TANK

One air sample was collected at the feed end of the glass tank. The result is given in Table 7.

TABLE 7 - DUST CONCENTRATION IN AIR AT THE GLASS TANK

Sample No.	Date	Time	Location and Operations	Dust Conc. M.P.C.F.
P.C.9	9/26	2:30P 2:40P	Sample was collected while walking around platform at feed end of tank. Batch feed is dust free.	1.0

The dust concentration is far below anything significant to health. The batch feed mechanism is the finest arrangement for controlling dust that we have seen.

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APPENDIX A

METHOD OF INVESTIGATION

Dust Count Samples

All of the samples for counting purposes were obtained with the mid impinger. Where workmen were stationed at one position the sample was collected in the breathing zone within a distance of a few inches of the worker's nose. In many cases it was necessary to follow employees about a department in order to obtain a sample representing their average exposure. This was particularly true in the batch houses while appraising the exposure of batch gatherers. Where no obvious source of dust was present a general air sample was collected to provide data on the exposure of groups of workmen. This type of sample occurred in the warehouses and machine rooms.

All of the dust count samples were collected in normal propyl alcohol with the usual time period being 10 minutes.

Dust Counting

All samples were counted in accord with accepted standard procedure. The dust suspension in the impinger tubes was deposited in a standard Sedgwick Rafter Cell, where it was allowed to settle for exactly 20 minutes, then all particles at or near the bottom, smaller than 5 microns, were counted at 5 widely spaced locations on the coll. This was repeated with another cell similarly prepared and all 10 counts averaged, corrected for the blank count, and the result computed on this corrected average count. The blank counts were made at suitable intervals.

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Dust Composition Samples

Dust counting alone does not permit appraisal of the silicosis hazard since it indicates only the number of visible dust particles without regard to their composition. That is, quartz dust which produces silicosis cannot be distinguished in the dust counting process from any harmless dust, and therefore auxiliary dust samples of greater size must be obtained for free silica analysis.

In addition to samples for dust counting, therefore, separate air-borne samples were obtained for determination of dust composition for free silica. These samples were collected by means of the I-H-F Dust Sampler. This device employs a portable exhaust fan with a capacity more than a hundred times that of the Midgat impinger pump. The air is drawn through a filter composed of a felt layer of salicylic acid crystals, about 0.2 inches in thickness. The filter has an area of approximately one square foot.

Dust collected by the I-H-F Dust Sampler is removed from the salicylic acid by treatment with alcohol. The salicylic acid dissolves leaving the dust particles. The solution is filtered and the dust washed free from alcohol soluble elements. Following separation by sedimentation the fractions are analyzed by the X-ray diffraction method.

Experience has shown that chemical methods for the determination of free silica in finely divided dust samples is unreliable. An alternative method based on the petrographic microscope is also unsatisfactory because of the impossibility of correct identification of different minerals with the small particles size present. We, therefore, employed X-ray diffraction analysis

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for the determination of free silica. These analyses were performed for us by the Saranac Laboratory, Saranac Lake, New York, under the direction of Dr. L. Gardner.

The Separation of Dust Sizes

It is known that only dust less than 5 microns in diameter is of significance with regard to silicosis. Therefore samples for composition analysis which contain particles as large as 40 or 50 microns, should be treated to remove these and other particles of non-respirable sizes and this we do by means of sedimentation. The separation is made at the 5 micron size, and X-ray analysis performed for the finer fraction. Occasionally the larger non-respirable fraction is analyzed.

A proper sampling of glass batch without attention to particle size would show about 70% silica by weight. It is known, however, that the major portion of the silica is of large particle size and frequent analyses of airborne dust from glass batch show only from one to five percent free silica.

The procedure for the separation is as follows: A sample is suspended in alcohol to a depth of 3.3 centimeters and when a uniform suspension has been obtained a settling period of 40 minutes is allowed. The supernatant liquid, together with all particles in suspension, is then drawn off and fresh alcohol added to the sediment sufficient to again make the total depth 3.3 centimeters. The new suspension is agitated and again settled for 40 minutes. This is repeated 10 to 15 times, until the supernatant liquid is observed to contain an insignificant quantity of fine particles.

APPENDIX B

HEALTH HAZARDS IN CONTAINER GLASS MANUFACTURE

Container glass made be manufactured from the following ingredients: sand, soda ash, dolomite, feldspar, slag, lime or limestone, salt cake, and cul barytes, and borax. Minor batch ingredients for decolorization or for the production of color include arsenic, selenium, sea coal, iron sulfide and antimony. A discussion of the toxicity of these ingredients follows:

Sand

Glass sand consists principally of the chemical compound, silicon dioxide (SiO_2). Its most common form is crystalline quartz. Quartz, itself may be converted to tridymite and cristobalite when heated to high temperatures.

Silicosis is one of the two characteristic lung diseases resulting from exposure to dust. It is characterized anatomically by generalized fibrotic changes and increased susceptibility to tuberculosis. Silicosis is caused by free silica either in the form of quartz, tridymite or cristobalite. It is generally recognized that combined silica (the silicates) with the exception of asbestos, does not produce disabling lung diseases.

Silicosis may arise from prolonged breathing of atmospheres containing finely divided free silica. The free silica is only significant in the particle size ranges from one to five microns or less, and modern thought pays attention to the presence of those particles in the air which are less than five microns in size.

Studies of the silicosis hazard in granite cutting, in the mining of anthracite coal and other industries, have furnished the basis for establishing

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a bench mark in terms of dust counts for maximum continuous exposure to free silica. Authorities believe that disabling silicosis will very seldom if ever occur if the exposure is below 5 million particles of silica dust, less than 5 microns in size, per cubic foot of air.

Soda Ash

Excessive exposure to soda ash dust is irritating to the respiratory tract and may produce dermatitis, this action being worse during warm weather. Studies of the health of workers in plants manufacturing this product have shown that as much as 30 years continuous exposure has not resulted in any systemic disease.

Feldspar

Feldspar is a generic term for a number of complex aluminum silicate containing sodium, calcium, potassium, or barium. These minerals may contain free silica but in general the amount is less than 5%. Materials containing more than 5% free silica are considered as nuisance dust and it is not believed that exposure to them will result in disabling disease.

Lime and Limestone

These alkaline ingredients of glass batch are also nuisance dusts. Excessive exposure to them during hot weather frequently results in dermatitis but no general systemic effects occur. They do not produce any characteristic lung disease.

Salt Cake (Sodium Sulfate)

Sodium sulfate dust is not toxic. Excessive concentrations may cause a nuisance.

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Barvtes (Barium Sulfate)

Barium sulfate is not known to cause any characteristic disease.

The Italians described a lung disease which they call barytosis.

Radiologists, such as Pendergrass, attribute the effect described by the Ital to the fact that barium sulfate is radiopaque. They believe that the inhalat of finely divided barium sulfate will produce a characteristic roentgenogram that there will not be disability associated with this condition. In this re it is similar to the lung condition described by Sander where the lungs of electric welders often exhibit an X-ray appearance practically identical with silicosis.

In general, therefore, we may conclude that barium sulfate will not cause occupational disease but that it may produce a characteristic X-ray film which could conceivably complicate the interpretation of the roentgenogram of workers also exposed to free silica. The implications of this are especially important to glass plants and is the basis for our recommendation to control t dust where it occurs.

Borax

From the industrial viewpoint borax is not toxic. Schwartz reports that it is known to cause dermatitis and therefore exposure to this compound should be kept within moderate limits, particularly in hot weather.

Gullet

Although glass consists principally of silica, that material is prase in a combined form as silicates. Numerous X-ray diffraction analyses of sample of air borne glass dust have shown that there is no free silica present.

During the early days of the studies of industrial exposures to dust it was believed that lung damage was caused by the mechanical action of sharp dust particles. This was thought to be true even in the case of free silica. Investigation of workers who had breathed large quantities of carborandum and diamond dust, however, disclosed that their lungs had not been damaged. It is known that fibrosis and irritation of lung tissue is a chemical action independent from mechanical irritation with the possible exception of exposure to asbestos.

Arsenic

Historically, poisoning from arsenic and its compounds has been recognized since ancient times. In arsenic poisoning there is an extreme gastro-enteritis with particular damage to the nervous system, and fatty degeneration of the cells in the glands and muscles. There may also be direct paralysis of the heart. The American Standards Association has recommended that the maximum allowable concentration to arsenic and its compounds should be 1-1/2 milligrams of arsenic per 10 cubic meters of air. Arsenic may also cause perforation of the nasal septum as well as severe dermatitis.

Selenium

Selenium and its compounds are cumulative poisons. Excessive exposure will produce gastro-intestinal disturbances, nervousness, pallor and a garlic odor in the breath and perspiration. Studies of the acute toxicity of selenium compounds show that the powdered metal is not very toxic when ingested. Czapek and Weil, report that 4 grams of the powdered metal given to dogs by mouth produced no toxic effects as the metal was not absorbed. On the contrary as little as 4

milligrams of sodium selenite or selenate per kilogram of body weight is usually fatal within a few minutes. No authority has suggested a maximum allowable concentration for continuous exposure to selenium and its compounds. It is doubtful that selenium is any more toxic than lead, cadmium, mercury and other cumulative metallic poisons and we therefore recommend that concentrations be maintained below one milligram per 10 cubic meters of air.

Sea Coal

This material is finely divided bituminous coal. Since this material contains much less than 1% free silica its handling cannot cause a silicosis haze. The coal dust itself does not cause characteristic lung disease.

Iron Sulfide

This compound is relatively non-toxic and its inhalation in moderate amounts is not considered harmful.

Antimony

The action of antimony in the body resembles that of arsenic, differing chiefly in greater local irritation and more difficult absorption. The metal is commonly associated with lead or arsenic and no clear cut picture of industrial antimony poisoning is available. No maximum allowable concentration has been established so it is common practice to assume a limit similar to lead (1.5 mgs. per 10 cubic meters of air).

Silicosis

Exposure to silica dust presents the major and frequently the only significant health hazard in glass manufacture. Fortunately the problem is

confined mainly to the handling of sand as a raw material. When it is combined with the other batch ingredients the silicosis exposure is practically nil.

Metal Poisoning

Frequently it is necessary to add certain metals and their compounds to glass either to prevent undesired color or to produce color. Metals such as lead may also be added when special glass characteristics are needed. These minor batch ingredients such as arsenic and selenium are added in small amounts and numerous investigations have shown that careful handling is common and does not result in a health hazard. However, we have encountered excessive dust when these metals are gathered and weighed because of careless handling by the particular workman. In these latter instances methods of control by exhaust ventilation are recommended on the basis that it is frequently impractical to convert a careless workman into a careful one.

Lead as a constituent of glass batch is generally a major batch ingredient and when used normally requires exhaust ventilation of portions of the process.

Dustiness Index of Sand

The dustiness index of glass sand is a measure of the quantity of respirable dust contained in a unit weight and therefore provides a basis for comparing various sands respecting their potentialities for producing atmospheric dust when handled, as by shoveling.

The analysis consists of sieving 100 grams of the material through a 325 mesh screen. The amount passing through the screen is weighed and a known portion of it dispersed in alcohol and counted using the microscope. This data

provides an estimate of the millions of particles of respirable dust present in 100 grams of the parent material.

Variations in the dustiness index from 30 to 600 are common. It is obvious that a material with a low dustiness index is desirable and that its use will assist materially in the prevention of silicosis. We are currently collecting data to provide a quantitative correlation between dustiness index and the actual dust concentrations near certain specific operations, e.g., freight car unloading by shovel and wheelbarrow.