FIBROUS GLASS AND INDUSTRIAL HYGIENE SURVEY

OWENS CORNING
Santa Clara, California

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INTRODUCTION

From May 17 to May 20, 1972, a fibrous glass dust and industrial hygiene survey was conducted at the Owens Corning Fiberglas, Santa Clara, California facility. Dr. Joseph Wagoner, Dr. William Johnson, Rick Waxweiler, John Dement and Patrick Shuler made the initial plant tour on May 17 and John Dement and Patrick Shuler remained to continue the survey.

During the week approximately 50 samples were taken in the wool plant, tile painting operations, and the glass batch area. These samples were used to evaluate fibrous glass exposure and free silica exposure. The following paragraphs describe the Santa Clara facilities which were sampled, along with sample results and recommendations for improvements.

DESCRIPTION OF PLANT SITE AND MEDICAL PROGRAMS

The plant is located in Santa Clara and employs approximately 670 blue collar workers. Most areas of the plant are operated 24 hours per day on a four shift basis. The manufacturing section of the plant is located under one roof and began actual production in July 1948.

The company has in plant medical facilities, and occupational health consultation is available from corporate headquarters in Toledo, Ohio. Dr. Jon L. Konzen is Medical Director of the Owens Corning Fiberglas Corporation. The plant has had one full time registered nurse for 12 years. Internists from the San José Medical Clinic in nearby San Jose visit the plant two days per week (two hours per day) primarily for physical examinations. Dermatology consultation is provided by Dr. Burkhart in San Jose.

The in-plant Medical Department has no X-ray equipment; however, pre-employment and periodic chest X-rays (14" x 17") have been provided for all employees at the San José Medical Clinic for three years. Periodic chest X-rays have been provided for employees in the batching and roofing operations

since approximately 1957. Periodic evaluations including a physical examination, chest X-ray, and urine sugar are provided every six months to two years depending on job classifications, age, and health status. Selective audiometry is performed; however, pulmonary function testing is not included.

Management claims they have never seen a chest disease case attributed to fibrous glass exposure, and they assert that the rate of acute and chronic lung disease in this plant is not excessive.

Allergic dermatitis secondary to fibrous glass exposure is not considered a current problem, although it has occurred in the past. No occupational dermatitis disease reports were submitted to State of California in the last six months of 1971. Eighty-five employees complained of mechanical dermatitis including itching in 1971, and these cases were treated by the registered nurse with various agents including Burow's solution.

The corporation employs Gerald Devitt as a full time industrial hygienist. Gus E. Pinoris works full time as Safety Director at Santa Clara. A total of 24 people are on the safety committee at this plant, 16 people selected by the union, and 8 representatives from management. Safety meetings are held once a month, and the minutes from these meetings are published.

A wide variety of fiberglass products are manufactured at Santa Clara to fulfill customer needs and specifications. Some of the major product lines are as follows:

1. Insulation Products (Home & Appliance)
2. Fiberglass Pipe Insulation
3. Fiberglass Ceiling Boards
4. Fiberglass Ducts and Duct Insulation
5. Roofing Products and Insulation

DESCRIPTION OF THE PROCESSES

There are eight fibrous glass forming lines at the Santa Clara plant excluding the aerospace operations. Two of these forming lines use centrifugal forming and four use air blower forming. Bonded mat materials are made by either steam blower forming or by the "Shuler" process.

Glass batch for each of the furnaces is mixed in one area. A list of the raw materials is given in Figure 3 of the Appendix. Batch for the centrifugal furnaces is automatically weighed and mixed. A diagram of this operation is given in Figure 2 of the Appendix. Glass batches for the Aerocor (air blower forming) and the bonded mat lines are hand mixed. A line diagram of the hand mixing location and points of local exhaust ventilation are shown in Figure 4 of the Appendix.

Charges for the various furnaces are conveyed from the mixing area to the furnaces by drums carried by an overhead conveyer. The two centrifugal forming lines have electric furnaces and all other furnaces are gas fired.

In the centrifugal forming process, boro-silicate glass is fed from the furnace forehearth into spinners where centrifugal force is used to force the glass through small holes in the periphery of the spinner thus forming fibers. Upon leaving the spinners, each glass stream is met by a high velocity air stream which helps further attenuate the glass fibers into the desired diameters. Fibers from this process are usually 5-7μ in diameter.

As the attenuated fibers move away from the spinners, a phenol-formaldehyde resin is applied by a spraying process. The fibers which are coated with the resin are then collected on a conveyer.

After the glass blanket leaves the forming area, it is conveyed to a curing oven where the resin is cured at temperatures between 400°F and 500°F.

Fibrous glass batts which are to be used to make ceiling tiles are also compressed simultaneously during the curing operation.

Following the curing operation, the glass batts are cut and trimmed to the final product dimensions. Vapor barriers may also be added at this point depending on product specification. Fibrous glass batts which are to be used for ceiling tiles are covered with a fibrous glass bonded mat and painted with a water base paint containing silica and talc.

Air blower forming (aerocor) is used to make fibrous glass of a relatively small diameter (1μ or less). There are four such forming lines at Santa Clara. Operations which follow forming are basically the same as those described above for centrifugal forming.

In air blower forming, molten glass flows through sieve-like openings in the furnace forehearth to form primary fibers. After leaving the forehearth, these fibers are attenuated into fine fibers by high air velocities.

Bonded mat is made by steam-jet forming and by the "Shuler" process. Steam forming uses the velocity of expanding steam to attenuate fibers. These fibers are basically continuous in nature and are collected on a conveyer in a criss-cross manner. A phenol-formaldehyde binder is added and the material cured in an oven to form a thin "textile like" material. The material is then wound on tubes.

The basic difference between the steam-jet and "Shuler" process for making bonded mat is the method by which fibers are attenuated. In the "Shuler" process glass flows through sieve-like bushings to form primary fibers. These fibers are then collected on a rotating polished drum. The pulling action of the drum on the fibers affects attenuation. The fibers are then blown from the drum onto a moving conveyer and the same curing process takes place as in steam-jet forming.

INSPECTION OF PLANT

Potential Health Hazards: The major potential health hazards observed during the visit were as follows:

1. Fibrous Glass Exposure (Skin & Respiratory)
2. Silica Exposure in the Acoustical Tile Spray Painting Operations
3. Silica Exposure in the Glass Batch Area
4. High Noise Exposure in Fibrous Glass Forming Areas
5. Solvent Exposure (Cyclohexane-toluene)
6. Talc Exposure During Ceiling Tile Painting
7. Coal Tar Pitch Volitiles Exposure During Roofing Tile Manufacture

Solvent exposures were not measured due to physical limitations. At this time, the results of the coal tar pitch analysis have not been received.

Personal Protection: Safety glasses and hearing protection devices are required in appropriate areas in the plant. Respirators must be worn in the batch mixing area and during the unloading of railroad cars. Air supplied respirators are used whenever sand blasting must be done. Safety shoes are not required but the company has a program to aid in their purchase.

Housekeeping: In general, the housekeeping at the plant was quite good. There is not an overcrowding of equipment and there is sufficient aisle space. Much of the floor cleaning is done with a vacuum sweeper. Compressed air is used to clean machines and clothing; however, pressure regulators have been installed in most areas.

Ventilation: A list of the locations, types, and ratings of ventilation and air pollution control equipment is listed in Table 4 in the appendix. No make-up air units are used in conjunction with this exhaust ventilation since the plant is located in a mild climate and the doors are open almost year round. There was no detectable negative pressure inside the building.

The air pollution control equipment in the eight fiber glass manufacturing lines have a combined maximum rating of 358,500 scfm. Most of this capacity is associated with the two large lines that utilize the centrifugal forming method. The sole roofing line utilizes three collectors with a maximum capacity of 64,200 scfm. Particulate glass furnace emissions are controlled with venturi scrubbers. Fume incinerators are used to control formaldehyde fumes generated in the curing ovens.

In the mixing area for glass batches which are done by hand, hooding is provided at the weighing station and at the dump from the mixer to the carry drums (See Figure 4). The automatic mixing system for the centrifugal forming lines is vented at the hopper discharge, at the discharge to the mixer, and at the discharge from the mixer to the conveying drums (See Figure 5). These points are vented to a Pagborn bag collector rated at 2500 cfm.

The actual spray painting of the acoustical tile is done in hoods which are enclosed on the top and three sides with downdraft ventilation being utilized inside the hoods. Air movement is provided by a propellar fan and is vented to the roof. For tile products that require sanding, local exhaust ventilation is used, venting to a low energy scrubber.

Local exhaust ventilation is provided for at sawing and trimming operations in the molded pipe area and in most other sections of the plant as required.

SURVEY PROCEDURES

Air sampling at the Santa Clara facility was done in the wool and roofing manufacturing section, the glass batch area, the acoustical ceiling tile area, and the molded pipe manufacture area. The type of exposures evaluated in each of these areas are as follows:

1. Wool Manufacture - Fibrous Glass Exposure and Silica Dust Exposure at the Hot End.
2. Roofing Manufacture - Silica Dust Exposure.

3. Glass Batch Area - Silica Dust Exposure
4. Acoustical Ceiling Tile Spray Painting - Silica Dust Exposure
5. Molded Pipe Manufacture - Fibrous Glass Exposure

Results of these samples are given in Tables 1, 2 & 3 in the Appendix.

The sampler used for all of these samples was a Mine Safety Appliance (MSA) permissible personal air sampler operated at a calibrated flow of 1.7 or 2.0 liters per minute. Respirable samples were taken using a 10 mm nylon cyclone[1] in connection with a MSA sampler fitted with a pulsation dampener[2].

Silica dust samples were collected on an MSA 37 mm polyvinyl chloride membrane filter and analyzed for free silica using the method described by Talvitie[3]. Fibrous glass samples were collected on tared Millipore Type AA cellulose ester membrane filters and fibers counted under phase contrast illumination at 430X magnification. Sample weights for the Millipore samples were determined in a temperature and humidity controlled room using a "Cahn Electro Balance".

CONCLUSIONS AND RECOMMENDATIONS

The following are conclusions drawn from the survey along with recommendations for needed improvements.

1. Although no meaningful safe limit for fibrous glass exposure has been developed, most exposure levels throughout the plant appear to be quite low. The highest fibrous glass concentrations occurred in handling products with uncured or no binder. More consideration should be given to prevent undue worker exposure to uncurred phenol-formaldehyde resin and fibrous glass.

2. Free silica concentrations in the batch house were above the present standards for both total and respirable fractions. Since the highest values were of the glass batch operator himself, this indicates that ventilation improvements are necessary at the hand

weighing and dumping stations. The respirator program in this area should be maintained, as an interim practice, in view of the inadequate ventilation.

3. Free silica concentrations in the roofing area were near the present standards for the respirable fraction. Possible improvements in local exhaust ventilation could be made at the point of sand addition.

4. Free silica concentrations in the acoustical tile spray painting area are also very near the present standards. Better enclosure of the painting booths would help to minimize any leakage.

5. The eye and hearing protection programs at the plant should be more strictly enforced. Eye protection is important due to the abrasive nature of fibrous glass. Some employees in the glass forming area were not wearing ear protection where the noise level is very high.

REFERENCES

1. Lippman, M. and W.B. Harris. "Size-selective Samplers for Estimating Respirable Dust Concentrations." Health Physics 8, 155 (1962).

2. LaViolette, P.A. and P.C. Reist. "An Improved Pulsation Dampener for Use with Mass Respirable Sampling Devices." Submitted to American Industrial Hygiene Association Journal.

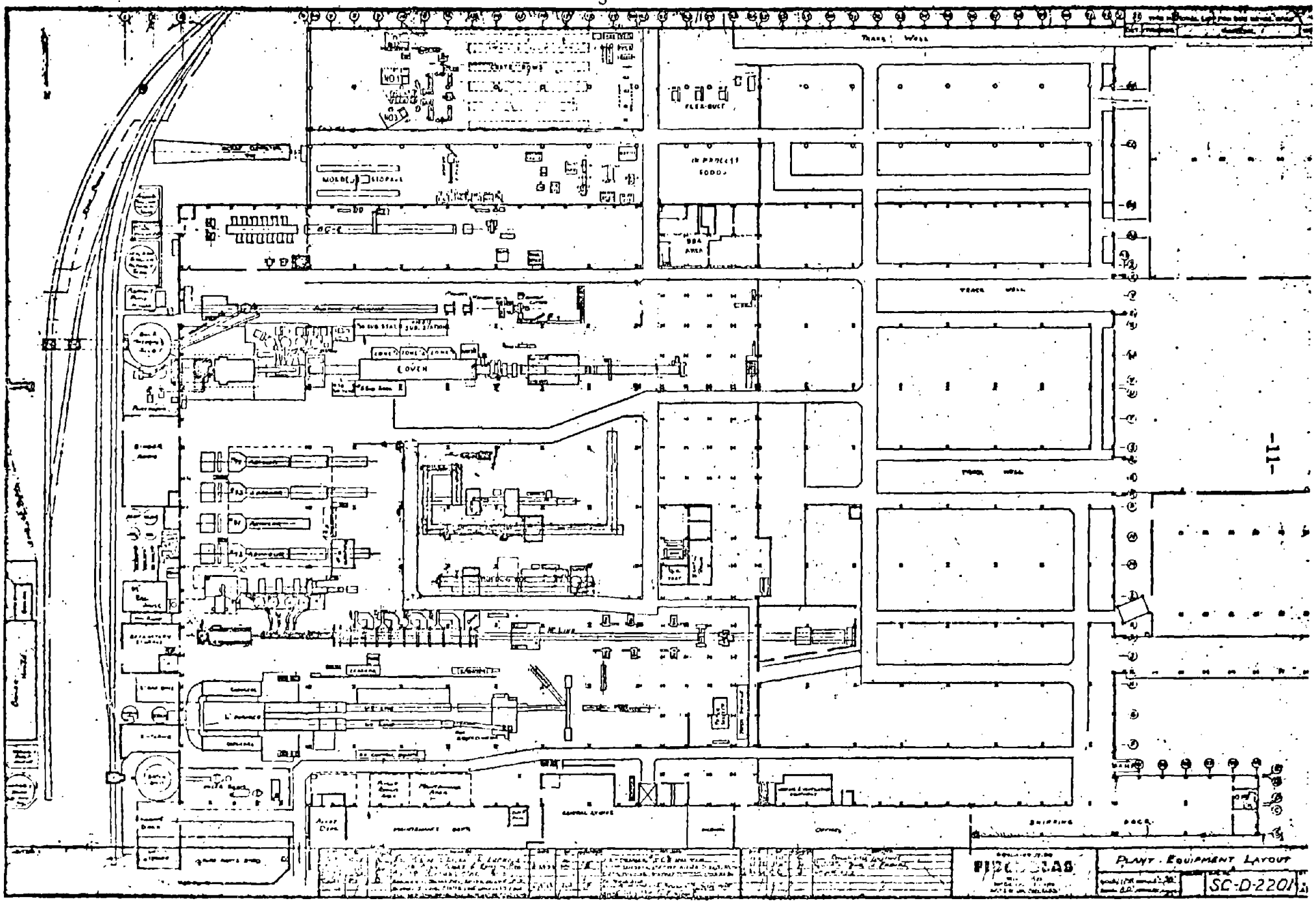
3. Talvitie, N.A. "Determination of Free Silica: Gravimetric and Spectrophotometric Procedures Applicable to Airborne and Settled Dust." American Industrial Hygiene Association Journal 25, 189 (1964).

A P P E N D I X

FIGURES

TABLES

Figure 1.



Elevation of Santa Clara Facility.

FIGURE 2

SCHEMATIC OF WOOL TYPE PROCESSES

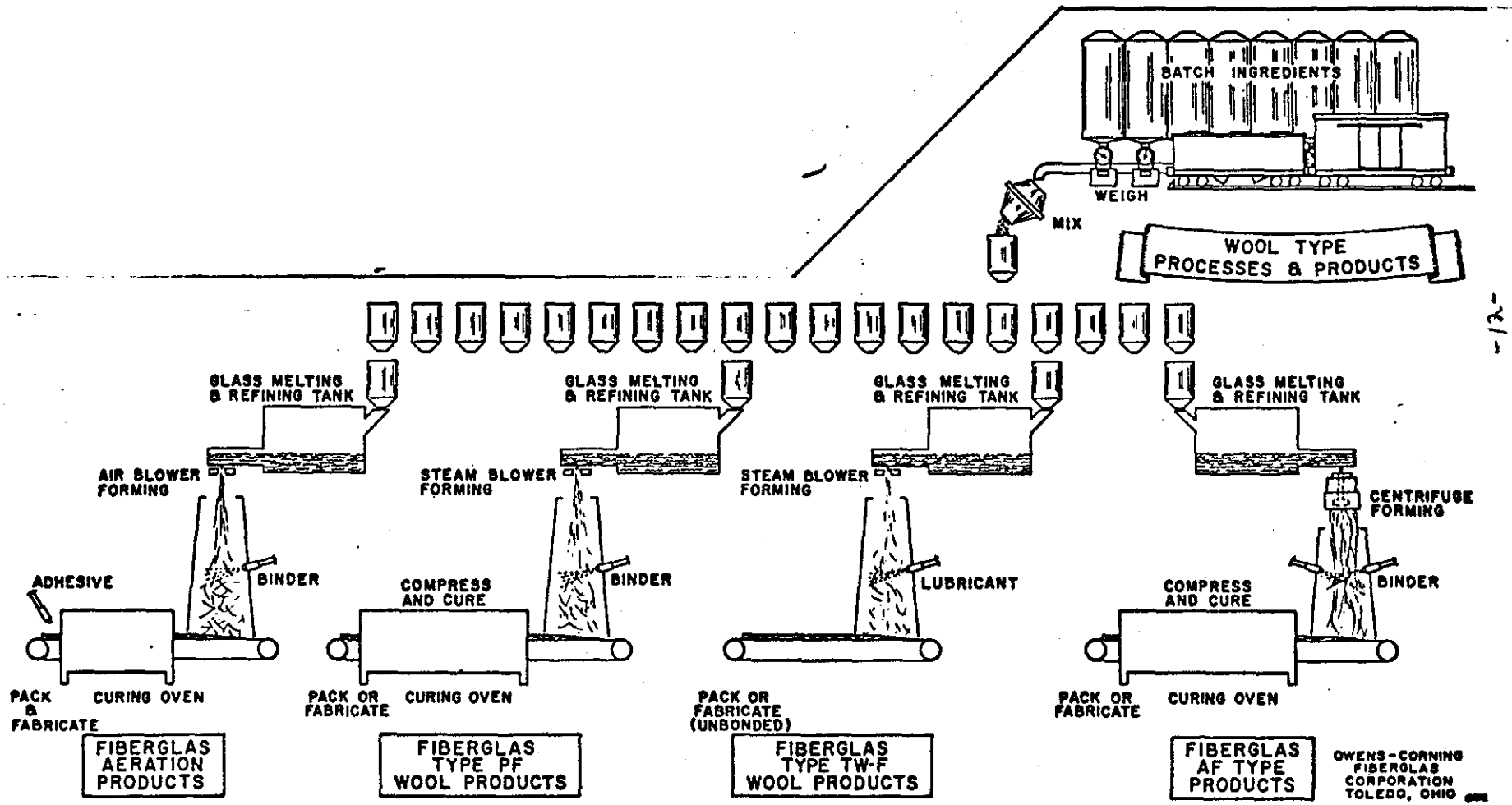


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FIGURE 3

MAJOR RAW MATERIALS
USED AT
OWENS-CORNING
Santa Clara, California

	MATERIAL	*STORED*
1.	Silica Flour	Bag
2.	Calcined Alumina	Bag
3.	Magnesite	Bag
4.	Quicklime	Bag
5.	Rutile	Bag
6.	Boro Silicate	Bag
7.	Kaolin	Bag
8.	Calcium Carbonate Pigment	Bag
9.	Zinc Oxide	Bag
10.	Sodium Sulfate	Bag
11.	Anhydrous Borax	Bag
12.	Sodium Silica Fluroide	Bag
13.	Phenol-Formaldehyde Resin	Tank
14.	Silica-Talc Spray Paint	Tank
15.	Sand	Hopper
16.	Gravel	Hopper
17.	Asphalt	Tank

Figure 4.

Ventilation in Mix Area for Aerocor Furnace Batches

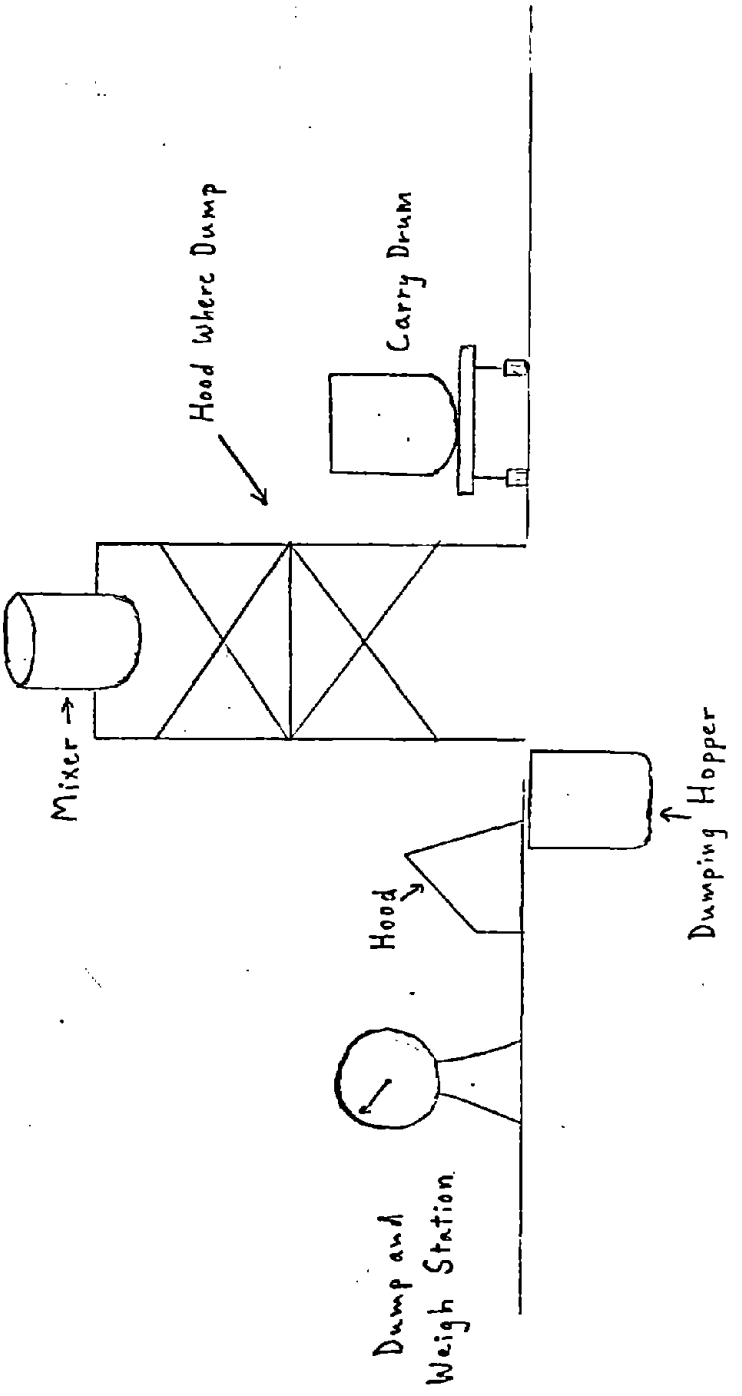

Figure 5.

Ventilation in Batch Conveying of Mixes for Centrifugal Furnaces

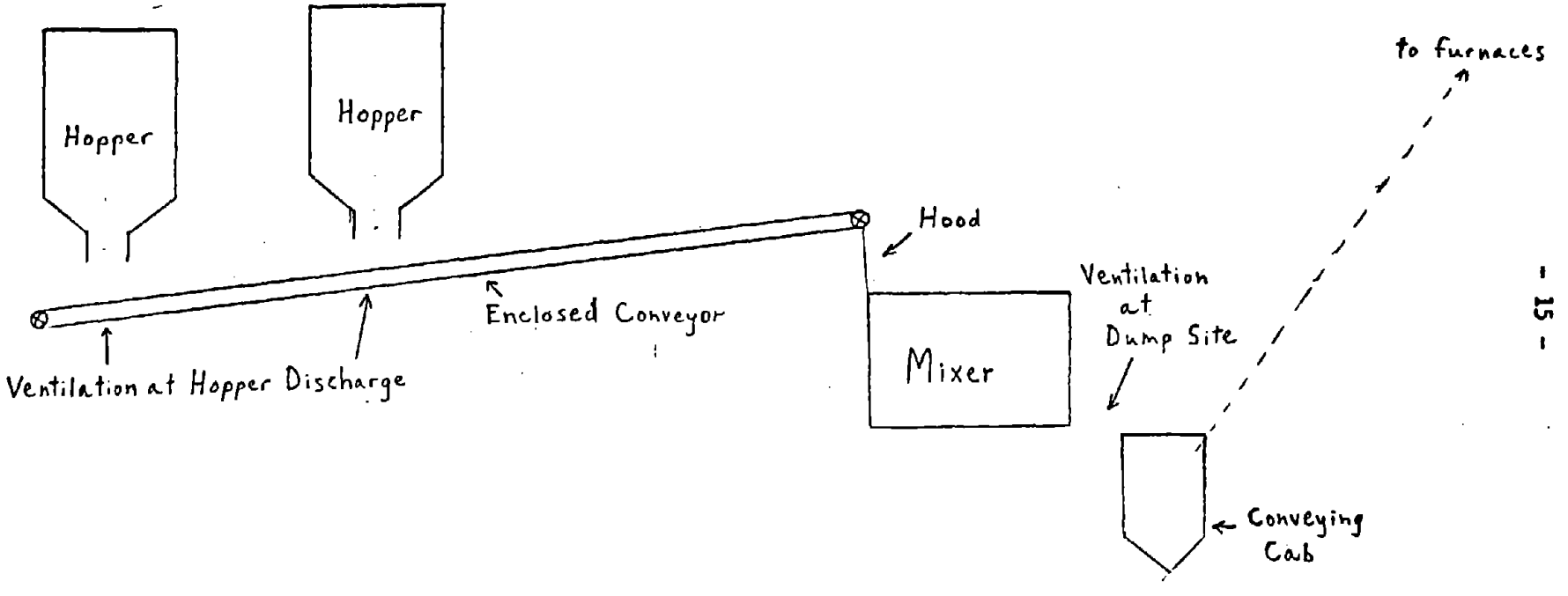

TABLE I

OWENS-CORNING
Santa Clara, California
FIBROUS GLASS EXPOSURE

SAMPLE #	*AREA OR WORKER SAMPLED*	*AIR VOL. M^3*	*Mg*	*CONCENTRATION*	
				Mg/M^3	*Fibers <10μ in Dia/Ml*
76	Aerocor #91 (Uncured binder)	0.3020	.100	0.33	1.36
77	Aerocor #91 Packer (Uncured binder)	0.6040	.030	0.05	0.57
78	Aerocor #93 Packer (No binder)	0.6079	.050	0.08	1.69
79	Packer Aere #93 (No binder)	0.2745	.120	0.43	0.60
80	Forehearth Operator #93	0.6036	.030	0.05	0.17
82	Wiper Aerocor #93 (No binder)	0.2484	.260	1.05	0.81
83	Packer Aerocor #92	0.5375	1.360	2.53	0.04
84	Packer Aerocor #92	0.5817	1.210	2.08	0.24
85	Packer, SC-1 Bonded Mat	0.5468	.520	0.95	0.84
86	Threader, SC-1 Bonded Mat	0.5567	.910	1.63	0.04
87	Hot Press, Molded Pipe	0.1430	2.080	14.54*	0.26
88	Stacker-Molded Pipe Sawing	0.1408	1.070	7.59	0.15
89	Wool Reclaim Packer	0.4933	1.230	2.49	0.09
90	Wool Reclaim Packer	0.3456	.350	1.01	0.10
91	Wool Reclaim Stripper	0.3150	.240	0.76	0.13
92	Wool Reclaim Stripper	0.3555	.640	1.80	0.08
93	Wool Reclaim Feeder	0.2813	.600	2.13	0.08
95	"M" Lire, Packer	0.4389	1.430	3.26	0.09
96	Molded Pipe, Hot Press	0.2360	.480	2.03	0.27
97	Saw Feeder, Molded Pipe	0.5080	.120	0.24	0.12
98	Hot Press, Molded Pipe	0.5180	.840	1.67	0.06
99	Saw Operator, Molded Pipe	0.5180	.500	0.97	0.11

* *Machine blown off during sample*

TABLE 2

OWENS-CORNING

Santa Clara, California

Silica Dust Exposures

in

*Glass Batch & Furnace Charge Areas**

SAMPLE #	*AREA OR PERSON SAMPLED*	*VOL. M^3*	*DW Mg*	*TOTAL CONC. Mg/M^3*	*SiO_2 WT. Mg*	*SiO_2 CONC. Mg/M^3*	*COMMENT*
VM- 6	Glass Batch Operator Resp.	0.24	0.3	1.25	0.13	0.54	Wears
VM- 7	Glass Batch Operator Total	0.29	4.8	16.55	2.53	8.40	Respirato
VM- 8	----------	----	Void	----	----	----	
VM- 9	G.A. at Glass Batch Mixer, Resp.	0.22	0.1	0.45	0.084	0.38	
VM-10	G.A. at Glass Batch Mixer, Total	0.26	0.5	1.96	0.26	1.00	
VM-11	G.A. at Aerocor Batch Weighing Station, Resp.	0.21	0.5	2.38	0.066	0.31	
VM-12	G.A. at Aerocor Batch Weighing Station, Total	0.25	1.8	7.20	0.71	2.8	
VM-13	G.A. in Glass Hopper Area, Resp.	0.26	0.5	1.92	0.096	0.38	
VM-14	G.A. in Glass Hopper Area, Total	0.22	0.3	1.36	0.027	0.12	
VM-15	Furnace Charge "M" Line, Resp.	0.36	0.2	0.55	0.029	0.08	
VM-16	Furnace Charge "M" Line, Total	0.44	0.3	0.68	0.031	0.07	
VM-17	Furnace Dump "M" Line, Resp.	0.36	0.2	0.55	0.031	0.08	
VM-18	Furnace Dump "M" Line, Total	0.44	0.9	2.04	0.054	0.12	
VM-19	Furnace Charge "N" Line, Resp.	0.35	0.1	0.28	0.045	0.13	
VM-20	Furnace Charge "N" Line, Total	0.42	0.7	1.66	0.066	0.16	

* *Present standards for free silica exposure are 0.3 Mg/M^3 for total dust and 0.1 Mg/M^3 for respirable dust.*

TABLE 3

OWENS-CORNING

Santa Clara, California

Silica Dust Exposures

in

*Shingle Production & Acoustical Tile Spray Painting**

SAMPLE #	*AREA OR PERSON SAMPLED*		*VOL. M^3*	*DW Mg*	*TOTAL CONC. Mg/M^3*	*SiO_2 WT. Mg*	*SiO_2 CONC. Mg/M^3*	*COMMENT*
VM-21	Shingle Roll Take-off	Resp.	0.36	0.2	0.55	0.038	0.10	
VM-22	Shingle Roll Take-off	Total	0.44	0.2	0.55	0.031	0.10	
VM-23	Shingle Sand Addition	Resp.	0.35	0.3	0.88	0.043	0.12	
VM-24	Shingle Sand Addition	Total	0.42	1.4	3.33	0.094	0.22	
VM-25	Color Addition (not operator)	Resp.	0.35	0.0	0.00	0.360	0.10	
VM-26	Color Addition (not operator)	Total	0.42	0.5	1.19	0.057	0.13	
VM-27	Shingle Sand Addition	Resp.	0.38	0.4	1.00	Analyzed for Coal Tar Pi Volatiles		
VM-28	Shingle Sand Addition	Total	0.46	6.4	13.91			
VM-29	Paint Attendant	Resp.	0.30	0.2	0.60	0.029	0.10	
VM-30	Paint Attendant	Total	0.36	0.2	0.60	0.940	2.60	
VM-31	G.A. at Paint Spray	Resp.	0.29	0.1	0.34	0.034	0.11	
VM-32	G.A. at Paint Spray	Total	0.36	0.3	0.83	0.034	0.10	
VM-33	G.A. at Paint Spray	Resp.	0.29	0.5	1.72	0.084	0.30	
VM-34	G.A. at Paint Spray	Total	0.34	2.9	8.52	0.044	0.13	
VM-35	Paint Attendant	Resp.	0.28	0.1	0.35	0.024	0.10	
VM-36	Paint Attendant	Total	0.36	0.8	2.22	0.037	0.10	

* *Present standards for free silica exposure are 0.3 Mg/M^3 for total dust and 0.1 Mg/M^3 for respirable dust.*

TABLE 4

OWENS-CORNING FIBERGLAS

Santa Clara, California

Local Exhaust Ventilation
&
Air Pollution Control Equipment

GLASS FORMING:

LINE	*LOCATION*	*TYPE COLLECTION EQUIPMENT*	*MAXIMUM RATING (scfm)*
Mat SC-1	Oven Fune	1300°F Incinerator	5000
Mat SC-2	Furnace	Baghouse	4000
	Oven	S After Burners	5000
Aerocore 91	Furnace	Venturi Scrubber	4000
	Oven	1300° Incinerator	5000
Aerocore 92	Furnace	Venturi Scrubber	6000
	Oven	1300° Incinerator	5000
Aerocore 93	Furnace	Venturi Scrubber	4000
	Oven	1300° Incinerator	5000
Aerocore 94	Furnace	Venturi Scrubber	4000
	Oven	1300° Incinerator	5000
AF M	Furnace	Electric	----
	Furnace Riser	Baghouse	1000
AF M	Forehearth	Baghouse	500
	Forming	4 Venturi Scrubber	
		4 After Burner 300°F	80,000
	Oven	2 1300° F Incinerator	12,000
	Cooling	Filter	30,000
	Local Exhaust	Pennclone	30,000
AF O	Furnace	Electric	----
	Furnace Riser	Electric	----
	Forming	4 Venturi Scrubber	----
		4 After Burner 300°F	80,000
	Oven	1 1300°F Incinerator	13,000
	Cooling	Low Energy Scrubber	30,000
	Local Exhuast	Pennclone	30,000
		Total for Glass Forming:	385,500 scfm

ROOFING:

MATERIAL COLLECTED	*TYPE COLLECTION EQUIPMENT*	*MAXIMUM RATING (scfm)*	
Asphalt Fume	Ultradyne Filter	30,000	
Dust	Sly Baghouse	4,200	
Sand	AAF Type W Rotoclone	30,000	
	Total for Roofing Manufacture:	64,200	scfm

GLASS BATCH AREA:

Batch Mix (Centrifugal)	Baghouse (Pangborn Type CH-2)	2,500	
Batch Mix (Aerocore & Borded Mat)	Baghouse (Draco)	2,500	
	Total for Glass Batch Area:	5,000	scfm

ACOUSTICAL TILE SPRAY PAINTING:

UFF Sander	Low Energy Scrubber	30,000	
3 Spray Booths	To Roof	50,700	
	Total for Spray Painting:	80,700	scfm

MOLDED PIPE MANUFACTURE:

Local Exhaust	Pennclone	30,000	

MISCELLANEOUS:

Sand Blast	Baghouse	20,000	