INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

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Report on

INDUSTRIAL HYGIENE SURVEY OF SELECTED PROCESS OPERATIONS

for

PITTSBURGH-CORNING CORPORATION
Port Allegany, Pennsylvania

April 14-15, 1966

by

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I. Introduction

This survey was undertaken at the request of Dr. Lee B. Grant, Medical Director, Pittsburgh Plate Glass Company. Dr. Grant initially visited the Port Allegany plant during October 25-28, 1965 and summarized plant areas requiring further industrial hygiene assessment in a December 25, 1965 letter to Mr. L. O. Griffith, Plant Manager. The survey reported below concentrated on the evaluation of operations singled out by Dr. Grant, but also included additional operations. In this report all aspects of environmental assessment investigated at the Port Allegany plant are discussed, with the exception of assessment of lead exposure by analysis of urine or blood samples obtained from workmen utilizing lead base paints. Dr. Grant will report on this phase of the survey.

Mr. Fred Van Dusen, Ceramics Engineer, Port Allegany plant, accompanied the author during the entire survey and also assisted with several measurements. His assistance is gratefully acknowledged.

II. Recommendations

A. Plant No. 1: Glass Block

1. Ear protective equipment should be fitted to operators in the vicinity of the block forming circle, fire polishing line, block sealing machinery, and the glass tank. Noise in these zones is excessive.

2. A permanent, rigid, hinged frontpiece should be installed on the front of the decorative paint spraying booth to replace the presently used makeshift, cardboard frontpiece.

3. A stringent personal hygiene program should be instituted for operators in the paint spray booth to ensure that paint on hands, fingers, etc. is not ingested.

B. Plant No. 2: Fabrication of Foam Glass

1. Louvers on overhead air supply hoods above the mould filling operator should be adjusted as described in this report and then locked in position. In this manner, dust from the mould can be prevented from entering the face zone of the operator.

2. Ear protection equipment should be furnished to the mould filling operator, who is exposed to brief, but regularly spaced sound level peaks of 106 db and base levels of 98 db.

3. Two overhead 8" diameter air ducts at line 1 mould filling position should be realigned as described in this report.

4. Ear protection equipment should be furnished to band saw and grinder operators.

5. The use of compressed air to clean clothes and work surfaces at the grinding operation site should be discontinued and a suction source should be substituted.

6. The exhaust line to the knockout bench should be repaired.

7. Exhaust ventilation should be installed at the stay-dry pipe covering operation where asphalt fumes are generated in large quantities.

C. Plant No. 6: Foamthane

1. Toluene-2,4-diisocyanate concentrations in air did not exceed the recommended ceiling value. However, the amount of TDI in the air of this plant can be greatly reduced by erecting a permanent, three-sided enclosure for the bun cutting operation. At present, a tagged, plastic curtain is being used for this purpose.

D. Plant No. 8: Unibestos

1. Asbestos dust in the vicinity of the feeder operator was excessive when measured by standard techniques. The feeder operator should wear respiratory protective equipment at all times.

2. To reduce airborne dust, a general tightening up of "housekeeping" practices should be instituted in this plant. Several specific suggestions are included in this report.

III. Threshold Limit Values of Substances Measured in This Survey

"The threshold limit values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. Because of wide variation in individual susceptibility, exposure of an occasional individual at or even below the threshold limit may not prevent discomfort, aggravation of a pre-existing condition, or occupational illness.

"Threshold limits should be used as guides in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentrations."

Threshold values for all substances measured in this survey are presented in Table 1.

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*Extracted from the Preface, Threshold Limit Values for 1965. American Conference of Governmental Hygienists, 1014 Broadway, Cincinnati 2, Ohio.

Table 1

Threshold Limit Values For Substances Measured In This Survey±

Substance	ppm*	mg/m³**	MPPCF***
Asbestos (less than 1% crystalline silica)			5
Lead		0.2	
Toluene-2, 4-diisocyanate	0.02 (Ceiling Value)		

Broad-band (600-4800 cps) Noise **** 85 db.

**** See Industrial Noise Manual, 2nd Ed. American Industrial Hygiene Association, 14125 Prevost, Detroit, Michigan, 1966, Ch. 7.

*** Millions of Particles Per Cubic Foot.

** Approximate milligrams of particulate per cubic meter of air.

* Parts of vapor or gas per million parts of air by volume at 25° C and 760 mmHg pressure.

± Based on values adopted in 1965 by the American Conference of Governmental Industrial Hygienists.

IV. Description of Sampling and Analytical Methods

The air sampling and measurement techniques used to assess the environment during this study are described below.

Asbestos Dust

A midget impinger containing 10 ml. of demineralized, distilled water was used to collect dust in air sampled at 0.1 cfm for ten minutes. Samples were agitated prior to withdrawing drops of suspension for microscopic examination in a Dunn Cell. Particles less than ten microns in projected area diameter were counted by viewing the sample with an objective lens of 0.65 N.A. (10 X) and a 15 X Ocular. Approximately 200-300 particles were counted in two different sample withdrawals. The counting standard deviation was estimated to be $(N)^{1/2}$, where N is the total count for the sample. A blank count was made on the distilled water. Dust concentration in the air, expressed as millions of particles per cubic foot (mppcf), was calculated from the sample volume, liquid collection reservoir, and sample and blank dust counts. The techniques used adhered to United States Public Health Service and Asbestos industry recommended procedures.**

Lead

Lead in air as particulates from paint spraying was sampled at 27 cfm by using an electrostatic precipitator.* An HA Millipore filter paper was also used. Total particulate weight was determined by direct weighing of samples on a microbalance ($\pm$ 0.01 mg). Lead was determined by assuming the airborne material lead content to be that of the bulk paint (45-51% by weight).

**"Method for Determining Asbestos Dust Concentration." Asbestos Textile Institute, Pompton Lakes, New Jersey, 1964.

* Del Electronics Corporation, Mt. Vernon, New York.

Toluene-2,4-diisocyanate

A Unico* TDI Analysis in Air Kit was used. Air is drawn at 0.1 cfm through 10 ml. of absorber solution in a midget impinger. The absorber solution is analyzed in the field by colorimetric methods** and the resultant color is compared to a set of permanent color standards.

Sound Intensity

A General Radio Company*** sound level meter, Type 1551 C, with ceramic microphone was used. All measurements were made on the instrument C-scale. The instrument was calibrated in the anechoic chamber at the Graduate School of Public Health, University of Pittsburgh.

*** West Concord, Massachusetts 01781.

** Marcali, K.: "Microdetermination of TDI in the Atmosphere." Anal. Chem. 29, 552 (1957).

* Union Industrial Equipment Company, 150 Cove Street, Fall River, Mass.

V. Results and Discussion

A. Plant No. 2: Glass Block Production

1. Noise Measurements

Table 2 is a summary of results of sound intensity measurements performed in the vicinity of block forming and spraying operations. The results indicate that noise levels are very high and are beyond the threshold of damage risk, even when the polishing operation is OFF. A stringent criterion for sound intensity is 85 db when sound is measured on a broad band basis (C-scale), as it was in this survey. An industry-wide level is 95 db, which is less stringent. The levels measured in the vicinity of glass block operations exceeded even the less stringent criterion. Therefore, ear protection must be furnished to operators in the Glass Block plant if the possibility of hearing damage is to be eliminated. At present the risk is greatest in the vicinity of block forming.

Table 2

Summary of Sound Levels in the Vicinity of Selected Glass Block Plant Operations*±

Sample Number	Location of Measurement	Sound Intensity, Decibels
1	Two feet from Forming Circle on line 4 between Operator Room and polishing stage (Polishing Operation OFF)	99
2	Same as (1), but Cooling Air ON and Flame Polishing Gas ON	103-105
3	Between lines 3 and 4 (Polishing Operation OFF)	100
4	Same as (3), but Cooling Air ON and Flame Polishing Gas ON	102
5	Midway between No. 3 and 4 lines near Forming Circle (Polishing Operation OFF)	101
6	Same as (5), but Cooling Air and Flame Polishing Gas ON	102-103
7	Approximately 2 feet from Operator near No. 3 line	104
8	Adjoining belt exit, No. 3 line	103
9	Near Glass Tank wall (background)	98
10	Between lines 2 and 3 at Sealing Operation, at Operator's side	99
11	Entry to storage room at end of belt.No. 4 .. near Sealing Area (Polishing Operation OFF)	98
12	Vinyl Spraying of Block Edges 2 feet from No. 3 line operation, next to operator	92

*All measurements made on April 14, 1966 between 8:00 and 8:30 a.m.

±Dry bulb temperature = 88°F.; Wetbulb temperature = 77°F.; Relative humidity = 61%.

2. Hood Air Velocities, Vinyl Edge Spraying

Air velocities in the No. 3 line operation varied from 150 to 1,000 fpm from side entry to rear hood entry, indicating satisfactory ventilation control of vapors in this operation. Large particles cannot be exhausted and protection of the eyes was accomplished by the use of safety goggles. This operation does not require any modification to afford further operator protection.

3. Decorative Paint Spraying

Air velocities at the makeshift hood frontpiece (cardboard) were measured and air samples for particulates in air were obtained. The men had fabricated a 13" x 18" cut-out in a flat section of cardboard used to cover the hood face. The cardboard did a good job of control: air velocities at the opening were 500-600 fpm. A rigid hinged door faceplate, rather than the cardboard now in use, should be attached to the spray booth.

Particulate concentration in the breathing zone of the operator, based on a Millipore filter sample and an electrostatic precipitator sample, was 0.3 - 0.4 mg/m^3. The enamel used contained 45 - 51% lead oxide so that the lead in the air was not in excess of the threshold limit value of 0.2 mg/m^3.

It appeared to me that a more serious problem in this operation is the extensive paint contamination on hands and clothing which results from cleaning spray guns (which plug every 4-5 blocks) and extending hands into the box. Without a very rigid personal hygiene program, the operator could easily ingest a large quantity of lead picked up by contamination.

B. Plant No. 2: Fabrication of Foam Glass

1. Mould Stripping

The mould stripping operation has been a source of minor eye injuries. The flow of air from overhead hoods downward over the operator appeared to re-entrain dust upward from the mould to the operator's eye. It is believed that the reason for variations in severity of incidence of these injuries at different stations is related to the adjustment of air louvers on the overhead hoods. Thus, at Station No. 1 air velocities were 4560 - 6000 fpm at the face of the slotted 3 ft. x 1 1/2 ft. hood. At Stations 2 - 4, air velocities at the face were 1500 - 4000 fpm. No. 2 Station had lowest hood face air velocities. The reason for these variations is that the resistances of the ventilation lines are varied by the men as they adjust the louvers. The remedy to this situation is to lock the louvers in position after adjustment by engineering personnel.

At Station 1 the louvers were adjusted in a series of test positions to see if air could be directed both downward at the operator's back and forward towards the oven and over the roller table. These cursory studies were made in the presence of Mr. Van Dusen. It appeared that by proper adjustment of louvers, with some set perpendicular to the floor and some at approximately 45° to the floor, the air could be effectively used to keep dust from the operator's face.

The only alternative I can suggest to the above simple solution, is the installation of suction sources below the knockout table. I believe the present situation can be remedied by simple louver adjustment without recourse to major engineering of the facility. If simple louver adjustment and redirection of air results in too little air reaching the operator's back, there is sufficient air at each hood to extend the hood to face dimensions of 2 1/2 ft. x 3 ft.

2. Mould Filling

Sound intensity levels at the filling operation were 98 - 106 db, which are excessive. The 106 db level was intermittent, occurring only during the filling cycle (approximately 1 second), but ear protection should be utilized by the operator.

Two overhead 8" diameter air ducts at line 1 filling position are poorly located. Air is directed at the floor, with the resulting upward flow of dust. The jet should be lowered and aligned parallel to the floor.

3. Grinding Operations

Hood air velocities at the grinders for 5" block face and side cuts were greater than 1000 fpm, indicating excellent control. An exhaust duct under the knockout bench at the grinding site was not operative because of a connection break on the floor. This is a poor location for the duct. It should be relocated (overhead entry) or someone should be responsible for checking the connection in the present site. However, dust was well under control at this location. Installation of exhaust control on the band saw would further improve the operation.

Sound intensity level at the band saw was 92 db: at the grinder it was 94 db. In my opinion, continuous exposure to levels in excess of 85 db is an unnecessary risk. These men should wear a form of ear protector.

In this area the men used compressed air to "dust-off" surfaces and themselves. An air jet is an excellent dust disperser and housekeeping would be improved if an industrial vacuum cleaner, rather than an air jet, was used for this purpose.

4. Stay-Dry Pipe Cover

In this operation a synthetic asphalt, Kendex 4230, is rolled on the foam glass pipe sections. A condensed liquid fume rises from the hot, wet rollers and is often in the breathing zone of the operator. An air sample (Millipore filter) obtained at the breathing zone of the operator indicated a concentration of 5.1 mg/m^3. Unfortunately, the ingredients in Kendex 4230 could not be determined and it is not possible to assess the health hazard of this exposure. The fume from the operation also impairs visibility in the shop. It is recommended that side-slot suction ventilation be utilized at this site. The slot air velocity will decrease to 10% of its value one diameter from the face so the tar wheel and exhaust slot must be in close proximity.

The saturated vapors from this operation will condense on any cold surface, including an exhaust slot. Frequent cleaning of a hood exhausting asphalt fumes is the only way to ensure good performance.

5. Accoustic Tile Spraying

Hood face air velocities at this operation were 150 - 250 fpm and control was satisfactory.

C. Plant No. 6: Foamthane

1. Toluene-2,4-diisocyanate (TDI) Concentrations in Air

Table 3 is a summary of TDI concentrations based on air sampling in this plant. All measured air concentrations of TDI were less than the ceiling value recommended by the American Conference of Governmental Industrial Hygienists (0.02 ppm).

The operation which requires further control is hot wire cutting. At present the men have erected a flexible plastic curtain enclosure for the operation. This enclosure should be a rigid one enclosing three sides of the work bench from hood rim to floor. This recommendation is based on measured air velocities at this site. Five feet from the ground, in front of the work bench, velocities were 50 - 75 fpm, which is comparable to room air velocities. Seven feet from the ground 100 fpm velocities were found. These velocities are low and are probably due to air leakage into the plastic enclosure at ground level in the rear of the work bench.

Table 3

Concentrations of Toluene-2,4-diisocyanate in Air, Plant No. 6*

Sample	Location	TDI Concentration ppm
1	Breathing zone of operator (foam formation)	<0.01
2	Breathing zone of operator 1; Bun cutting at end of belt (wall side)	0.01
3	Breathing zone of operator 2; Bun cutting (center of room side)	<0.01
4	Breathing zone of operator; Hot wire cutting	0.01
5	Breathing zone of operator; Band saw	<0.01
6	Repeat Sample 4, wire cutting	0.01
7	Background sample	<0.01

*Sampling performed on April 14, 1966, 1:30 - 3:00 p.m.

D. Plant No. 8: Unibestos

Dust in this plant was sampled and assessed using the midget impinger techniques which are still standard practice in the United States. It should be stressed that these techniques are undergoing transition and leave much be be desired, but they have been used for many years and are still the basis for recommended threshold limit values. Table 4 is a summary of the results of three air samples obtained in the plant. The concentration of dust in the breathing zone of the feeder is excessive. The feeder wore a respirator and this practice, if voluntary, should be compulsory.

Table 4

Concentrations of Asbestos in Air of Unibestos Plant*

Sample	Location	MPPCF**
1	Breathing zone of Sawyer	1.4 ± 0.1
2	Breathing zone of Feeder	11.5 ± 0.8
3	Background Dust in Vicinity of Feeding Operations	2.3 ± 0.4

** Millions of Particles Per Cubic Foot

* Sampling performed on April 14, 1966, 4:00 - 5:30 p.m.

Housekeeping procedures in this plant should be greatly improved for they undoubtedly contribute to the airborne dust. Some of the observed procedures, which should be modified or discontinued, are listed below.

1. Shoveling scrap material from storage bin to feed bins.

2. Feed bin conveyor belt returns (Lines 1 and 2) are not enclosed and material drops to the floor, thus creating dust.

3. Line 1 cyclone hopper at entry to the conveyor belt leaks.

4. Material drops from the fan entry feed line conveyor belt to a 55 Gal. drum, dispersing dust as it falls.

Air velocities at the feed bin faces varied from 50 - 90 fpm in the D11 bin to 130 - 170 fpm in the scrap bin. These velocities are too low for effective control of dust at this site.

Air velocities above the cutting saw bed were 150 - 200 fpm and appeared to be effectively controlling generated dust.