INDUSTRIAL HYGIENE SURVEY

Construction Insulation Shop - Building 511-2018

Report 63-IH-3-G-1

SUMMARY: The Construction Insulation Shop (Building 2018), Plant 512 location, routinely fabricates large quantities of insulation block with ventilated band saws. This more efficient procedure of fabrication has replaced an older, time honored, practice of using simple handsaws to do the job. However, it has, at the same time, created a health hazard resulting from exposure to excessive concentrations of atmospheric dust.

The hazard to health has been evaluated and reported previously* with the result that one material, "Thermobestos" was clearly identified with the hazard (exceeded TLV) and another material, "Kaylo", was safe to fabricate (within TLV). The present report (the third on this subject) was initiated in an attempt to supply answers to three basic questions: (1) was there any error in the original evaluation of "Kaylo", (2) can supplementary exhaust ventilation reduce the "Thermobestos" hazard to within safe acceptable limits, and (3) is a hazard to health produced in the fabrication of a third material, i.e., "Carey-Temp".

The information uncovered in the present evaluation reveals the following facts:

1. "Kaylo" insulation blocks can be safely fabricated with the existing equipment.

2. "Thermobestos" insulation blocks cannot be safely fabricated at the present time with existing equipment, but could be safely fabricated if the exhaust ventilation is improved.

3. The TLV (Threshold Limit Value) for "Carey-Temp" is identical with that established for both "Kaylo" and "Thermobestos", i.e., 20 mppcf (million particles per cubic foot) of air.

4. "Carey-Temp" also cannot be safely fabricated with the existing equipment, but could be if improvements are made in the ventilation system.

5. The original "downdraft" exhaust ventilation rates, on either band saw, do not meet the recommended capture velocity rate of 4,000 fpm (feet per minute).

6. The supplementary "overhead" exhaust ventilation on both band saws, is an improvement and the rates do meet the recommended capture velocity rate of 4,000 fpm.

I.H. Reports 62-IH-1-G-1 and 62-IH-2-G-1

EXHIBIT

TRODUCTION: A report, submitted in March 1962, stated that an inhalation hazard to health was produced in the Construction Insulation Shop whenever "Thermobestos" insulation blocks were fabricated. In July 1962, a second survey was conducted in order to evaluate three new "Thermobestos" materials which had been supplied by the manufacturer for evaluation. This survey revealed that, although the inhalation hazard to health had been substantially reduced from that encountered during the first survey, the atmospheric dust concentrations being emitted during fabrication of these new products, were still in excess of the Threshold Limit Values as designated in the first report. Therefore, all recommendations should remain exactly as stated in the initial report of March 1962.

The manufacturer and Union Carbide's Purchasing Department expressed a great deal of concern about the findings revealed in this initial report when it was uncovered that the manufacturer's Research Department also had evaluated these materials and was not able to produce results comparable with those contained in the report of March 1962. That is to say, the atmospheric dust concentrations reported by the manufacturer, when processing "Thermobestos" insulation blocks, were substantially higher than those revealed in Report 62-IH-1-G-1. This revelation disclosed the need for a more extensive evaluation of this problem so as to resolve all differences of opinion relative to the atmospheric dust exposures in this environment.

This decision in favor of further evaluation, promoted the production of a much more extensive study than was originally planned, a study which eventually encompassed three separate intervals of dust sampling, analysis, and evalution before all of the unanswered health problems could be resolved.

SCUSSION: These three investigations were actually initiated for the general purposes of both clarification and identification - purposely for clarification of the actual hazard to health (if any) connected with the fabrication of three different insulation materials and identification of acceptable measures for use in reducing all exposures to within safe acceptable limits. However, each investigation occurred for clearly identifiable reasons as explained below:

The investigation of 24 Jan 63 was conducted because:

1. The Johns Manville Company submitted a report, compiled by the Research Department, which contained data that conflicted with that submitted by this department in Report 62-IH-1-G-1.

2. This department desired to clarify the reasons for the discrepancy between the two reports and to identify positively the actual conditions as they exist in the working environment

The investigation of 25 and 26 Feb 63 was conducted because:

1. In the preceding investigation, the two insulation materials in question, i.e., "Thermobestos" and "Kaylo" were evaluated inadvertently during the same afternoon, a procedure which was not in keeping with an attempt to stimulate the conditions of the original report. In the original report, each material was evaluated on separate occasions so as to preclude the possibility that any one sample might contain dust produced by both operations.

2. The "Kaylo" insulation material had to be re-evaluated.

3. The Construction Insulation Shop requested that a new insulation material, i.e., "Carey-Temp", be evaluated.

The investigation of 6 Mar 1963 was conducted because

1. The Construction Insulation Shop recently had installed supplementary exhaust ventilation on both band saws and desired to know if this additional control method would reduce the "Thermobestos" dust concentrations to within safe acceptable limits.

A comparison of the reasons listed above discloses that each was different in content and concerned actually with different investigations but all were interrelated in part, i.e., each was concerned with the same environment, the same location and the same specific methods of fabrication. Consequently, the sampling procedures, utilized in each instance, basically were identical and in accordance with the following condensed explanation:

First: Two methods of fabrication, i.e., cutting and edging, and cutting a radius, were evaluated at each band saw since this is standard practice followed in the fabrication of any insulation material.

Second: The environmental conditions of both preceding reports, i.e., 62-IH-1-G-1 and 62-IH-2-G-1, were duplicated in that all outside doors to the building were closed.

Third: Each dust sample was collected in the operator's breathing zone as he worked in the fabrication process.

Fourth: The complete fabrication of "Carey-Temp" insulation blocks was evaluated in two ways: First, with all available ventilation in operation and second, with only the original downdraft ventilation in operation.

Specialized sampling procedures were utilized also during portions of the latter two investigations, in an endeavor to evaluate the supplementary exhaust ventilation system which had been installed as recommended. These were as follows:

First: The complete fabrication of "Thermobestos" insulation block was evaluated in two ways: First, with all available ventilation in operation and second, with only the original downdraft ventilation in operation.

Second: The complete fabrication of "Carey-Temp" insulation block was evaluated while utilizing all available exhaust ventilation.

It is necessary to explain that "Kaylo" insulation blocks were not included as a part of this evaluation since the initial investigation, (performed without supplementary exhaust ventilation) disclosed only one exposure exceeding the TLV of 20 mppcf of air and, therefore, it could be assumed that any ventilation that might be added should be more than adequate in controlling the hazard.

EVALUATIONS:

A. Atmospheric dust exposures:

1. The concentrations of inhalable dust, present in the breathing zone when fabricating any one of the three types of insulation materials, were determined in accordance with the following procedure:

   a. Three locations and nine different conditions of exposure, as described on Page 9, were selected for evaluation.

   b. Atmospheric dust samples were collected through the use of the impingement* principle of air sampling. The midget impinger apparatus (described on Page 5) served as the instrument of use.

   c. The concentration of dust collected in each sample was established through the use of standard light field microscopic counting techniques as described on Page 5.

2. The size of the particles of inhaled dust was determined, for both "Kaylo and "Thermobestos", in the initial survey of 1962 in accordance with the procedure described on Page 5. Consequently, no effort was expended to repeat the determination for any of the insulation materials since the sawing techniques as well as equipment, i.e., saw blades with three teeth to the inch operating at 2200 linear feet per minute, were identical on both occasions and, therefore, the size of the particles should not be expected to deviate to any great degree from the prior recorded values.

3. The composition of the dust, i.e., percentage crystalline free silica or percentage asbestos was determined for both "Kaylo" and "Thermobestos" in the initial survey of 1962. Consequently, no effort was expended to repeat this determination since the materials used on both occasions, were reported as being identical in composition. However, since the composition of "Carey-Temp" was not established at any earlier date it was deemed imperative that it be determined and reported at this time. This was accomplished as described on Page 5.

B. Local exhaust ventilation controls:

1. The velocity of the air being exhausted through the ventilation hood openings on both band saws (#1 and #2) was measured through the use of a Model 60 Anemotherm air meter.

2. Four variable conditions of interest were evaluated:

   a. The velocity of air through the downdraft hood on both saws with all other hoods on the system closed off.

* This means to strike against, as (in this application) the striking or dashing of atmospheric dust particles against the bottom of a small impinger flask containing a specific volume of dust-free water as a collecting medium.

b. The velocity of air through the downdraft hood on both saws with all other hoods on the system open.

c. The velocity of air through the supplementary overhead hood on both saws with all other hoods on the system closed off.

d. The velocity of air through the supplementary overhead hood on both saws with all other hoods on the system open.

PROCEDURES: Both sampling and analytical methods were as follows:

SAMPLING:

1. All samples used in determining the actual concentrations in air were collected with a midget impinger apparatus, sampling 0.1 cubic feet of air per minute through impinger flasks containing 15 milliliters of double distilled dust-free water.

2. All samples used in obtaining particle size distribution data were collected on millipore filters connected to a small battery-operated pump.

ANALYTICAL:

1. Each dust sample was evaluated through the use of a counting procedure referred to as the light field microscopic counting technique.*

2. The particle sizing techniques were derived from two separate sources. First, the sample was prepared for sizing in accordance with a permanent mounting method.+ Second, the actual sizing was accomplished in accordance with the recommended technique depicting the use of a filar micrometer and a standard microscope while using both the 43X (high and dry) and the 97X (oil immersion) objectives.‡

3. The evaluation and free silica determination of "Carey-Temp" material was accomplished through the use of two methods. First, through information supplied by Mr. E. D. Ermanc, Director of Research of the Philip Carey Manufacturing Company and second, through contracted analysis performed by Mr. Thomas M. Durkan, Chief Chemist for the Trudeau Foundation, Inc., Saranak Lake, N. Y.

RESULTS: See Pages 8, 9, 10 and 11.

* Drinker and Hatch: "Industrial Dust", 2nd Edition, pp. 152-153, McGraw-Hill Book Company, Inc., New York, 1954.

\+ Pautus, H. J., Talvitie, N. A., Fraser, D. A., and Keenan, R. G.: "Use of Membrane Filter in Air Sampling", A.I.H.A. Quarterly, Vol. 18, p. 269, September, 1957.

‡ Drinker and Hatch: "Industrial Dust", 2nd Edition, pp. 166-179, McGraw-Hill Book Company, Inc., New York, 1954.

CONCLUSIONS:

Relative to dust exposures from Graph #1 & Tables on Pages 8 & 9:

1. "Thermobestos" insulation blocks should not be fabricated when using only the original downdraft exhaust ventilation.

2. "Kaylo" insulation blocks could be fabricated safely when using only the original downdraft exhaust ventilation if existing leaks, observed on the #1 band saw, are corrected.

3. "Kaylo" insulation blocks definitely may be safely fabricated when using the entire exhaust ventilation facilities now available, i.e., hoods above the blocks as well as below.

From Graph #2 & Tables on Pages 8 & 9:

1. Methods of handling "Thermobestos" blocks (preparatory to sawing) and scraps (after sawing) contribute greatly to specific individual exposures as demonstrated by the following facts:

   a. The fabrication process, which always begins at the #2 band saw with the simple cutting of each 18" x 36" x 4" block into three smaller blocks about 18" x 12" x 4", is normally the least dusty of all the fabrication operations as revealed by the samples taken on 24 Jan 19

   b. However, on 6 Mar 1963, this operation was revealed as being one of the dustiest, regardless of the ventilation being used.

   c. There was only one major variable between the samples taken on the two dates, i.e., the method of handling the blocks preparatory to sawing. Consideration of the procedure used on these dates reveals: (1) that on 24 Jan 1963, the blocks were rolled up to the saw after having been removed from their shipping cartons and stacked on a "dolly" for easy individual removal and (2) on 6 Mar 1963, the block were not removed from their shipping cartons until needed by the worker. A large amount of dust is produced when blocks are removed individually from the cartons as a result of the natural abrasion produced when one block is pulled over the surface of the other. Consequently, the dust concentrations on this date at this location were greater than normal.

2. The supplementary overhead ventilation (added since the time of the preceding two reports) does successfully reduce the dust exposures. However, it does not reduce "Thermobestos" dust exposures to within safe acceptable limits when cutting radii.

From Graph #3 & Table on Page 9:

1. "Carey-Temp" dust concentrations for each exposure was substantially greater than the comparable "Thermobestos" dust concentrations and in excess of even the most lenient TLV established for human exposures, i.e 50 mppcf of air.

2. The existing exhaust ventilation system as installed on both band saws is incapable of reducing the dust hazard, associated with the fabrication of "Carey-Temp", to within safe acceptable limits, i.e., 20 mppcf of air.

Relative to the exhaust ventilation system:

1. The duct velocity in the downdraft ventilation system on both band saws is far below the recommended value of 4000 fpm.

2. The duct velocity in the overhead ventilation system on both band saws is equal to or more than the recommended value of 4000 fpm.

3. The velocity in the downdraft ventilation systems for both band saws could be increased by patching all holes, leaks, etc., now in existence.

RECOMMENDATIONS:

1. Do not fabricate 18" x 36" x 4" "Carey-Temp" or "Thermobestos" insulation materials unless:

   a. The atmospheric dust problem can be reduced to below 20 mppcf of air through the use of improved ventilation techniques or repairs to the existing system, or

   b. The manufacturers of the two makes of insulation materials are able to produce a product which will not release, upon fabrication with a band saw, dust concentrations in excess of 20 mppcf of air.

Submitted by: Robert E. Peale

R. E. Peale
Industrial Hygienist

REP:hl

23 October 1963

INDUSTRIAL HYGIENE SURVEY
Evaluation of Atmospheric Dust Conditions at the Construction Insulation Shop
Table #1
Atmospheric Dust Concentration Data
Collected When Using Only Partial
Ventilation, i.e., Only Below the Blocks

Cutting & Edging Insulation Blocks

Date	Type of Material	Description of Location	Concentration in mppcf
25 Feb 63	Kaylo	#1, i.e., South Side of the #2 Band Saw	9.32
24 Jan 63	Thermobestos	#1, " " " " " " " "	10.00
6 Mar 63	"	#1, " " " " " " " "	51.50
25 Feb 63	Kaylo	#2, i.e., South Side of the #1 Band Saw	17.92
24 Jan 63	Thermobestos	#2, " " " " " " " "	26.36
6 Mar 63	"	#2, " " " " " " " "	42.70

Cutting a Radius on Insulation Blocks

Date	Type of Material	Description of Location	Concentration in mppcf
Mar 62	Kaylo	#3, i.e., South Side of the #2 Band Saw	17.10
25 Feb 63	"	#3, " " " " " " " "	3.39
Mar 62	Thermobestos	#3, " " " " " " " "	101.40
24 Jan 63	"	#3, " " " " " " " "	69.59
6 Mar 63	"	#3, " " " " " " " "	36.82
Mar 62	Kaylo	#4, i.e., South Side of the #1 Band Saw	3.06
25 Feb 63	"	#4, " " " " " " " "	29.35
Mar 62	Thermobestos	#4, " " " " " " " "	83.30
24 Jan 63	"	#4, " " " " " " " "	66.69
6 Mar 63	"	#4, " " " " " " " "	70.00

Table #2
Atmospheric Dust Concentration Data
Collected When Using All Available
Ventilation, i.e., Both Above & Below the Blocks

Cutting & Edging Insulation Blocks

Date	Type of Material	Description of Location	Concentrati in mppcf
6 Mar 63	Thermobestos	#1a, i.e., South Side of the #2 Band Saw	30.20
26 Feb 63	Carey-Temp	#1a, " " " " " " " "	51.70
6 Mar 63	Thermobestos	#2a, i.e., South Side of the #1 Band Saw	17.59
26 Feb 63	Carey-Temp	#2a, " " " " " " " "	68.20

Cutting a Radius on Insulation Blocks

Date	Type of Material	Description of Location	Concentrat: in mppcf
6 Mar 63	Thermobestos	#3a, i.e., South Side of the #2 Band Saw	22.42
6 Mar 63	Thermobestos	#4a, i.e., South Side of the #1 Band Saw	51.70
26 Feb 63	Carey-Temp	#4a, " " " " " " " "	85.40
26 Feb 63	Carey-Temp	#5a, i.e., North Side of the #1 Band Saw	100.90

Index for Graphs #1, #2 & #3

#1 = South Side #2 Band Saw - Cutting Blocks - Ventilation Only Below
#2 = " " #1 " " - Edging " - " " "
#3 = " " #2 " " - Cutting a Radius - " " "
#4 = " " #1 " " - " " " " - " " "
#1a = " " #2 " " - Cutting Blocks - " Both Above & Below
#2a = " " #1 " " - Edging " - " " " " "
#3a = " " #2 " " - Cutting a Radius - " " " " "
#4a = " " #1 " " - " " " " - " " " " "
#5a = North Side #1 Band Saw - Cutting a Radius - Ventilation Both Above & Below

Table #3
Determination of Percentage Crystalline Free Silica
Present in "Thermobestos", "Kaylo" & "Carey-Temp"
as Quartz by the "Talvitie" Method

"Thermobestos"
(As Contained in Report 62-IH-1-G-1)

Trial #	W_1 in Grams	W_2 in Grams	W_3 in Grams	% Free SiO_2
1	0.5002	0.0390	0.0069	6.42
2	0.5000	0.0347	0.0068	5.58
3	0.5002	0.0396	0.0082	6.28
Average Percentage Crystalline Free SiO_2 = 6.4				

"Kaylo"
(As Contained in Report 62-IH-1-G-1)

Trial #	W_1 in Grams	W_2 in Grams	W_3 in Grams	% Free SiO_2
1	0.5000	0.0807	0.0433	7.48
2	0.5000	0.0730	0.0364	7.32
3	0.5000	0.0563	0.0190	7.46
Average Percentage Crystalline Free SiO_2 = 7.4				

"Carey-Temp"
(As Reported by Mr. Thomas M. Durkan)
4 October 1963

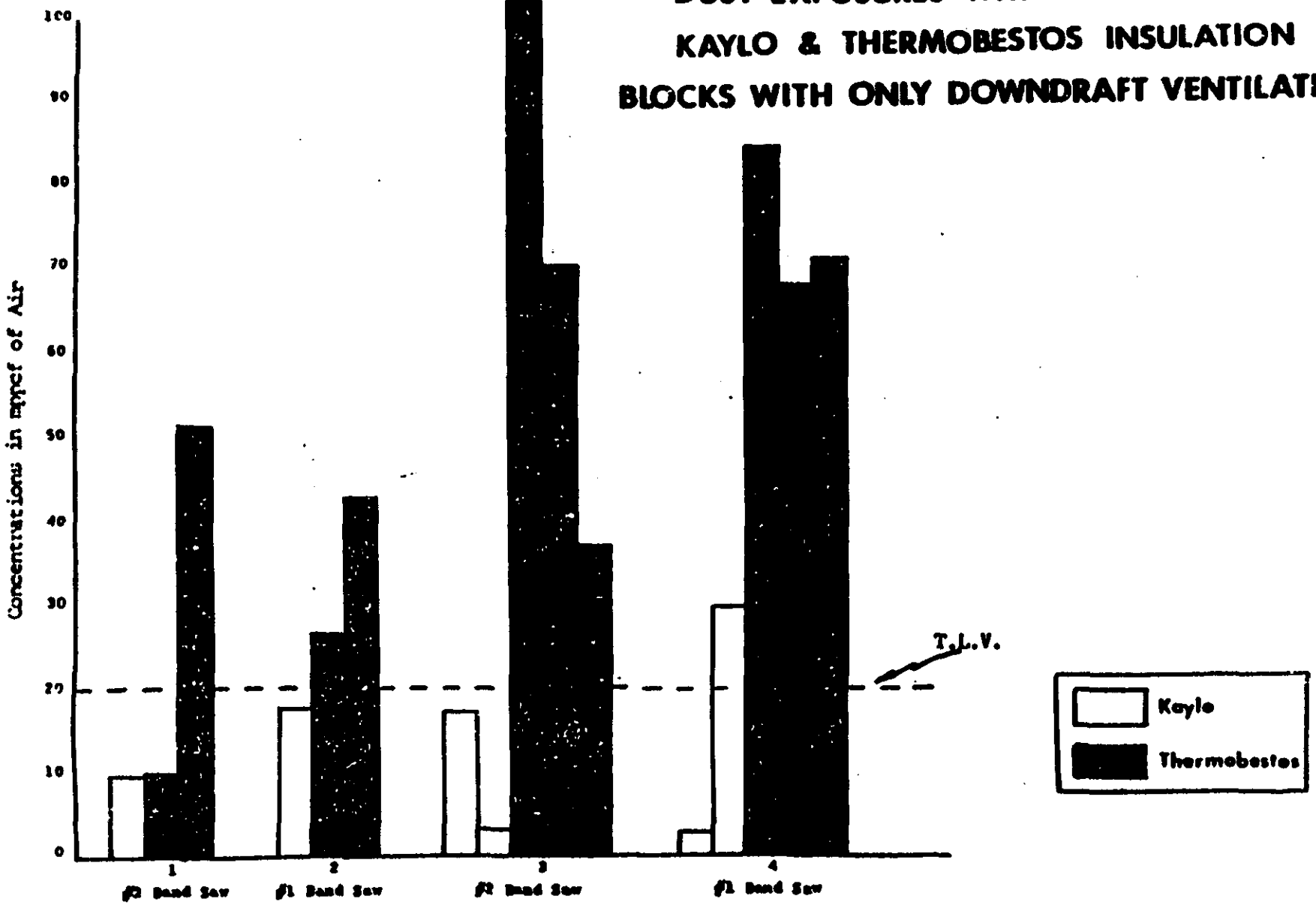
Components Soluble in Hcl	10.8%
Other Components Soluble in Phosphoric Acid	88.8%
	99.6%
Percentage Crystalline Free SiO_2 as Quartz	00.4%

Table #4
Ventilation Rates on Two Band Saws

Date	Band Saw	Hood Being Checked	Description of Condition	Ventilation Rate in fpm
25 Feb 63	#2	Downdraft	Only Downdraft System in Operation	1500
6 Mar 63	#2	"	" " " " "	1450
25 Feb 63	#2	"	Downdraft & Overhead System in Operation	1200
6 Mar 63	#2	"	" " " " "	1200
25 Feb 63	#2	"	Every Hood in the System Open	950
6 Mar 63	#2	"	" " " " "	900
25 Feb 63	#2	Overhead	Downdraft & Overhead System in Operation	6500
Mar 63	#2	"	" " " " "	4800
25 Feb 63	#2	"	Every Hood in the System Open	4000
6 Mar 63	#2	"	" " " " "	
25 Feb 63	#1	Downdraft	Only Downdraft System in Operation	2100
Mar 63	#1	"	" " " " "	1500
Feb 63	#1	"	Downdraft & Overhead System in Operation	1600
Mar 63	#1	"	" " " " "	1150
25 Feb 63	#1	"	Every Hood in the System Open	1100
6 Mar 63	#1	"	" " " " "	
25 Feb 63	#1	Overhead	Downdraft & Overhead System in Operation	5500
6 Mar 63	#1	"	" " " " "	4500
25 Feb 63	#1	"	Every Hood in the System Open	4200
6 Mar 63	#1	"	" " " " "	

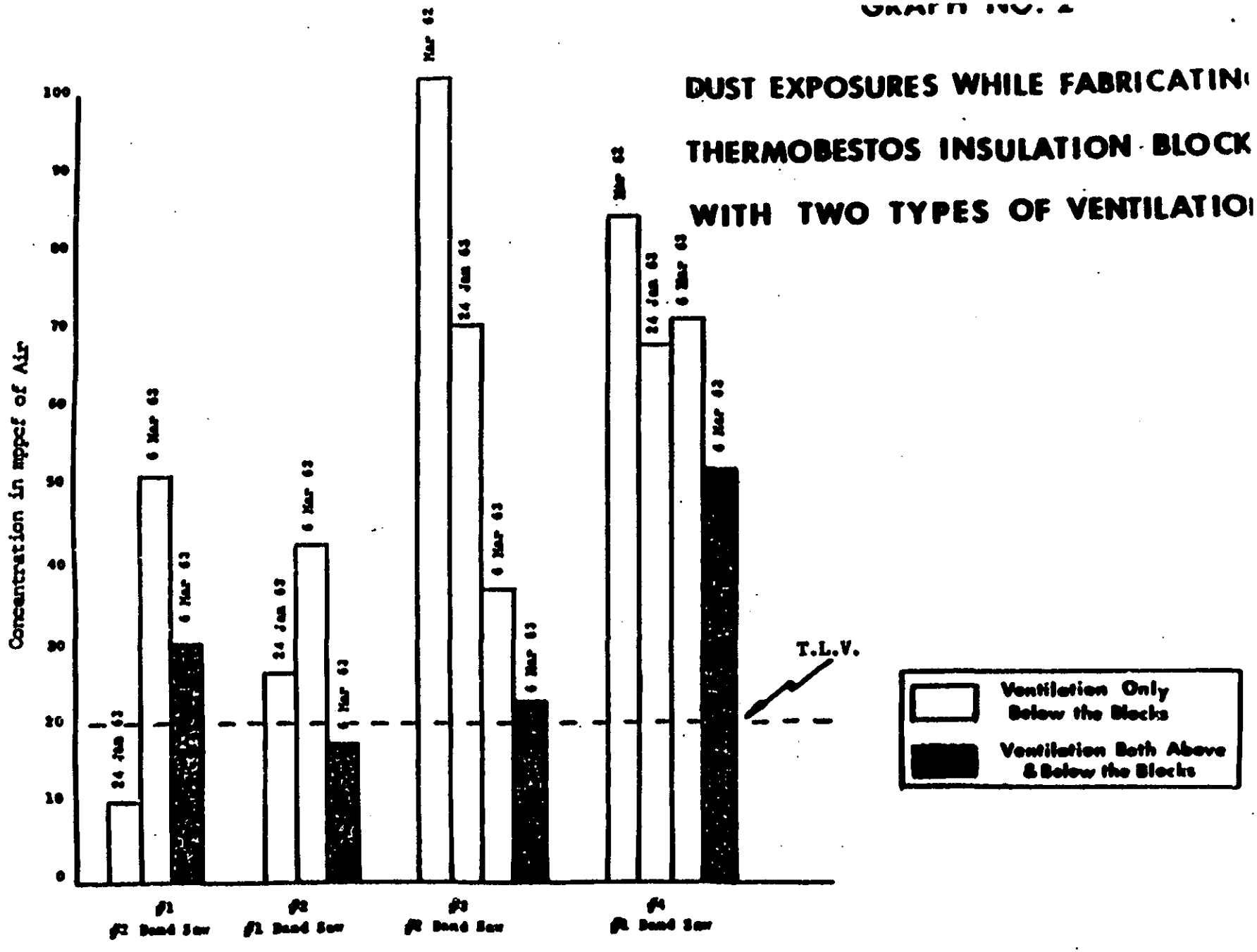
GRAPH NO. 1

DUST EXPOSURES WHILE FABRICATING KAYLO & THERMOBESTOS INSULATION BLOCKS WITH ONLY DOWNDRAFT VENTILATIC



GRAPH NO. 4

DUST EXPOSURES WHILE FABRICATIN
THERMOBESTOS INSULATION BLOCK
WITH TWO TYPES OF VENTILATIO



DUST EXPOSURES WHILE FABRICATING THERMOBESTOS & CAREY-TEMP INSULATI BLOCKS WITH BOTH DOWNDRAFT AN OVERHEAD VENTILATION