PLAINTIFF'S EXHIBIT
UC-170

REVIEW OF ASBESTOS-HEALTH LITERATURE

Over the past decade, the occupational and environmental health hazards of asbestos have received as much if not more attention from the worldwide medical profession than any other toxic substance known to man, with the possible exception of automobile emissions and the by-products of cigarette smoking. While the medical literature now contains more than 4,000 articles and learned papers on asbestos-related disease, only a small percentage of this vast accumulation can be considered of significance in our understanding of the problem. It is the purpose of this review to identify those papers that are of special importance, to briefly report on the findings contained therein, and to provide a cross-reference of the papers with regard to the general areas of the problem with which they deal. No attempt will be made to comment critically on the contents of the papers reviewed.

General Reviews

While numerous comprehensive reviews of the asbestos-health problem have appeared in the popular press (Brodeur, Sherrill, Porter, etc.), these have all been argumentative in tone and cannot in any way be considered scientific papers. Only three general reviews of the overall issue have been published in learned journals or by scientific organizations of high repute. These are Dr. George Wright's "Asbestos and Health in 1969,"[1] the National Academy of Sciences pamphlet "Asbestos: The Need For and Feasibility of Air Pollution Controls,"[2] and the rather abbreviated "Report of the Advisory Committee on Asbestos Cancers to the Director of the International Agency for Research on Cancer."[3] A fourth general review, "Preliminary Air Pollution Survey of Asbestos,"[4] was prepared in 1969 by Litton Systems Incorporated for the old National Air Pollution Control Administration (predecessor to the EPA), but it is merely a non-critical literature review and cannot be placed in the same category as the above three papers and documents. It was, in essence, superseded by the NAS document, which was also prepared for the EPA.

The Wright, NAS and IARC documents all examine the various aspects of the problem, and in general agree that the occupational health hazards of asbestos are serious but controllable, and that the general public is not presently in danger from exposure to asbestos in the environment.

Early Studies and Asbestosis

As some critics of the industry are fond of pointing out, the first mention of asbestos-related disease in the literature occurred nearly 70 years ago.[5,5a] By 1930 asbestosis was a generally recognized occupational hazard of asbestos exposure,[6] but it was not until 1947 that the first major link between asbestos and lung cancer was established.[7] Mesothelioma, on the other hand, was identified as an asbestos induced occupational disease even later, the first important study on this disease appearing in 1960.[10]

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Asbestos and Lung Cancer

In 1947, E.R.A. Merewether, Chief Inspector of Factories in the United Kingdom, reported 31 lung cancer deaths among 235 persons known to have died with asbestosis between 1924 and 1946.[7] This discovery of a high incidence of lung cancer among asbestosis sufferers lead to the launching of one of the most important of all asbestos-health investigations. Commonly referred to as the Knox-Doll studies, this research centered on employees at a single asbestos textile factory in Great Britain. The first results were published by Doll in 1955,[8] with subsequent updates being issued in 1965, 1966 and 1968, the last being entitled "Mortality from Lung Cancer and Other Causes among Workers in an Asbestos Textile Factory."[9]

Since Knox-Doll, numerous other investigators have reported a lung cancer link with asbestos, the work of Dr. Irving J. Selikoff being the most widely quoted.

Mesothelioma

In 1960, Dr. J. C. Wagner et al published "Diffuse Pleural Mesothelioma and Asbestos Exposure in the North Western Cape Province," in which they reported finding 33 cases of this rare tumor in a part of South Africa important for crocidolite mining.[10] Of considerable significance was the fact that 16 of the cases had not worked at the mines, but had only lived in the vicinity or had had household exposure. Wagner's paper is considered to be the first major evidence linking mesothelioma with asbestos exposure, although a number of earlier obscure German papers had also noted the relationship.

Because many of the cases reported by Wagner had not been occupationally exposed, a number of investigators launched studies to determine if the general public was at hazard to mesothelioma from asbestos in the general environment. The most important of these were by Newhouse and Thompson[11] (the case of the woman who developed mesothelioma from washing her husband's clothes comes from this study), Stumphius and Meyer,[12] Borow et al,[13] Lieben and Pistawka,[14] and McDonald et al.[15] Both Newhouse and

Lieben found numerous non-occupational mesotheliomas; Stumphius found a number of cases among non-asbestos handling shipyard employees; Borow found two non-occupational cases out of 17 (now increased to two out of more than 50) in the Manville area; and McDonald, whose study involved the entire Canadian population, found no cases in the neighborhood of Canadian chrysotile mines nor in the household of people working in those mines, although he did find non-occupational cases associated with insulation work. McDonald also reported that only 14-16% of the cases had "definite" or "probable" asbestos exposure.

From the strictly occupational standpoint, the most important studies have been those of Newhouse on a British asbestos textile factory;[16] Selikoff on the insulation workers,[17] on an amosite insulation plant,[17] and on the J-M Manville plant (unpublished); Mancuso on American textile workers;[18] and McEwen on shipyard workers in Scotland (it is this study upon which Selikoff has based his predictions of an epidemic of mesotheliomas among U.S. World War II shipyard workers).[19]

GI Cancer

Selikoff was the first to report an increased rate of GI cancer among occupationally exposed employees.[17] Since then a number of other investigators, such as McDonald[20] and Newhouse,[16] have also reported increased rates, while still others, such as Knox-Doll,[9] have not. The NAS document considers the evidence inconclusive, while the IARC report considers that a "small excess risk" exists from this disease.

Asbestos (Ferruginous) Bodies

The general public health scare re asbestos arose out of two events: (1) the finding of non-occupationally exposed mesotheliomas in the vicinity of asbestos mines and factories, and (2) the discovery of coated asbestos fibers (asbestos bodies) in the lungs of city dwellers.[21] Approximately five years ago, there was widespread controversy over "asbestos bodies." Some researchers claimed that we were all in peril because of this fact,[22] while other investigatiors sought to place the issue in its proper perspective by showing that not all asbestos bodies actually had a core of asbestos,[23] and should therefore more properly be called ferruginous bodies.[24] The controversy largely subsided when Selikoff,[25] Gross and others found uncoated free asbestos fibers in human lungs, yet could find no link to disease. Selikoff further found no increase in the number of asbestos bodies in human lungs in New York City between the 1930's and the 1960's, despite the growth in the use of asbestos.[26] In Great Britain, on the other hand, Um did find an increase over the years.[26a] Today, the presence of small amounts of asbestos in the lungs of most members of the general public is accepted as fact without attributing to it any particular importance.[2]

Asbestos Mining and Milling

While no epidemiological studies have been conducted of employees in the United States asbestos mining and milling industry, the Canadian, South African, Italian and Finish industries have all been examined, with varying degrees of detail. Certainly the most comprehensive mining study has been that of McDonald et al in the chrysotile producing region of Quebec.[20] Studying more than 10,000 past and present miners, McDonald established that the overall mortality rate of the cohort was less than that of the general Canadian population, that mesothelioma was not a significant cause of death among the miners, and that an excess of lung cancer was limited to those workers that have the highest cumulative exposure. In South Africa, Webster[27] and Sluis-Cremer[28] looked at both the crocidolite and amosite mining industries, the most striking discovery being the relative absence of mesotheliomas among amosite and crocidolite miners in the Transvaal district as compared to the large number found in the crocidolite producing region of the South West Cape. Vigiliani has studied chrysotile miners in Italy[29] and Kiviluoto and Meurman have examined the Finish anthophyllite mining industry.[30]

Textile Manufacturing

In the asbestos manufacturing industry, the production of asbestos textiles has received more attention than all other segments of the industry combined. The reason for this is relatively simple -- textile production was in the past probably the dustiest of all asbestos manufacturing operations and hence the most likely to result in substantial cases of disease among the employees exposed. The most important studies have been those of Knox-Doll,[9] Newhouse,[16] Mancuso[18] and Enterline.[31] All reported greatly increased rates of asbestos-related disease among the cohorts studied. Selikoff's unpublished study of Manville workers and Enterline's study of J-M retired employees[32] both included textile workers in the cohorts, but no attempt has been made to separate their mortality rates from the rest of the employees studied. Of special interest in Enterline's study was the fact that maintenance workers showed a greater excess mortality from asbestos-related disease than did production line employees.

Asbestos-Cement Manufacturing

Dr. Hans Weill's ongoing study of asbestos-cement workers in two plants in New Orleans is the first large scale investigation of this most important segment of the industry.[33] The results of this research are as yet preliminary but seem to indicate a risk considerably less than has been demonstrated in the textile manufacturing and insulation application and removal industries.

In a report given at the Lyon conference in October 1972, Enterline presented a breakout of data from his retired employee study on workers in rigid shingles and sheet and asbestos-cement pipe operations. Both subgroups from the larger study showed excess mortality from asbestos-related disease.[34]

In an earlier paper, Enterline reported on his study of more than 12,000 United States asbestos "Building Products" workers, in which he found an excess of lung cancer and respiratory disease (asbestosis) but no overall mortality excess.[31]

Asbestos Friction Materials

Enterline studied 7,500 asbestos friction materials workers from 11 U.S. plants and found an excess of lung cancer, GI cancer, and respiratory disease, but no overall mortality increase.[31] No other papers have been produced in this area.

Insulation Manufacturing

Selikoff's study of amosite insulation workers (the famous Patterson study),[17] in which he demonstrated high rates of all asbestos-related diseases, is the only research conducted in this segment of the industry thus far.

Other Manufacturing

The vinyl-asbestos floor tile, packings and gaskets, asbestos felts, asbestos paper, and asbestos reinforced plastics segments of the industry have not been examined thus far.

Insulation Application Trades

The asbestos insulation workers are the only major group of end product users that have been examined extensively, Selikoff's two ongoing studies being the prime examples.[17]

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As a subgroup of the overall insulation application and removal trades, shipyard workers have received special attention. The most important research conducted in this area has been that of Selikoff,[17] McEwen,[19] Harries[35] and Murphy.[36] The special attention paid to this group has stemmed from the supposition that the uncontrolled use of asbestos insulations during the Second World War contaminated entire shipyard areas, thus extending the hazard of asbestos inhalation to many more individuals than merely those handling the material. The McEwen and Harries studies have been important in this regard.

Dust Levels and Disease

Because asbestos-related disease is both dose and time related, the disease being found today is a result of conditions existing 20-30 years ago and longer. Efforts to determine the highest level of exposure that will result in no disease, i.e. to find a "safe" exposure level, are hampered by two factors:

1. Very few dust counts were taken before the mid-50's. Thus, most studies have estimated past exposure levels in relative terms, i.e. "low, medium or high."

2. Within the past 10 years, the accepted method for determining exposure has changed from particle to fiber counting. Efforts at determining a conversion factor for converting past particle counts to their equivalent in fibers per cc have been generally unsuccessful.[36a, 36b] Thus, it has not been possible to accurately translate past dust data into modern terms for the purpose of setting standards. Gibbs, using data from the McDonald studies, has suggested that standards based on particle counts should be established in those industries where sufficient past dust data of this type is available.[36b]

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Attempts at determining safe exposure levels have, thus, been relatively few. Selikoff et al have concluded that the time weighted average exposure of insulation workers is less than 5 fibers of asbestos per cubic centimeter of air. However, no dust counts were taken by the Mount Sinai group earlier than 1969 nor has the data leading to this conclusion been published in a scientific journal for professional scrutiny.

The most important study yet published in this area has been the 1968 report of the Sub-Committee on Asbestos of the Committee on Hygiene Standards of the British Occupational Hygiene Society. Entitled "Hygiene Standards for Chrysotile Asbestos Dust," the paper recommended the establishment of the now famous "two fiber standard."[36c] The United States two fiber standard, scheduled to go into effect in 1976, is based largely on this report.

Among those studies that have sought to establish a relationship between past particle counts and disease are those by McDonald,[20] Murphy,[36] Enterline[32] and Weill.[33]

Asbestos in the Environment

Various investigators have demonstrated the existence of asbestos in ambient air and water.[37,38] None of this research has established a link between the quantity of asbestos discovered and any increase of disease among the general public. Speculation on this point, however, has run rampant. The concensus of both the NAS and IARC reports is that current levels of asbestos in the environment present no hazard to health.

One possible source of asbestos in the environment that has been thoroughly investigated is emissions from brake lining wear. Lynch in 1968[39] and Jacko et al in 1973[40] reported that brake lining wear was an inconsequential factor in ambient asbestos air pollution.

The use of asbestos-containing spray insulations has also been investigated by the Mount Sinai Environmental Sciences Laboratory. However since this practice has been banned by the EPA, the study is now of only academic importance.[37]

The natural action of wind and water on serpentine rock formations release small though detectable amounts of asbestos into ambient air and water, but precise data as to the contribution of these "natural sources" to ambient concentrations is unavailable.[37]

Selikoff has investigated the asbestos content of parenteral drugs.[41] Other studies on asbestos ingestion and injection are due for publication shortly.

Variables on Pathogenicity

One difficulty in finding a solution to the asbestos-health probelm has been the scarcity of data relating to the manner in which asbestos causes disease, especially the various types of cancer associated with asbestos exposure. Selikoff has established a synergistic relationship between cigarette smoking, asbestos inhalation and lung cancer, but has not discovered the mechanism whereby the relationship operates.[42] Cralley et al have suggested that trace metals attached to the fiber are the prime cause of carcinogenisis.[43]

Many researchers have concluded that crocidolite is more hazardous than either chrysotile or amosite, and that amosite is perhaps more hazardous than chrysotile.[3] Timbrell suggested that the varying aerodynamic properties of the different types of asbestos fiber in the human lung may account for their differing biological potency.[44] Stanton[45,45a] and Gross,[46] on the other hand, believe that fiber size is of primary importance in the carcinogenicity of asbestos and other fibrous materials, the smaller EM sized fibers being less, if at all, hazardous.

A 17863

Research Needs

Despite the tremendous amount of data that has been published on the health effects of asbestos, most studies do little more than confirm observations already reported upon by previous investigators. A number of vital questions still remain unanswered. Among these are:

1. Is there a safe exposure level for protection against the various asbestos-related diseases? If so, what is it? Does it vary from disease to disease or from type of asbestos to type of asbestos?
2. What is the true relationship between asbestosis and lung cancer (some researchers believe asbestos-related lung cancer will occur only in individuals who already have asbestosis, while others maintain that it doesn't matter)?
3. What are the relative cancer risks following exposure to only one variety of asbestos?
4. How does asbestos cause or contribute to the causation of disease, especially cancer?
5. What other causes of mesothelioma are there, in addition to asbestos exposure
6. Can asbestos cause other diseases in addition to asbestosis, lung cancer, mesothelioma and GI cancer (it has been suggested that asbestos can cause ovarian cancer in women and also cancer of the larynx and esophagus)?
7. Is it possible to detect asbestosis early enough so that it is reversible?

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Conclusion

According to Dr. Premysl Pelnar of the Institute of Occupational and Environmental Health in Montreal, approximately 90 percent of all information and data now available on asbestos-health is the result of medical studies undertaken within the past ten years. Nonetheless, major sections of the asbestos manufacturing industry have not been investigated at all, or have been investigated by only one researcher, whose results are therefore not comparable with other studies nor, consequently, are they refutable. Until we have answers to all the unanswered questions, and until we know through scientific investigation that this or that use of asbestos is safe or unsafe, the asbestos industry will continue to be plagued by its own uncertainty and the unfounded speculation of those who would question the unknowns rather than examine them.

A17870

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A17871

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A17873

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<u>NOTE ON REFERENCES</u>: (1) In some cases, Dr. Selikoff's study of the insulation workers being a prime example, numerous papers have appeared over the years dealing with the same study. The paper or presentation referenced above is not necessarily the first to appear on the study, but will more often be the most recent or the most comprehensive of those that have been published. (2) Even in a short review of this nature, the number of references is extensive. For this reason, papers and presentations of primary importance are marked with an asterick.

A17874

PLAINTIFF'S EXHIBIT
UC-171

INTERNAL CORRESPONDENCE

UNION CARBIDE CHEMICALS COMPANY • **INSTITUTE PLANT** P. O. BOX 2831, CHARLESTON, WEST VIRGINIA

To (Name) R. J. Sexton, M.D.
Company
Location Medical Department - Plant 512

Date 29 November 1963
Originating Dept. Industrial Hygiene - Plant 512
Answering letter date

Copy to Mr. L. H. Dickinson, Mr. H. S. Eastman, Mr. S. C. Giambruno, Mr. R. A. Baker, Mr. B. F. King, Dr. E. H. Best, Dr. C. U. Dernehl, Mr. J. W. Perry, Mr. P. E. Henry, Mr. R. A. Neal, Mr. D. R. Matheny, Mr. N. H. Ketcham, Mr. L. B. Weddell - Safety Dept., Mr. F. G. Comerford

Subject Construction Insulation Shop
Building 511-2018

In accordance with Mr. P. E. Henry's request of Thursday, 7 Nov 63, I have investigated the fabrication of "Carey-Temp" pipe covering. This operation is carried out with band saws and, on the basis of visual observation alone, it has been decided that there should be no health hazard associated with this particular type of operation.

This investigation took place during the morning of Thursday, 14 Nov 63, in the company of Mr. K. B. Lanham, Foreman of the Fabrication Insulation Shop, and consisted merely of observing the process of the cutting of half sections of eight inch diameter "Carey-Temp" pipe covering with a band saw. No effort was made, at that time, to determine the actual concentration of atmospheric dust being produced during this operation. It should not be necessary to perform this specific test so long as working conditions are not altered appreciably from those observed on this date. However, a more thorough evaluation of these conditions will be performed if (1) it is specifically requested, (2) employees begin complaining about reactions such as [illegible], etc., (3) a thicker material, i.e., more than two inches in diameter [illegible] substituted for fabrication, or (4) the fabrication shop begins cutting [illegible] curved half-section from large blocks of "Carey-Temp".

Very truly yours,

R. E. Peele
Industrial Hygienist

REP:hl

A24050

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 <u>can</u> be safely fabricated with the existing equipment.

2. "Thermobestos" insulation blocks <u>cannot be safely fabricated at the present time with existing equipment</u>, 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 <u>cannot</u> be safely fabricated with the existing equipment, but <u>could be</u> 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

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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 blocks 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 blocks was evaluated while utilizing all available exhaust ventilation.

A24052

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.

A24053

INTRODUCTION: 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 IH-III-1-C-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, prompted 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.

DISCUSSION: 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 these 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, [illegible] their Research Department, which contained data that [illegible] that submitted by this department in Report [illegible].

2. This department desired to clarify the reasons for the discrepancy between the two reports and to identify [illegible], the actual conditions as they exist in the [illegible] 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 [illegible] tested inadvertently during the same afternoon, a procedure which was not in keeping with an attempt to simulate 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 [illegible] produced by both operations.

A24054

UNION CARBIDE

INTERNAL CORRESPONDENCE

UNION CARBIDE CHEMICALS COMPANY • INSTITUTE PLANT P. O. BOX 2831, CHARLESTON, WEST VIRGINIA

To (Name) Mr. S. C. Giambruno
Company
Location Industrial Relations

Date 23 October 1963
Originating Dept. Medical Department - Plant 512
Answering letter date

Copy to Mr. L. H. Dickinson, Mr. H. S. Eastman, Mr. R. A. Huber, Mr. R. F. King, Dr. E. H. Best, Dr. C. U. Dernehl, Mr. J. W. Perry, Mr. P. E. Henry, Mr. R. A. Neal, Mr. D. R. Matheny, Mr. H. H. Ketcham, Mr. L. B. Weddell - Safety Dept.

Subject Insulation Block Dust Survey Construction Insulation Shop Plant 511

Enclosed is a very excellent and very complete Industrial Hygiene report on the potential hazardousness of "Thermobestos", "Kaylo" and "Carey-Temp" insulation blocks which have been processed in the Construction Department's Insulation Shop. The report points out definitely that "Thermobestos" and "Carey-Temp" insulation blocks cannot be fabricated safely with existing equipment, but that "Kaylo" insulation blocks can be fabricated safely. Mr. Peele's recommendations are quite definite and I am sure that you will wish to comply with them. I believe this particular project should be considered completed.

If there are any comments, suggestions or criticism, please direct these to me.

Very truly yours,

R. J. Sexton, M.D.
Plant Medical Director

RJS:hl

Enclosures

A24055

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. Emmons, 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 Filters 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 1963.

   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 blocks 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.

A24057

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: R. E. Peele
R. E. Peele
Industrial Hygienist

REP:hl

23 October 1963

A24058

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	17.32
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, " " " " " " " "	70.09

A24059

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	Concentration in mppcf
6 Mar 63	Thermobestos	#1a, i.e., South Side of the #2 Band Saw	39.20
26 Feb 63	Carey-Temp	#1a, " " " " " " " "	51.70
6 Mar 63	Thermobestos	#2a, i.e., South Side of the #1 Band Saw	17.50
26 Feb 63	Carey-Temp	#2a, " " " " " " " "	58.20

Cutting a Radius on Insulation Blocks

Date	Type of Material	Description of Location	Concentration 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	100.40

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-III-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-III-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 H. 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%

A24061

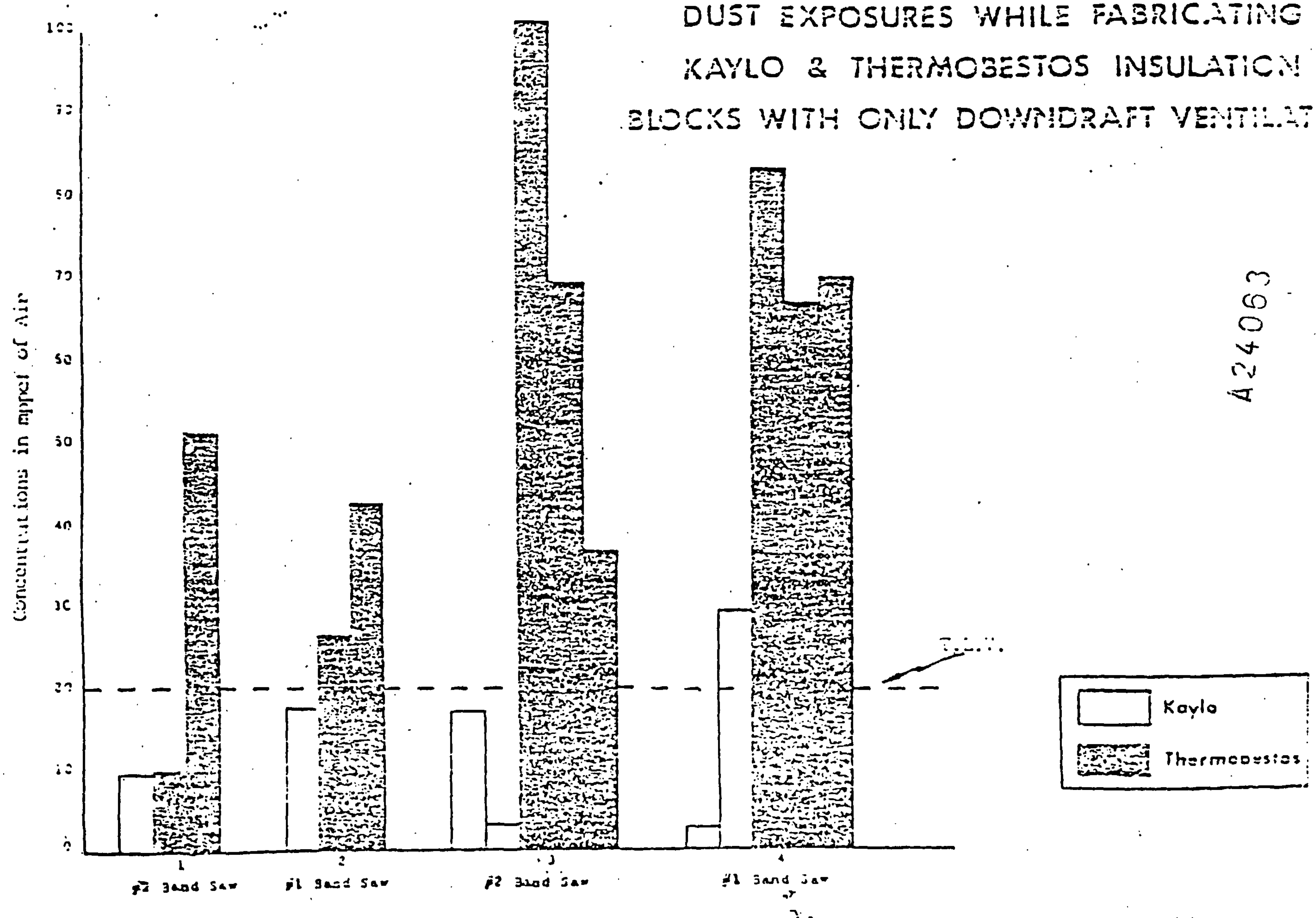
Table #4
Ventilation Rates on Two Band Saws

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	"	" " " " " "	4900
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
6 Mar 63	#1	"	" " " " "	1500
25 Feb 63	#1	"	Downdraft & Overhead System in Operation	1500
6 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	"	" " " " " "	

A24062

GRAPH NO. 1

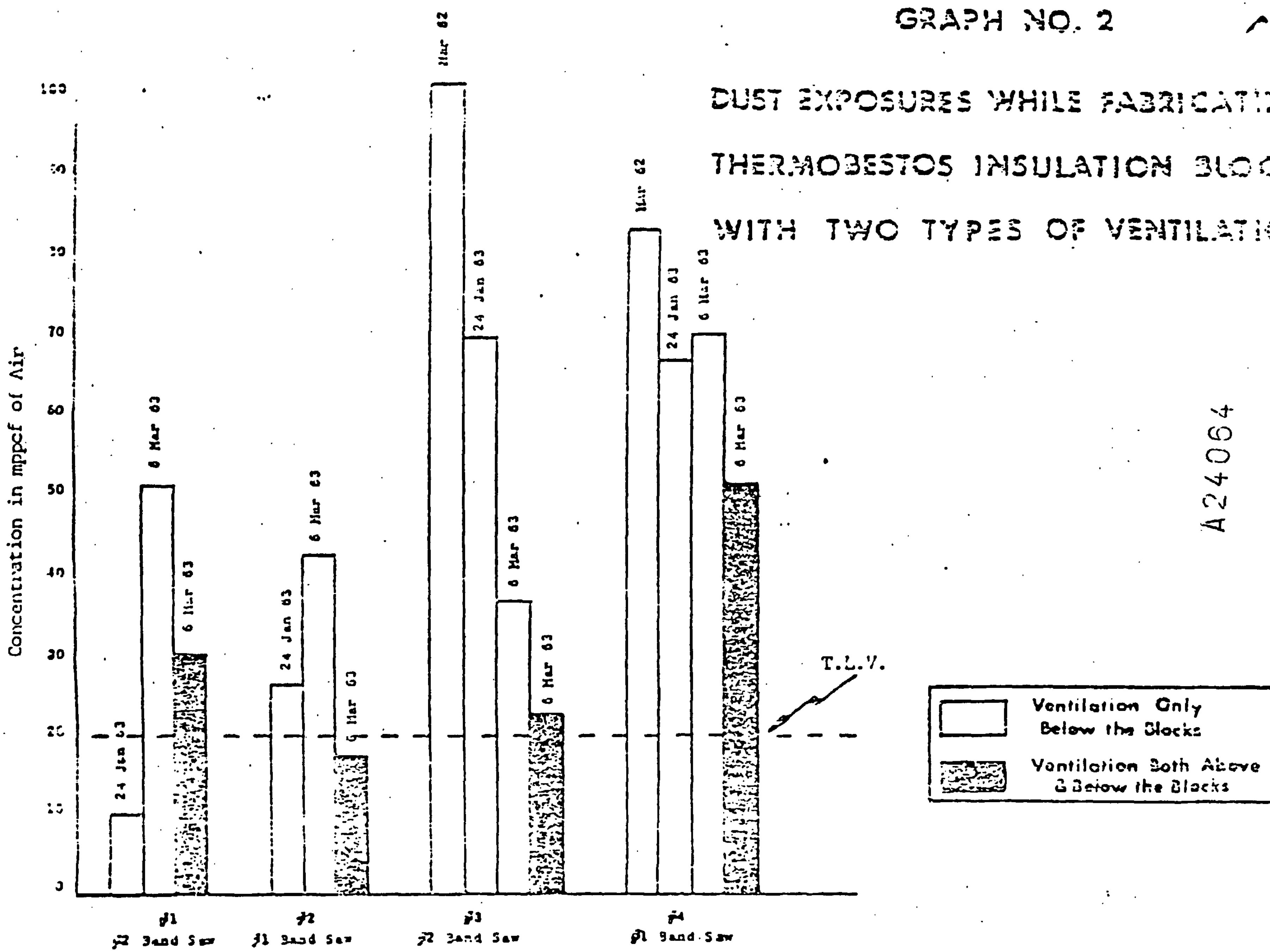
DUST EXPOSURES WHILE FABRICATING KAYLO & THERMOBESTOS INSULATION BLOCKS WITH ONLY DOWNDRAFT VENTILATIO



A24063

GRAPH NO. 2

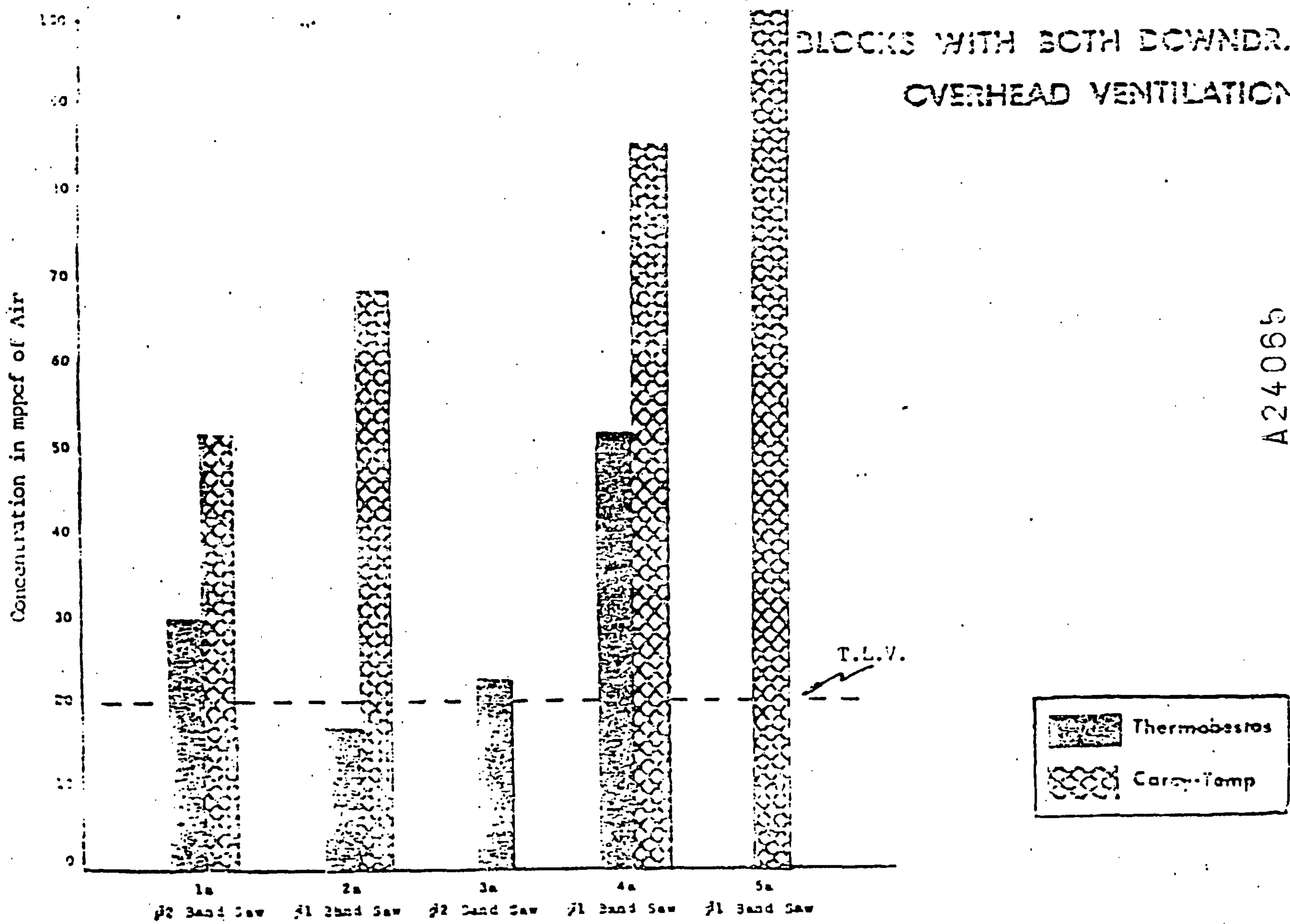
DUST EXPOSURES WHILE FABRICATING THERMOBESTOS INSULATION BLOCKS WITH TWO TYPES OF VENTILATION



A24064

GRAPH NO. 3

DUST EXPOSURES WHILE FABRICATING THERMOBESTOS & CAREY-TEMP INSULATING BLOCKS WITH BOTH DOWNDRAFT AND OVERHEAD VENTILATION



A24065