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Report on

# INDUSTRIAL HYGIENE SURVEY OF SELECTED PLANT OPERATIONS

PPG INDUSTRIES
Pittsburgh-Corning Corporation
Port Allegany, Pennsylvania

August 27-28, 1968

By

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## I. INTRODUCTION

A survey of airborne dust concentrations was performed in the Unibestos area of the Pittsburgh-Corning Port Allegany plant on August 27-28 by Dr. Morton Corn. The survey was performed at the request of Lee Grant, M.D., Medical Director, PPG Industries. The survey was aimed specifically at assessing the degree of dust control achieved in the Unibestos facility with the improvements made since the former survey by the author in April, 1966. Also, because a new assessment technique for asbestos fibers (Membrane filter) is now being used, the present survey was performed by simultaneously sampling at the same location with the traditional sampling instrument (midget impinger) and the new instrument.

During the period of the survey outdoor weather conditions were clear, cool, and sunny, with outdoor temperatures in the range 60-75°F.

It should be noted that the dust collection system in the Unibestos facility was thoroughly cleaned during the week prior to this survey. Therefore, it can be reasonably assumed that dust concentrations measured in this survey are representative of the lowest concentrations which can be achieved with the present dust control system.

## II. SUMMARY AND RECOMMENDATIONS

This survey was performed by simultaneously sampling airborne dust in the Unibestos plant by two different techniques. Results of both methods of assessment suggest that dust concentrations in the plant are high when judged by the present U. S. Threshold Limit Value for asbestos dust, or by the recently proposed British guidelines for asbestos dust. Because the dust collection system was operating at, or close to the maximum efficiency achievable with present facilities, modifications and additions to the present system would appear to be in order. It is beyond the scope of this report to present detailed recommendations for system modification, but certain obvious major sources of dust emission in the plant as cited in Section V of this report.

It is recommended that attention be focussed on major redesign of th present system. It is obvious that additional air capacity for new local exhaust hoods will be necessary, and that this capacity probably cannot be found in the present system, which was not adequately handling existing hoods.

III. THRESHOLD LIMIT VALUE OF ASBESTOS DUST

"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 exposures 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 conditions."*

The American Conference of Governmental Industrial Hygienists had, in 1967, a T.L.V. for asbestos of 5 million particles per cubic foot, as determined by impinger sampling and counting by light-field techniques. In a considered revision (1968), the Conference endorsed the retention of this T.L.V. for "most forms of asbestos". However, for crocidolite, because of the production of mesotheliomas, it was recommended that workers be equipped with air-supplied helmets because no safe limit can be established for this form of asbestos at this time."

The British Occupational Hygiene society recently issued hygienic standards for chrysotile asbestos dust.** The standards are based on the objective that the risk of contracting asbestos be reduced to 1 per cent of those who have a lifetime's exposure to the dust. By "asbestosis" the committee meant the earliest demonstrable effects on the lung due to asbestos. These standards are cited here because they are more stringent than the U.S. guideline referred to above. The exposure guidelines are:

TABLE I

BRITISH HYGIENIC GUIDELINES FOR ASBESTOS DUST

| DUST CATEGORY | CONCENTRATION AVERAGED OVER 3 MONTHS | |
|---|---|---|
| | Fibers/cm$^3$ | MPPCF*** |
| Negligible | 0 - 0.4 | 0.011 |
| Low | 0.5 - 1.9 | 0.014 - 0.054 |
| Medium | 2.0 - 10 | 0.057 - 0.28 |
| High | over 10 | over 0.28 |

* Extracted from the Preface, Threshold Limit Values for 1968. American Conference of Governmental Industrial Hygienists, 1014 Broadway, Cincinnati, Ohio 45202.

** Ann. Occup. Hyg. 11, 47-69 (1968).

*** Million particles per cubic foot(as fibers).

The concentrations refer to fibers greater than 5 microns in length as determined by the membrane filter method.

IV. DESCRIPTION OF SAMPLING AND ANALYTICAL METHODS

Because of the current state of evaluation of the methods of assessing the potential hazard of asbestos dust, the standard impinger technique and the membrane filter technique were used in this survey.

A. Impinger Method

A midget impinger containing 10 ml of demineralized, distilled water was operated at 0.1 cfm air flow rate by means of a battery operated pump. Samples were agitated prior to withdrawing drops of suspension for examination in a Spencer Brightline Haemocytometer Cell. Particles were counted by viewing the sample with an objective lens of 0.25 Numerical Aperture (10x) and a 15x Ocular. Approximately 200-300 particles were counted in each size class, except where frequency of occurrence in the viewing field was very low, indicating concentrations in air far below the threshold limit value. 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.

B. Membrane Filter Method

A membrane filter (Type HA Millipore) was used to obtain samples for microscopic evaluation of fiber and dust particle concentrations. This paper is composed of pores 0.45 microns in size and has been shown to retain, with 100% efficiency, particles down to 0.05 micron diameter[1].

The filter was first visually examined to detect any loose dust or uneven dust deposition. In the few cases where the filter deposit did not pass this examination it was necessary to resuspend the collected dust in distilled water and refilter this suspension on VF grade Millipore filter to assure an even dust distribution over the entire filter area. A pie shaped segment of the filter was then placed on a microscope slide and rendered completely transparent with Cargille certified index of refraction liquids. Cargille liquid of index of

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[1] Megaw, W.J. and Wiffen, R.D.: Int. J. Air Wat. Poll. 1, 501 (1963).

refraction 1.500 was usually most suitable. The counting of the dust particles and the counting and sizing of asbestos fibers was performed with the aid of a Zeiss Photomicroscope using Phase Contrast Illumination. The objective lens was a Zeiss Neofluor Ph 63x with a numerical aperture of 0.90. The eyepiece had a magnification of 20x and contained a calibrated Porton graticule. The optovar feature of the Zeiss scope contributed to the total magnification of 2016x. Resolution was approximately 0.35 microns. Particles and fibers of size 0.30 microns could be detected.

In the evaluation procedure, all particles and fibers in the Porton field of view were counted and the fibers were grouped by fiber length into three categories (less than five microns, five to ten microns, and larger than ten microns). This procedure was repeated for a number of randomly selected fields on the face of the filter. Because only a portion of the total filter area was evaluated by this method, it was necessary to correct the count by the ratio of the total filter area to the evaluated area. The resultant particle or fiber number was divided by the volume of the air sample to obtain dust or fiber concentration expressed as millions of particles per cubic foot (MPPCF).

The statistical reliability of the evaluation was expressed as the standard deviation, calculated as $N^{1/2}$, where N is the particle or fiber count.

The procedure outlined follows, in its essential points, that recommended by J. R. Lynch and H. E. Ayer in their article "Measurement of Asbestos Exposure" which appeared in the Journal of Occupational Medicine, Volume 10, January, 1968.

## V. RESULTS AND DISCUSSION

Measured concentrations of dust and asbestos fibers are summarized in Table 2. All samples were obtained in the breathing zone of men or at breathing level in areas where men were not at work at the time samples were obtained (in aisles, for instance). Impinger and membrane filter samples were obtained simultaneously at the sites shown. Only at the last five sites were midget impingers used without simultaneous membrane filters operating.

It is seldom that air sampling reveals a picture as consistent as the one depicted by the data in Table 2. With the exception of two samples obtained with the impinger, all results indicate concentrations

in excess of the present U.S. Threshold Limit Value of 5 MPPCF. It should be noted that the U.S.T.L.V. is in terms of total particles and not fibers alone. This approach stems from epidemiological methods initially used in surveying the asbestos industries. According to the British classification, three membrane filter samples were in the Medium dust category (0.057-0.28 million fibers (>5 um) per cubic foot) and the remaining six samples were in the High dust category ( 0.28 million fibers (>5 um) per cubic foot).

These results suggest that with the present dust control facilities operating under optimum conditions of maintenance, dust concentrations are high in the Unibestos plant.

The highest concentrations of dust were measured at cutting stations and in the vicinity of the feed stations in the raw materials formulation area. The high results at the buildup station were due to dust from the feed area backing up to the buildup area. The high dust levels at the Uniclad area are surprising, but it was noted that the men use a special abrasive sponge to smooth the rolls and this may contribute to the dust. Exhaust hoods are not used in this area.

Possible major sources of the excessive dust are not hard to pinpoint and they will now be cited.

A. Raw materials formulation area.

1. Transfer of asbestos from bags to feed bins and recovered asbestos from the collection "house" to bins are major sources of dust emission. Present efforts directed at pneumatic pick-up of scrap will reduce the latter source.

2. Line feed bin hoods are not effective based on measured face velocities. The new bin hood design is superior to the old design, but the need to open asbestos bags from the tops of bins results in low air velocities at the bases of bin opening faces. The problem is the sloping face design of the bin entry.

3. Low room air velocities in the feed area indicates poor air turnover in this room. Velocities were 20-30 fpm.

4. Doors remain open in the scrap storage bin and dust enters the room as material drops to the base of the bin and "pulses" the dust-laden air outward.

5. Floor sweeping and cleaning in this area generate a large amount of dust.

B. Unibestos Cutting Area

1. Absence of hood at No. 3 Line Unloading Station.

2. Line No. 3 "push-pull" hood system at cutter is inefficient. The "push" and "pull" areas are equal and the jet merely "splashes" off the "pull" hood after expansion in transit.

3. Line No. 3 exit hood ineffective.

4. Line No. 2 cutting hood is downdraft on the left side, side draft on right side. The latter is ineffective.

5. The hood set-up for Line No. 1,a canvas hood installed by the operator, appeared to work well and should be looked at for permanent design and use on Lines 2 and 3.

Thus, the problem in this area is really one of poor or non-existent local exhaust hood design. It is beyond the scope of this report to present detailed hood designs. The designs required at these sites are not elaborate, but the additional air capacity must be in the dust collection system. Information conveyed to the author by Mr. Dolaway indicated that the present system does not have this capacity.

TABLE 3

DUST AND ASBESTOS FIBER CONCENTRATIONS AT SELECTED PLANT LOCATIONS

| Date and Time of Sample | Description of Sampling Site | Dust or Fiber Concentration, MPPCF ± Standard Deviation | | | | | |
|---|---|---|---|---|---|---|---|
| | | Impinger Sampling | | Membrane Filter Sampling | | | |
| | | Particles | Fibers | Fibers <5 μm | Fibers 5 - 10 μm | Fibers >10 μm | Partic |
| '27 1:05 PM-1:15 PM | Loader BZ* Cutting Unibestos (2' x 6") on Line No. 2 | 6.1 ± 0.6 | 0.60 ± 0.17 | 1.54 ± 0.11 | 0.093 ± 0.028 | 0.051 ± 0.021 | 2.40 ± |
| '27 1:25 PM-1:35 PM | Unloader BZ* Cutting Unibestos (2' x 6") on Line No. 2 | 6.2 ± 0.6 | 0.65 ± 0.18 | 0.82 ± 0.11 | 0.077 ± 0.034 | 0.015 ± 0.015 | 2.34 ± |
| '27 1:45 PM-1:55 PM | Unloader BZ* Cutting Unibestos (2 1/2' x 16") Line No. 3 | 19.2 ± 1.0 | 1.95 ± 0.31 | 2.17 ± 0.19 | 0.14 ± 0.05 | 0.017 ± 0.017 | 3.62 ± |
| '27 2:25 PM-2:35 PM | Loader BZ* Cutting Unibestos (2 1/2' x 16") Line No. 3 | 28.3 ± 1.7 | 3.20 ± 0.56 | 1.62 ± 0.15 | 0.23 ± 0.06 | 0.071 ± 0.032 | 2.44 ± |
| '27 3:05 PM-3:15 PM | General Background in Aisles at breathing level. Opposite office adjacent to cutting area | 2.9 ± 0.4 | 0.80 ± 0.20 | 0.93 ± 0.11 | 0.49 ± 0.08 | 0.44 ± 0.08 | 6.69 ± |
| '27 4:20 PM-4:30 PM | Raw Materials & Line Formulation Area Line Feed Operator BZ* in vicinity of Lines 1A, 1B, & 1C. Note: large amounts of visible dust. | 10.0 ± 0.7 | 2.00 ± 0.32 | 4.74 ± 0.28 | 0.51 ± 0.09 | 0.22 ± 0.06 | 5.72 ± |

*Breathing Zone.

TABLE 2 (con' ued)

| Date and Time of Sample | Description of Sampling Site | Dust or Fiber Concentration, MPPCF ± Standard Deviation | | | | | |
|---|---|---|---|---|---|---|---|
| | | Impinger Sampling | | Membrane Filter Sampling | | | |
| | | Particles | Fibers | Fibers <5 um | Fibers 5 - 10 um | Fibers >10 um | Particles |
| 8/27 4:35 PM-4:45 PM | Raw materials and Line Formulation Area Background Sampling at breathing level Note: Large amounts of visible dust | 44.3 ± 2.1 | 6.40 ± 0.80 | 4.43 ± 0.29 | 1.88 ± 0.19 | 0.72 ± 0.11 | 7.07 ± 0.3 |
| 8/28 8:30 AM-8:40 AM | Breathing Level Adjacent to Kiln (in aisle opposite control panel). | 2.3 ± 0.3 | 0.40 ± 0.14 | 1.40 ± 0.16 | 0.15 ± 0.05 | 0.074 ± 0.037 | 7.38 ± 0.3 |
| 8/28 8:55 AM-9:05 AM | Raw materials and Line Formulation Area. Breathing Level in vicinity of Lines 1 and 2 bins and adjacent to storage area. | 5.2 ± 0.5 | 0.50 ± 0.16 | 4.75 ± 0.29 | 0.57 ± 0.10 | 0.31 ± 0.07 | 6.98 ± 0.3 |
| 8/28 9:35 AM-9:45 AM | BZ* of builder operator at Line No. 2 (2' x 6" rolls) | 32.0 ± 1.8 | 9.20 ± 0.96 | ---- | ---- | ---- | ---- |
| 8/28 9:50 AM-10:00 AM | BZ* of builder operator at Line No. 1 | 9.7 ± 0.7 | 0.50 ± 0.16 | ---- | ---- | ---- | ---- |
| 8/28 10:05 AM-10:15 AM | Breathing level in storage areas behind Lines No. 1 and 2. Feed bins (Asbestos and Decalite bag storage). | 26.3 ± 1.1 | 2.10 ± 0.32 | ---- | ---- | ---- | ---- |

* Breathing Zone.

TABLE 2 (continued)

| Date and Time of Sample | Description of Sampling Site | Dust or Fiber Concentration, MPPCF + Standard Deviation | | | | | |
|---|---|---|---|---|---|---|---|
| | | Impinger Sampling | | Membrane Filter Sampling | | | |
| | | Particles | Fibers | Fibers <5 um | Fibers 5 - 10 um | Fibers >10 um | Particles |
| 8/28 10:25 AM-10:35 AM | Cutting Area BZ* of Line No. 1 Feed Operator (Cutting 16" x 2' rolls) | 17.3 ± 0.9 | 0.90 ± 0.21 | ---- | ---- | ---- | ---- |
| 8/28 10:50 AM-11:00 AM | Uniclad Area BZ* operator | 61.2 ± 2.5 | 1.20 ± 0.35 | ---- | ---- | ---- | ---- |

* Breathing Zone.