PLAINTIFF'S EXHIBIT
UC-711

On June 7, 1972, stringent Federal regulations went into effect on the commercial use of asbestos. The impact of these regulations on the drilling industry has been a source of concern and confusion to suppliers and users, alike.

Because of this, we at Montello determined to ascertain how our unique, wet-refined Super Visbestos would perform, in the context of the OSHA regulations, under the widely varying conditions found on drilling rigs. With the invaluable cooperation and assistance of several companies, four on-site tests and their evaluation have now been completed.

Attached is a copy of an extensive report which gives a detailed interpretation of the results from these four tests. Site selection was based on a desire to evaluate the broadest possible range of dumping environments. Three different forms of our asbestos were checked to determine the effects of fine grinding, coarse grinding (i.e. crushing) and granulating, on air entrained dust levels.

We believe interested readers will find this report informative. On the next page, we've recapped the more important points which it includes. In substance, the results lead us to believe that there is no reasonable expectation of exceeding the limit values imposed by the regulations, when using either Crushed Super Visbestos or the much cleaner New Granular Super Visbestos.

We'll be glad to answer any questions you may have. Just drop us a line or call our Sand Springs office.

Respectfully presented,

MONTELLO, INC.

Kenneth N. Campbell

KNC/jd

Montello
P.O. BOX 130, SAND SPRINGS, OKLAHOMA 74063 /(918)-245-6661/TWX 910-840-3007

A study covering airborne dust concentrations in drilling fluid operations using wet-refined asbestos has been completed. The following are some of the more important points to consider:

1. All tests were performed using Montello's exclusive wet processed asbestos products. The findings cannot be safely applied to any of the several dry ground products on the market.

2. Fiber counts were highest on fine ground material and lowest on granular material, with coarsely ground (crushed) material falling between these two.

3. Crushed Super Visbestos, which has been used in the field for several years, consistently fell well below the OSHA regulations as to maximum ceiling limit and 8 hour, time weighted average, (TWA).

4. New Granular Super Visbestos, now available in the field at no extra cost, proved to be from 20% to 50% cleaner than Crushed Super Visbestos.

5. Neither form of Super Visbestos exceeded even the much more stringent TWA level which will become effective in 1976.

6. Based on this test series, Super Visbestos in either form offers a safety margin of 5 to 1 or more, in complying with the limits set by the regulations. Therefore, we believe there is no reasonable expectation of exceeding the legal limits, when using Crushed or New Granular Super Visbestos.

# AIRBORNE ASBESTOS DUST CONCENTRATIONS

# in

# DRILLING FLUID OPERATIONS

# using

# WET-REFINED ASBESTOS

This report provides a general interpretation of the overall results from four on-site evaluations. Individual reports on each are available.

H. B. Rhodes

&

E. J. Kleber

PLEASE NOTE: Most of the companies co-operating in these tests are customers of Montello and conducted the tests to ascertain that their use of the product complies with standards set forth in the federal Occupational Safety and Health Act. Results of these tests are made available to other companies solely for their use in making their own evaluations of procedures to be followed in using the material. No representations are made, nor are to be implied, from this report as to the safety of this material no matter how it is used.

UNION CARBIDE CORPORATION
Mining & Metals Division
Niagara Falls, New York

February 22, 1973

## INTRODUCTION

A survey has been made to examine the levels of asbestos dust that may occur when wet-refined asbestos is used as an ingredient in drilling fluids. Both open-air and enclosed dumping operations were checked. A range of dumping rates from 10 to 80 sacks per hour was used.

Tests were run with three types of wet-refined asbestos:

1. A fine-ground hydrophobic asbestos known commercially as Arcovis 953. (2)

2. A coarse-ground asbestos known commercially as Super-Visbestos.

3. A new version of Super-Visbestos in the form of 1/8" granular pellets.

It is important to emphasize that the dust levels reported herein are specific for the wet-refined asbestos types described and do not apply to dry-processed California or Canadian asbestos.

The reports giving the details of the dumping and sampling at four locations and the raw data obtained are appended for reference. This report provides a more general interpretation of the overall results.

## SUMMARY AND CONCLUSIONS

The highest dust level measured during any of the nine dumping operations tested was 5.5 fibers/cc. greater than 5 micrometers in length(1) which is over 55% of the allowable ceiling concentration. This level occurred during the dumping of the fine-ground product in a small enclosed area to simulate North Slope conditions and is not typical of routine mud operations. The more representative tests gave results below 2 fibers/cc. which is less than 20% of allowable.

Time-weighted average values were calculated for all dumps on the basis of one dumping period per shift and a background exposure of 0.3 fiber/cc. during the time asbestos was not being handled. The highest value found in any of the dumps was 0.7 fibers/cc. for North Slope conditions with 0.3-0.4 fibers/cc. typical of normal operations. The latter values are less than 10% of the current allowable value of 5 fibers/cc. and 20% of the projected value of 2 fibers/cc. in 1976.

As would be expected, the new-granular product gave much less dust, i.e., 20-50%, than the coarse-ground Super-Visbestos.

## CALCULATION PROCEDURES

The OSHA regulations permit exposure to a ceiling concentration of 10 fibers/cc. and an 8-hour time-weighted average exposure of 5 fibers/cc. In this work, the ceiling concentration occurred in the breathing zone of the operator during the dumping of the asbestos and is reported directly as measured.

---

(1) For convenience, in this discussion the term "fibers/cc." will be taken to mean the entire term, "fibers/cc. greater than 5 micrometers in length."

(2) Use of this product is covered by U.S. Patent No. 3,618,680.

The 8-hour time-weighted average is basically a simple concept that can be expressed as:

$$\text{T.W.A.} = \text{Time-Weighted Average} = \frac{\sum \left[\text{Fibers/cc. in a particular sample}\right] \left[\text{Time in hours over which the particular sample was collected}\right]}{8}$$

Where: $\sum$ = Summation of samples collected over the 8-hour period.

In order to be strictly correct, it is necessary to sample over the entire 8-hour period to define the TWA. In these tests, however, only a short post-dump sample was obtained. Normally, at a well, an operator dumps for a short period once a shift (or tour) and spends the remainder of the time out of the immediate dump area. It is thus reasonable to estimate the TWA for the operator as a combination of the ceiling concentration (measured) exposure during the dump and a background exposure for the remainder of the shift. The data obtained in this work indicate a reasonable and probably conservative (high) value for the background of 0.3 fibers/cc. This number will be used in the calculation of 8-hour TWA values.

## REVIEW OF DATA

Dust counts have been obtained at four locations; three by Union Carbide and one by [redacted] Complete reports are appended for reference.

In this section, the data are reviewed and the technical basis for the background level assumption just described is provided. An 8-hour time-weighted average value is also calculated for each dump.

### [redacted] Central Oklahoma Well Location

In this test, 20 sacks of regular Super-Visbestos were dumped over a 21-minute period. After a wait of about 10 minutes, 20 sacks of the New Granular Super-Visbestos were dumped over a 26-minute period.

The fiber count data for the airborne dust samples obtained is shown graphically in Figure 1. The figure gives fiber count as a function of elapsed time.

The ceiling concentration sample taken in the breathing zone of the operator during the dump of regular Super-Visbestos gave a count of 1.9 fibers. When granular Super-Visbestos was dumped 10 minutes later, the count was down to only 0.4 fibers. During these same periods, the downwind counts were 0.51 and 0.31 fibers, respectively, while upwind values of <0.1 and 0.15 fibers were found. The wind was a light, somewhat variable breeze so all of these values seem reasonable and internally consistent.

Note that the highest environmental sample found (Position 3, downwind) was only 0.5 fiber and this occurred during the dumping of the ground Super-Visbestos. With granular Super-Visbestos the maximum seen was 0.3 fiber or less. The assumed value of 0.3 fiber for the background level when no asbestos is being handled thus seems reasonable.

Note that both environmental samples (Positions 1 and 3) were 0.3 fiber or below during the granular Super-Visbestos dump. The assumed value of 0.3 fiber for the background level when no asbestos is being handled thus seems reasonable.



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The data in Figure 1 can be used to estimate TWA values for both types of asbestos dumped. For the regular Super-Visbestos, consider the exposure to be 1.9 fibers for the 30-minute period covering both the dump and subsequent time until the lower reading was obtained. For the remaining 7-1/2 hours of the shift, it is assumed that the operator dumps no more asbestos and is exposed to a background level of 0.3 fibers.

Thus:

$$TWA = \frac{(1.9 \text{ fibers})\ (0.5 \text{ hours}) + (0.3 \text{ fibers})\ (7.5 \text{ hours})}{8 \text{ hours}}$$

$$TWA = \frac{3.21}{8} = 0.4 \text{ fibers}$$

This is only (0.4) (100)/5 = 8% of the allowable exposure level.

For the granular Super-Visbestos, consider the exposure to be 0.4 fibers for 0.5 hour and the assumed background of 0.3 fibers for 7.5 hours. Thus:

$$TWA = \frac{(0.4)\ (0.5) + (0.3)\ (7.5)}{8} = 0.3 \text{ fibers}$$

This is 6% of the allowable TWA.

[redacted] Location Near Houston, Texas

The next series of tests to be examined were run at [redacted] on September 25 and 26, 1972. These tests were intended to simulate conditions on the North Slope. Dumping was done in a small, covered enclosure about 10' x 11' x 9' high. Dumps were made with one side open 8' to approximate normal conditions and with everything closed as occurs in the Arctic during extremely cold and windy weather. Finely-ground hydrophobic asbestos (Arcovis 953) and granular Super-Visbestos were dumped on successive days.

Finely-Ground Hydrophobic Asbestos: In the first day's test, 30 sacks of Arcovis 953 were dumped in 29 minutes with the 8' door open. Dust levels were monitored during the dump and for a 1-1/2 hour period thereafter.

Approximately 2-1/2 hours later the door was closed and 30 more sacks of Arcovis were dumped in 36 minutes. Dust levels were again measured during the dump and for about 1-1/2 hours thereafter. The data are shown in Figure 2 with the airborne asbestos dust concentration in fibers/cc. greater than 5 micrometers given as a function of elapsed time.

The exact sample point locations referred to in the figure are shown in the appended report. They are approximately:

1. In a "dead" corner adjacent to the door.
2. Directly over the hopper. (The hopper is near the wall on the opposite side from the door.)
3. Breathing zone of operator during dump.
4. Over empty sacks in rear corner near hopper.



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During the first dump, with the door open, the ceiling concentration sample from the operator's breathing zone gave a level of 1.3 fibers. All of the other samples were 0.3 fiber or less.

In the second dump with the room closed tightly, the breathing zone (#3) and the sample directly over the hopper were very close at 5 5 and 5.2 fibers, respectively. When the dump was finished, the level over the hopper (#2) then dropped sharply to 0.5 fiber. At the same time, the level at Point 4, near the hopper but over the empty bags was only 0.3 fiber.

In normal practice in the Arctic, the dump is made and the operator leaves the area entirely. On this basis, it would be reasonable to use a value of 0 fibers for the time outside of the dump in estimating the TWA exposure. In order to keep the data directly comparable with the other locations covered in this report, however, the value of 0.3 fiber will be used. The results in Figure 2 also corroborate that the 0.3 level for general background is probably high.

The data can be used to estimate the TWA values for both the open and closed dumps. For the open dump, consider the exposure to be 1.3 fibers for 1/2 hour and 0.3 fiber for 7-1/2 hours.

Thus:

$$TWA = \frac{(1.3)\ (0.5) + (0.3)\ (7.5)}{8} = 0.4 \text{ fiber}$$

For the closed-door dump, the values are 5.5 fibers ~2/3 hours and 0.3 fibers for the remaining 7-1/3 hours to give:

$$TWA = \frac{(5.5)\ (2/3) + (0.3)\ (7\text{-}1/3)}{8} = 0.7 \text{ fibers}$$

Granular Super-Visbestos: In the second day's test, 30 bags of granular Super-Visbestos were dumped in 29 minutes with the door opening closed off. Dust levels were monitored during the dump and for a 1-1/2 hour period thereafter. The door was then opened and 30 more bags were dumped in 30 minutes. Dust levels were again measured during the dump and for approximately 1-1/3 hours thereafter. Sample collection points were at the same locations just described. The data are shown in Figure 3 in the same coordinates as Figure 2 but at different scales.

Before examining the data, it should be recalled that on the previous day, a more dusty product, Arcovis 953, had been dumped with the building closed. Sample Point #1 gave a reading of 1.0 fibers on a sample collected during and after the Arcovis dump. (See Figure 2)

During the first Super-Visbestos dump shown in Figure 3, Point 1 gave a value of 0.8 fiber. This dropped sharply to only 0.1 fiber when the door was opened. Also, a background sample taken over the hopper before the start of this dump had a reading of 0.7 fiber. This suggests that the closed room at the start of these dumps contained a level of 0.7 - 0.8 fibers as a residual from the previous days' tests.



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During the first granular Super-Visbestos dump (room closed) the ceiling concentration breathing zone sample, #3, showed a level of 1.8 fibers. At the same time, the adjacent region over the hopper, Point #2, was at essentially the same level, i.e., 1.7 fibers. When the dump was finished, the level over the hopper (Point #2) dropped to the very low value of 0.2 fiber. At Point #4, near the hopper but over the empty bags, the level was only 0.1 fiber throughout the two hours.

During the second dump, with the door open, the breathing zone (#3) and hopper (#2) samples were both only 0.4 fiber. The formerly "dead" area (#1) was 0.1 fiber throughout. The hopper (#2) dropped to 0.1 fiber after the dump was completed. The #4 position, in the corner over the bags, went up from 0.1 fiber to the still very low level of 0.3 fiber.

Recognizing the inherent inaccuracies in the dust count technique, these data obtained and those obtained with the Arcovis present an internally consistent picture. It appears that the hopper is generally acting as an aspirator and is removing dust-laden air from the immediate vicinity. Its effect does not appear to reach as far as the opposite corner of the room, Position #1, however. The modest increase in Point #4 with the door open could be due to a "dead" area developing in the corner but the data are too limited to more than speculate.

The data from Figure 3 can be used to estimate the TWA values for the operator. For the closed-door case, the peak concentration would be 1.8 fibers for 1/2 hour to give:

$$TWA = \frac{(1.8)\ (0.5) + (0.3)\ (7.5)}{8} = 0.4 \text{ fiber}$$

For the open-door dump, the values are 0.4 and 0.3, respectively, to give:

$$TWA = \frac{(0.4)\ (0.5) + (0.3)\ (7.5)}{8} = 0.3 \text{ fiber}$$

[redacted] Texas Panhandle Well Location

The third series of tests were run at [redacted] The mud was mixed in a 25' x 7' mud house with open doors at both ends. The hopper was adjacent to the door at one end of the house. A diagram is available in the complete report appended.

The test consisted of a dump of 10 bags of Super-Visbestos at regularly spaced intervals of 6 minutes over a 60-minute period. This was followed by a 30-minute wait and then a dump of 10 bags of granular Super-Visbestos in the same manner. During the entire period, the wind outside was blowing strongly. It was in a direction, however, such that even though both doors were open there was no strong draft through the building.

For these tests, samples were collected at the following points:

Position 1: Opposite corner at same end of trailer as mud hopper.

Position 2: End of trailer at opposite from the mud hopper.

Position 3: Operator breathing zone during dumps.



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The dust count results obtained are shown graphically in Figure 4. For the dump of regular Super-Visbestos, the dust level in the breathing zone was 1.0 fiber. The environmental samples near the hopper and at the other end of the trailer were considerably lower and decreased with distance from the hopper.

During the following half hour (12:15-12:45), the two environmental samples showed a moderate increase which also continued over the ensuing one-hour dump of the granular Super-Visbestos. In the half hour after the second dump, however, the levels at both Position 1 and Position 2 dropped. The breathing zone sample collected during this dump was the same as the adjacent environmental sample at Position 1, i.e., 0.5 fiber.

This pattern suggests that the second breathing zone sample is more representative of the general level at the hopper end of the trailer than a direct measure of dust generation by the granular Super-Visbestos. The correct granular Super-Visbestos level, however, should be no more than the 0.5 fiber measured.

As in the previous tests, the general level of environmental samples, i.e., 0.1 - 0.3 fibers in the opposite end of the trailer, and 0.3 - 0.5 fibers directly adjacent to the dumping area, continue to support the validity of the value of 0.3 fiber as the background exposure level for the time period when asbestos is not being handled.

Regular Super-Visbestos:

$$TWA = \frac{(1.03)\ (1) + (0.3)\ (7)}{8} = 0.4 \text{ fiber}$$

Granular Super-Visbestos:

$$TWA = \frac{(0.5)\ (1) + (0.3)\ (7)}{8} = 0.3 \text{ fiber}$$

[redacted] South Louisiana Well Location

The last data to be considered were obtained by [redacted] This was an open-air dump wherein 21 bags of granular Super-Visbestos were dumped in 15 minutes and 5 minutes were spent in cleanup and disposal of the bags. A slight wind was blowing towards the worker. Two samples were collected simultaneously in the breathing zone of the worker during the dump. (1) One sample was collected at the same time in the breathing zone of an observer standing about 3' upwind. Results are shown in the table below.

| SAMPLE NO. | LOCATION | TIME MINUTES | FLOW RATE LITERS/MIN | TOTAL VOLUME LITERS | ASBESTOS CONC. FIBERS/CC. |
|---|---|---|---|---|---|
| 1 | At breathing zone of worker. | 22.0 | 1.5 | 33.0 | 1.4 |
| 2 | At breathing zone of worker. | 21.3 | 2.9 | 61.8 | 0.6 |
| 3 | At breathing zone of the observer. | 20.3 | 4.3 | 87.3 | 0.0 |



(1) During the dump, as well as during cleanup and associated operations.

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The data from the two breathing zone samples, although somewhat different, are in reasonable agreement for this kind of dust sampling and counting. The levels found are also in the same general range as the results obtained at the other three locations. The zero level found for the observer also supports the assumption of the 0.3 fiber value for TWA calculations. Thus:

$$TWA = \frac{(1.4)\ (0.33) + (0.3)\ (7.67)}{8} = 0.35$$

or using the 0.6 fiber reading

$$TWA = \frac{(0.6)\ (0.33) + (0.3)\ (7.67)}{8} = 0.31$$

## DISCUSSION OF RESULTS

The data from the various tests have been assembled in Table I arranged approximately in the order of increasing dumping rate. Both ceiling concentration and estimated time-weighted-average values are included. The data are shown graphically as a function of dumping rate in Figures 5 and 6.

### Ceiling Concentration

Figure 5 gives the ceiling concentration results. The highest value observed was 5.5 fibers that occurred when the fine-ground material was dumped in a small enclosed area. Even this level, however, is only 55% of that allowable in the OSHA regulations. All of the other data regardless of asbestos-type dumping rate or type of enclosure are below 2 fibers.

Certain of the data were paired, as shown by the connecting arrows, to test the effect of a single variable. The two pairs of points connected by the solid arrows are a direct comparison between coarse-ground (regular) and granular Super-Visbestos. As would be expected, the granular form gives half as much dust or less. The other points for granular dumps in open air at higher dump rates (open squares) bear out that the granular product form gives very low-dust levels.

The two sets of points connected by the dashed arrows compare open and enclosed dumping. Again, as is reasonable, the levels were approximately four times as great for the confined areas.

### Estimate Time-Weighted Averages

Figure 6 gives the estimated TWA values for the various dumps. As noted previously, these were calculated on the basis of the observed ceiling concentration during the dump and an assumed background of 0.3 fiber over the remainder of the shift

The highest value found was only 0.7 fiber with all of the rest of the results in the 0.3 - 0.4 range. These numbers are approximately 8% of the present allowable level of 5 fibers and only 20% of the 1976 level of 2 fibers.



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Location Key:

I Texas Panhandle
II Central Oklahoma
III Near Houston
IV Near Houston
V South Louisiana

TABLE I

AIRBORNE ASBESTOS DUST CONCENTRATIONS
IN
DRILLING FLUID OPERATIONS

| | LOCATION | SUPER-VISBESTOS PRODUCT | CONDITIONS | DUMPING | | | DUST LEVEL(1) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Ceiling Concentration | | Time-Weighted Ave. (TWA)(2) | |
| | | | | Sacks | Min. | Rate (Sacks/Min.) | Fibers/cc.(3) | % of Allowable(4) | Fibers/cc.(3) | % of Allowable(5) |
| I | [redacted] | Coarse-Ground (Regular) | 7'x25' Mud House. Open door at both ends | 10 | 59 | 0.17 | 1.0 | 10 | 0.4 | 8 |
| | [redacted] | Granular | 7'x25' Mud House. Open door at both ends | 10 | 59 | 0.17 | 0.5 | 5 | 0.3 | 6 |
| II | [redacted] | Coarse-Ground (Regular) | Open air Light breeze | 20 | 21 | 0.95 | 1.9 | 19 | 0.4 | 8 |
| | [redacted] | Granular | Open air Light breeze | 20 | 26 | 0.77 | 0.4 | 4 | 0.3 | 6 |
| III | [redacted] | Fine-Ground (Hydrophobic) | 10'x11' Room Totally enclosed | 30 | 36 | 0.83 | 5.5 | 55 | 0.7 | 14 |
| | [redacted] | Fine-Ground (Hydrophobic) | 10'x11' Room 1 side open, 8' | 30 | 29 | 1.03 | 1.3 | 13 | 0.4 | 8 |
| IV | [redacted] | Granular | 10'x11' Room Totally enclosed | 30 | 29 | 1.03 | 1.8 | 18 | 0.4 | 8 |
| | [redacted] | Granular | 10'x11' Room 1 side open, 8' | 30 | 30 | 1.00 | 0.4 | 4 | 0.3 | 6 |
| V | [redacted] | Granular | Open air Slight breeze | 21 | 15 | 1.40 | 1.4(6)<br>0.6(6) | 14<br>6 | 0.3<br>0.3 | 6 |

(1) Sampling and dust counting carried out in accordance with OSHA Regulation 1910.93a.
(2) Calculated at a background exposure of 0.3 fiber/cc. for all time except during actual dumping. One dump per 8-hour shift.
(3) Fibers/cc. greater than 5 micometers in length.
(4) Allowable = 10 fibers/cc. greater than 5 micrometers.
(5) Allowable = 5 fibers/cc. greater than 5 micrometers.
(6) Operator wore 2 samplers.

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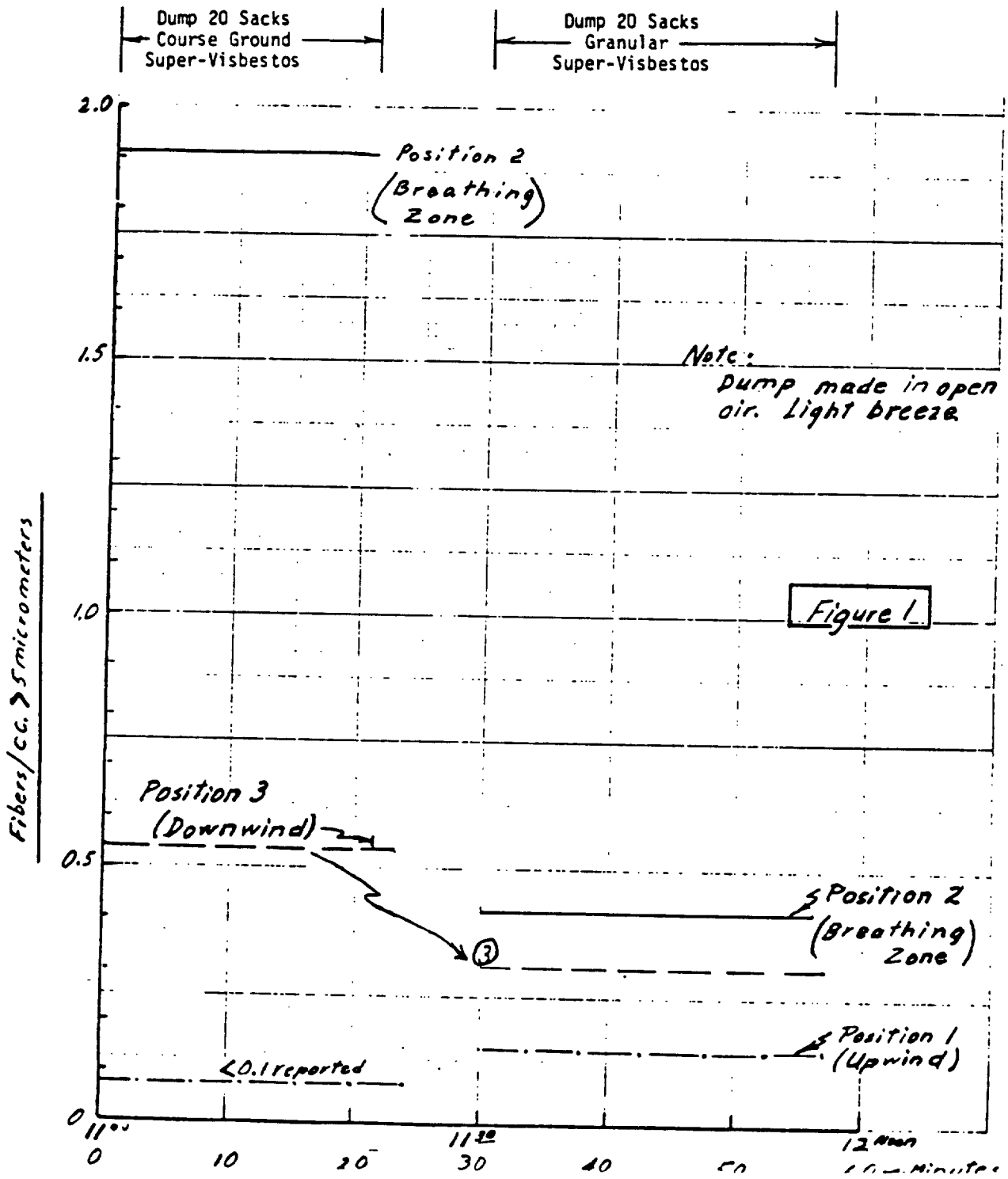
ASBESTOS FIBER COUNTS OF AIRBORNE SAMPLES COLLECTED

[redacted] Central Oklahoma Well Location

[redacted]

September 27, 1972

COURSE GROUND (REGULAR) AND GRANULAR SUPER-VISBESTOS



ASBESTOS FIBER COUNTS OF AIRBORNE SAMPLES COLLECTED

[redacted] Location Near Houston, Texas

[redacted]

September 25, 1972

FINE GROUND HYDROPHOBIC ASBESTOS (ARCOVIS 953)

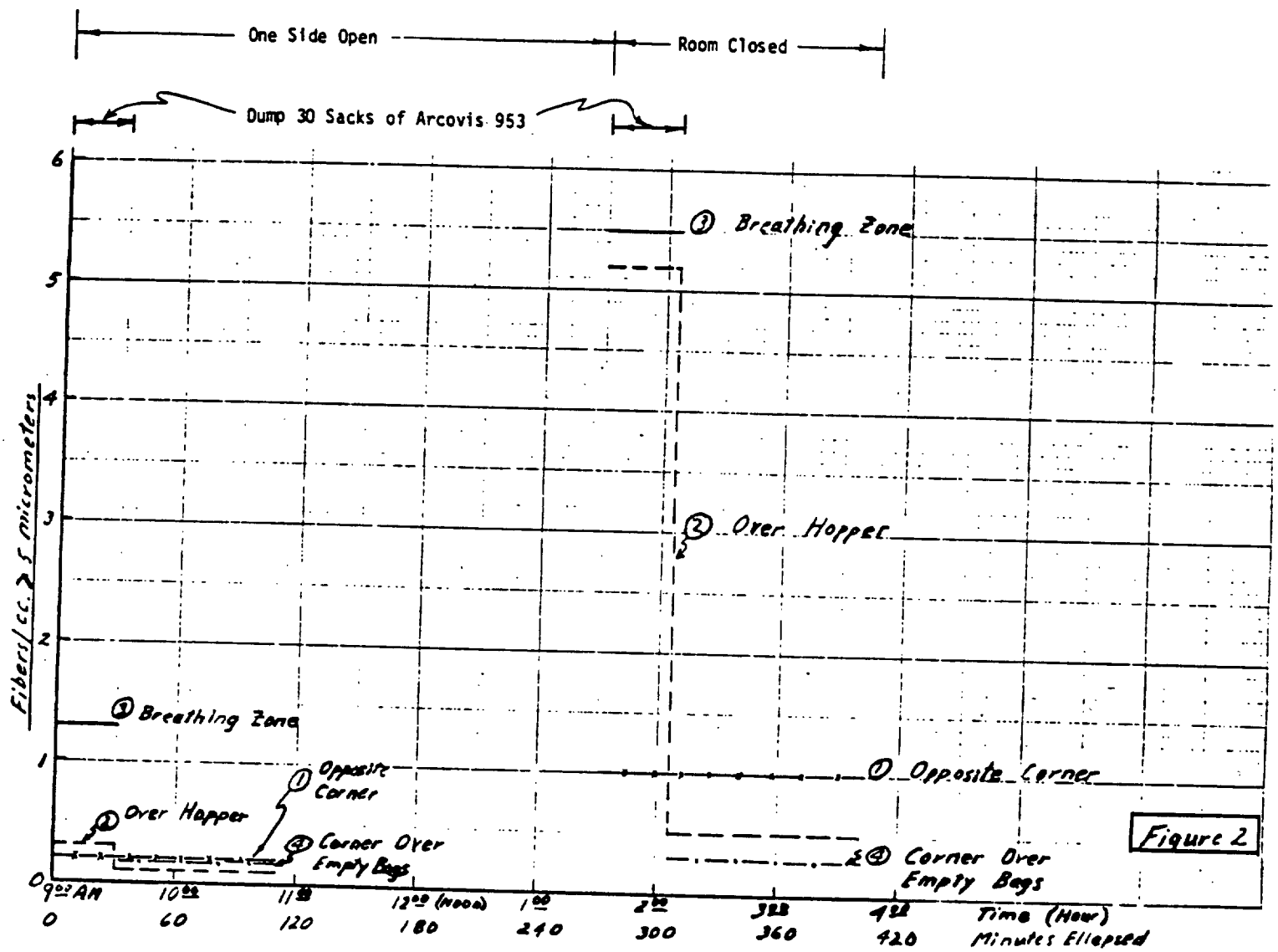



Figure 2

ASBESTOS FIBER COUNTS OF AIRBORNE SAMPLES COLLECTED

[redacted] Location Near Houston, Texas

[redacted]

September 26, 1972

GRANULAR SUPER-VISBESTOS

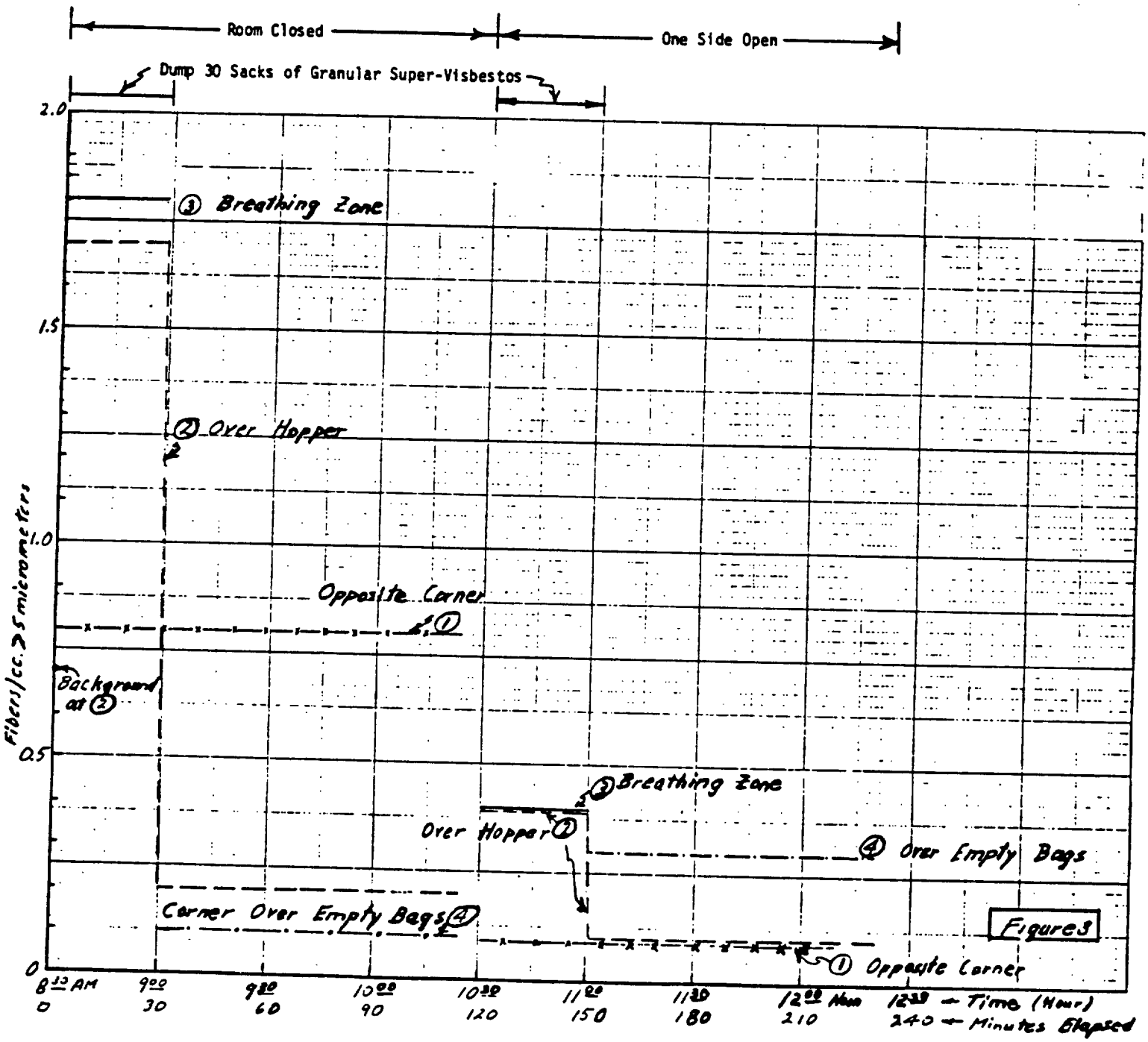



Figure 3


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ASBESTOS FIBER COUNTS OF AIRBORNE SAMPLES COLLECTED

[redacted] Texas Panhandle Well Location

[redacted]

September 28, 1972

COARSE GROUND (REGULAR) AND GRANULAR SUPER-VISBESTOS

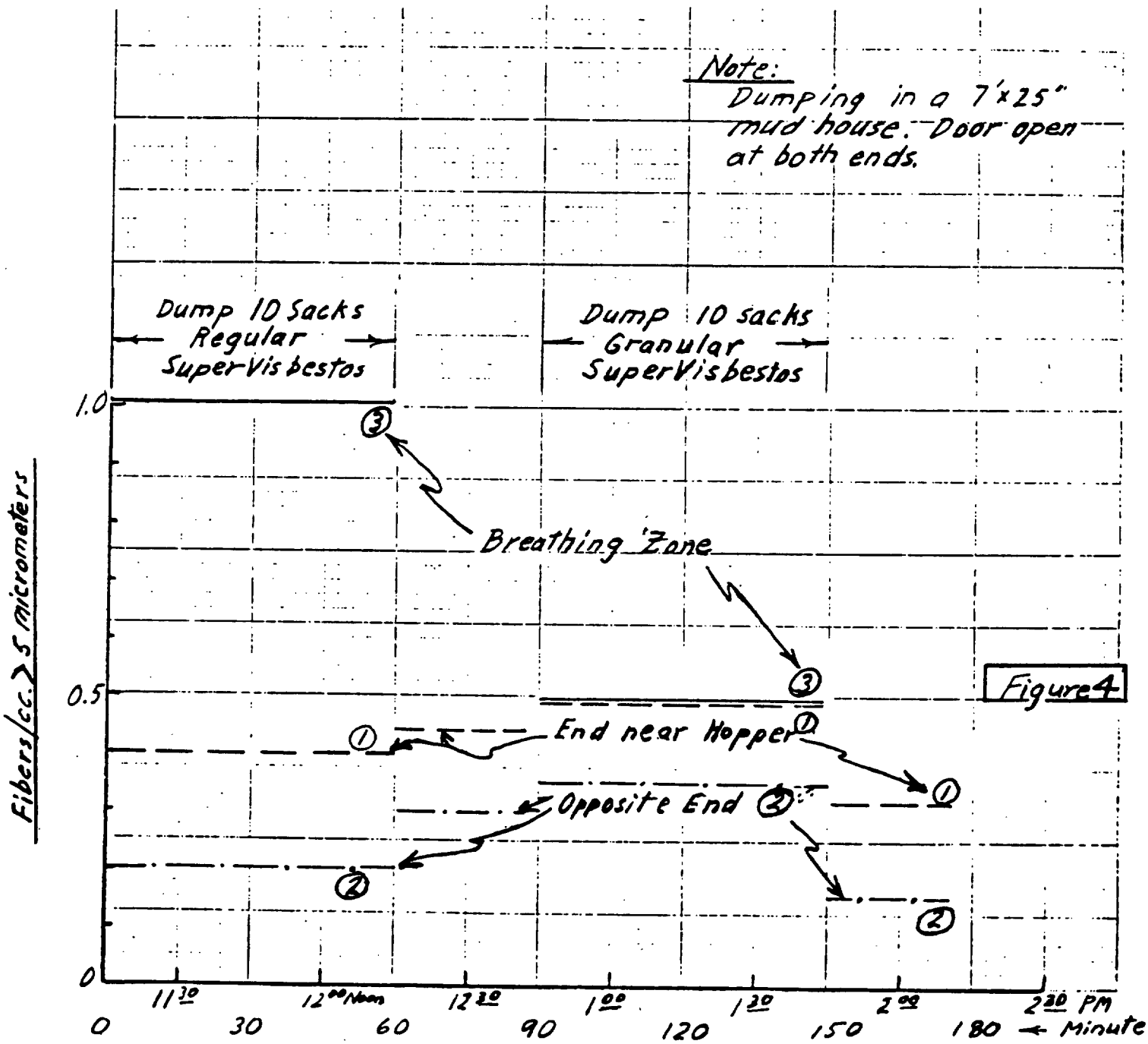



Figure 4


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ASBESTOS DUST CEILING CONCENTRATIONS

DRILLING MUD OPERATIONS

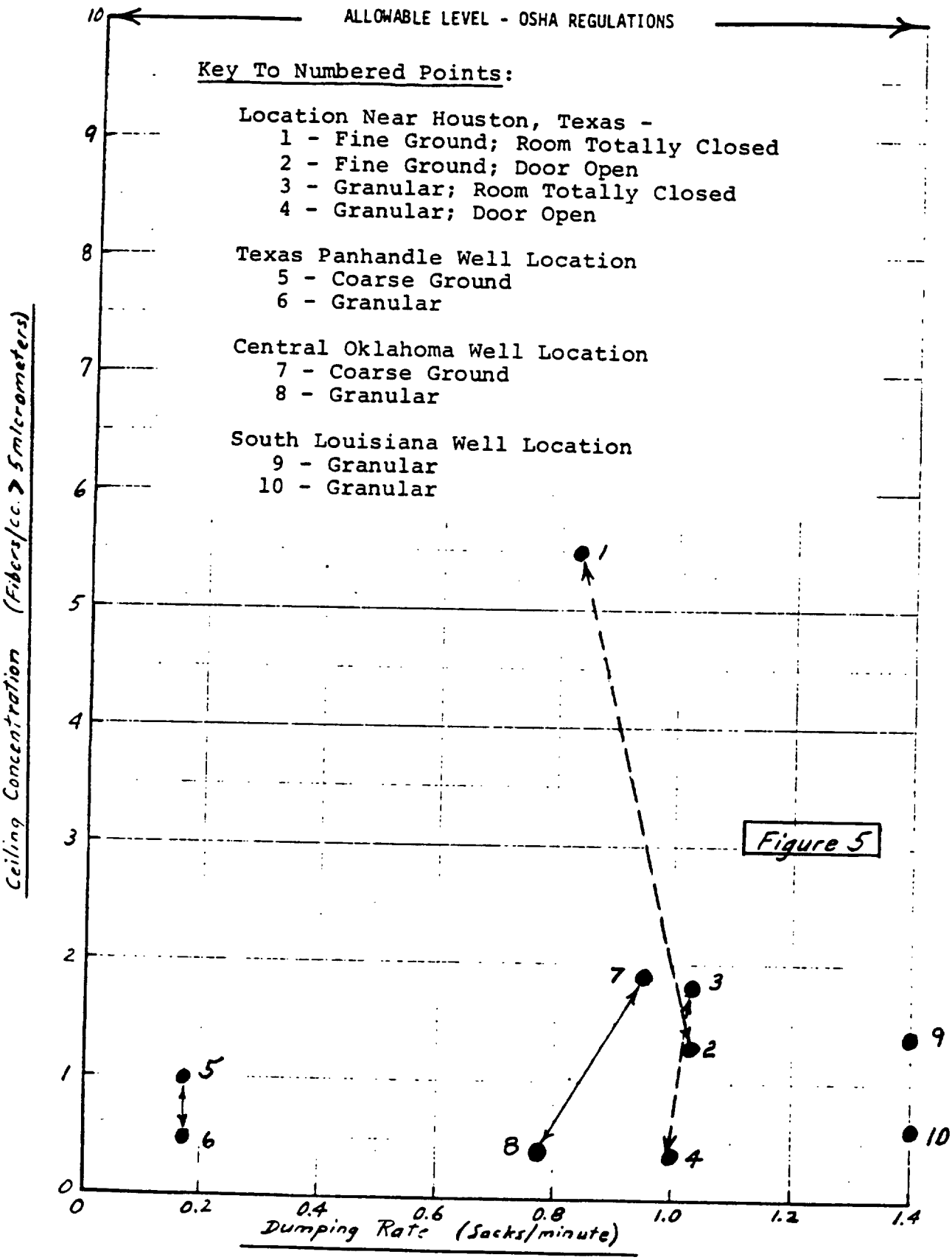



Figure 5


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# ASBESTOS DUST

## ESTIMATED TIME-WEIGHTED AVERAGE CONCENTRATIONS

Key To Numbered Points:

Location Near Houston, Texas -
1 - Fine Ground; Room Totally Closed
2 - Fine Ground; Door Open
3 - Granular; Room Totally Closed
4 - Granular; Door Open

Texas Panhandle Well Location
5 - Coarse Ground
6 - Granular

Central Oklahoma Well Location
7 - Coarse Ground
8 - Granular

South Louisiana Well Location
9 - Granular
10 - Granular

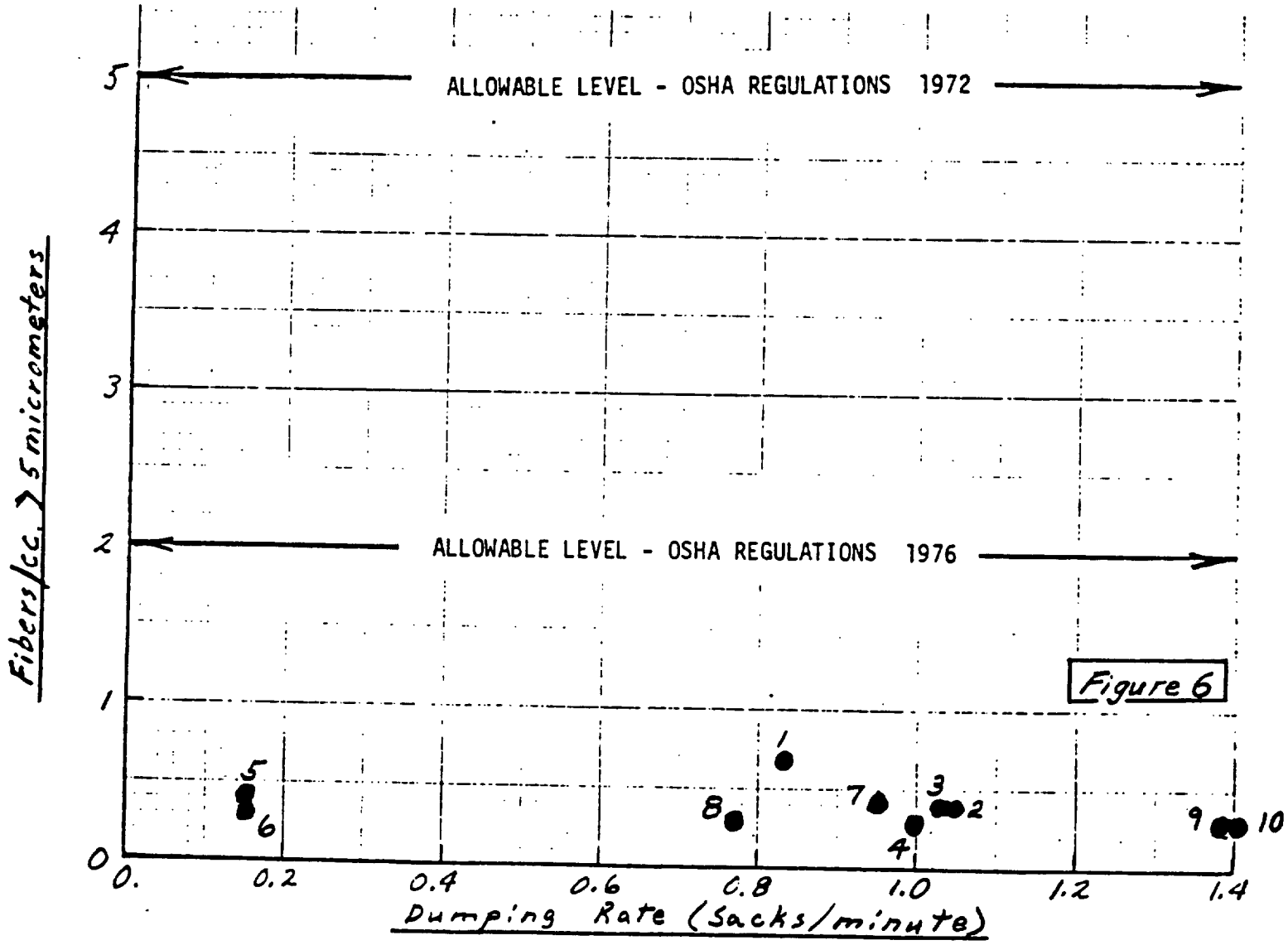



Figure 6