

AIRBORNE ASBESTOS DUST LEVELS

for

INTERMITTENT BATCH DUMPING OPERATIONS

with

"OPEN" CHRYSOTILE FIBER

April 22, 1974

H. B. Rhodes
and
E. J. Kleber
Union Carbide Corporation
Mining and Metals Division
Niagara Falls, New York

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SUMMARY AND CONCLUSIONS

This report presents the results of 18 surveys of the airborne asbestos dust level made at 13 different industrial locations. The manufacturing operations tested covered a wide variety of end products but had the common feature that relatively moderate quantities of "open" chrysotile asbestos fiber were dumped intermittently throughout the working day. All of our data for this type of operation available as of April 22, 1974 are included.

The asbestos usage rates tested ranged from 70 to 10,800 pounds per 8 hour shift. Most of the data were at rates less than 3000 pounds per shift so the conclusions drawn are limited to this range.

A great majority of the plants tested appear to be in compliance with the present airborne dust limits. They are also within or moving rapidly towards the 1976 level of two fibers/cc. At the moderate usage rates studied, hoods do not seem to be necessary to reach the 2 fiber/cc T.W.A. as long as care in handling is exercised. If the allowable T.W.A. should be reduced to 1 fiber/cc the use of respirators during the asbestos dumping and/or a good hood would be required.

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INTRODUCTION

During the past two and a half years the "Calidria" Asbestos Group has been measuring asbestos dust levels in a variety of industrial operations. This has been done on a no-charge basis as a service to the users. The basic objectives of the program have been:

1. To assist the asbestos users in complying with the initial monitoring requirement of the OSHA regulations.

2. To indicate in each case whether improvements in dust control were needed to be in compliance.

3. To obtain on overall view of the type of dust levels encountered in the various industrial situations and to understand what controls were appropriate.

This report presents a survey of the results obtained for the intermittent dumping of "opened" chrysolite asbestos fiber at usage rates ranging from 70 to 10,800 pounds per day. The data cover 18 test sequences run at 11 different industrial plants. Both Calidria and Canadian type asbestos were tested. All of our data for this type of operation available as of April 22, 1974 are included.

DESCRIPTION OF MANUFACTURING OPERATION

The plants tested made a wide variety of end products but used approximately the same processing procedure. Typically the asbestos and a number of other dry ingredients were dumped from bags into a liquid which was being agitated in a mixer. With an occasional exception, the asbestos dumping time ranged from a few minutes to the order of 20 minutes. Addition of the other ingredients also took about 5 - 20 minutes. After the ingredients were all in, the batch was mixed for around 30 - 60 minutes and transfered to containers. Overall it was typical that it took one to two hours from the start of a batch until the mixer was empty and ready for the next batch. Production rates thus varied, depending on the need for the product, from 1 to about 6 batches per 8 hour shift.

DUST COUNTING PROCEDURE

The very large number of locations where sampling was appropriate made it necessary to limit the number of samples at each location. A breathing zone sample during the asbestos dump was taken for the operator handling the asbestos. Breathing zone samples were also taken after the dump and in some cases prior to the dump. Environmental samples were obtained at one or more places adjacent to the area where the asbestos was being handled typically in places where other personnel could pass. The sampling period usually covered only one complete cycle.

All samples were obtained and the fiber counts made by the standard OSHA procedure. In the earlier part of the work all particles larger than five μ with an L/D ratio greater than three were counted as asbestos. In some of the subsequent tests, however, particles which satisfied these criteria but which were obviously not asbestos were still counted but were reported separately. Since this distinction was made on only about one third of the counts all results will be discussed in terms of totals, i.e. all particles larger than 5μ with L/D > 3.

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ESTIMATION OF TIME-WEIGHTED AVERAGE

As mentioned previously, batch preparation time in this series of industrial operations varied from one to two hours. The dust samples collected over a batch cycle would thus correspond to the ceiling exposure and to the maximum TWA that would occur if batches were made steadily and continuously over the eight hour shift. If only one batch per day were made, however, the measured exposure over the operating cycle would be averaged with a lower background level that existed for the rest of the shift to give a considerably lower TWA.

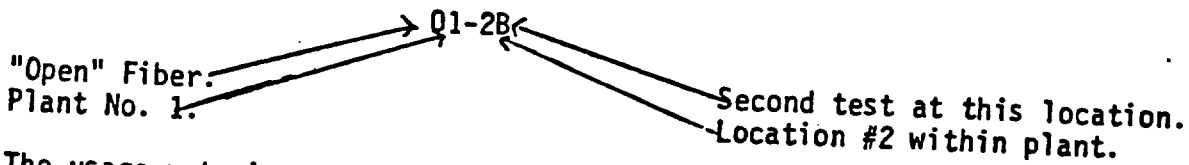
In the present tests there were cases where the operator made only one batch per day while in others as many as six were produced. In each case the "usual" number of batches per day was ascertained but it was evident that even in a given installation the number varied from day to day. In order to present a broader picture of this type of industrial operation the TWA's have been estimated for two conditions:

1. The number of batches stated by the manufacturer as typical.
2. Steady operation with as many batches as could be completed in eight hours.

PRESENTATION OF RESULTS

The test conditions and the results obtained are summarized in Table 1 attached at the end of this report. Since this is a rather extensive table it is appropriate to explain the key items listed.

The type of industrial operation, date of test, and I.D. code are shown at the left of the table. The I.D. code shows the type of fiber, the plant location, the test location within the plant, and the test number at the given location as follows:



The usage rate in pounds per eight hour day is shown next. The lower figure is for the rate given by the user as typical of daily operation. The higher figure represents maximum production in the given equipment. Values covered ranged from 70 to 21,600 lbs./8 hr. day.

A visual impression of the housekeeping and ventilation is also included. This was subjective since no ventilation tests were run.

A brief process description and the asbestos dumping procedure are also shown to complete the characterization of the operation. This is followed by the amount and time of the asbestos dump and the corresponding fiber count for the operator's breathing zone. With one exception, where the count was taken across the entire addition of dry ingredients, (code 02-2B) the results represent ceiling exposure conditions.

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The times and corresponding counts during the subsequent portion of the batch where asbestos bags were not being handled are listed in the column headed "Between Dumps". Based on the foregoing counts the estimated eight hour time weighted averages have been calculated for the two conditions described previously, i.e. as normally run and if batches were mixed repeatedly over the eight hour period.

As an illustration, the TWA calculations are shown below for the first industrial operation in Table 1, Latex Paint Manufacture Code 01-1A. Using the total fiber L/D>3 figures, the cycles were:

3 Batches/Day		1 Batch /Day	
Minutes	Fibers/cc>5μ	Minutes	Fibers/cc>5μ
27	0.3	27	0.3
26	0.8	26	0.8
1.5	11.0	1.5	11.0
4.0	1.9	4.0	1.9
89.0	0.3	89.0	0.3
12.5	0.2	332.5	0.2
160.0		480	

Calculated TWA - 3 Batches/Day

$$(27)(0.3)+(26)(0.8)+(1.5)(11.0)+(4.0)(1.9)+(89.0)(0.3)+(12.5)(0.2) = 0.5 \text{ fibers/cc}$$

Calculated TWA - 1 Batch/Day

$$(27)(0.3)+(26)(0.8)+(1.5)(11.0)+(4.0)(1.9)+(89.0)(0.3)+(332.5)(0.2) = 0.3 \text{ fibers/cc}$$

DISCUSSION OF RESULTS

Ceiling Concentrations

Figure 1 shows the ceiling concentrations from Table 1 as a function of asbestos usage rate. The OSHA ceiling limit of 10 fibers/cc > 5μ is also indicated on the Figure. The data points have been coded as "no hood", "fair or poor hood", and "good hood".

With regard to hoods, it has been observed that the larger installations tended to have some sort of hood over the dumping area. Often, however, the hoods were so poorly maintained and/or designed that it was difficult to ascertain if they were drawing at all. For this particular series of plants there were 3 locations that had good hoods, 3 that had poorly operating hoods, and 7 that had no hoods at all. This is too small a sample to permit any general conclusions but does at least indicate the situation in this kind of manufacturing operation.

The values of ceiling concentration shown in Figure 1 range from 0.3 to 51.1 fibers/cc. The highest figure was obtained in a plant where the hood was shut off and the operator was showing what a good job the hood did by raising a lot of dust. The values of 2.4 and 2.6 at 1620 lbs/day are for the same installation when the hood was on and the operator was working carefully.

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The next highest value of 37.2 fibers/cc was obtained in a plant with extremely poor housekeeping on a day when the hood ventilation was not operating. This was obviously a real industrial problem that needed correction but was not typical of conditions found. Based on results from other plants, it is also quite possible that they would be in compliance when the hood was operating.

When allowance is made for these two unusual situations, it is evident that the operations included in the survey were generally within or close to the OSHA limit. This is true for rates up to 1000 lbs. per day without hoods and up to several times that with even poorly operating hoods.

Time-Weighted Average Concentrations

Figure 2 shows the calculated time-weighted average concentrations from Table 1 as a function of asbestos usage rate. The actual usage rates during the testing ranged from 70 to 10,800 lbs. per eight hour shift. The highest rate represented 2 batches per day in equipment which was capable of 4 batches or an asbestos use of 21,600 lbs. per shift. This is hardly a small or intermediate asbestos usage but does represent intermittent dumping. The data are included for this reason and because they are available. The following discussion, however will focus on the rates up to 3000 lbs. per day which are of more direct interest and where data are more plentiful.

It is immediately evident from Figure 2 that, with the exception of the two non-typical operations described in the previous section, all of the test results fall below the present 5 fiber/cc OSHA limit. The situation with regard to the 1976 limit of 2 fibers/cc also looks quite good. The four data points, two at ~ 2.9 fibers for 560 lbs./day and two at ~ 3.8 fibers for 1120 lbs./day, are all from the same operation where asbestos and other dry ingredients were dumped into a hole in the floor. This procedure is being replaced by a good hood which has been delivered for immediate installation. This is expected to reduce the level here to below 2 fibers.

The data point at 3.6 fibers and 1600 lbs. per day is for an essentially continuous operation with a dry sweep cleanup. Changes will undoubtedly need to be made here. The only other data point clearly above 2 fibers, 2.8 fibers at 5600 lbs./day, was for a maximum throughput situation at a plant where the typical operation was below two fibers. A new hood fan has been ordered which is expeceed to put this plant below 2 fibers even at the higher operating rate.

There is currently considerable pressure to lower the TWA limit below 2. If a level such as 1 fiber/cc were selected, it is clear from Figure 2 that special provisions would be required for even the small, intermittent users. Examination of the levels between dumps given in Table 1 suggests that this might be achieved for up to about 1000-2000 lbs. per day by the use of a respirator during the dumping and cleanup of the asbestos together with careful handling of the bags.

Another alternative is obviously a good hood. A preliminary survey indicates that a self-contained hood unit that will probably satisfy the requirements would cost $3000-$5000.

CONCLUSIONS

The conclusions made herein are limited to intermittent dumping of opened asbestos fiber at usage rates up to 3000 lbs. per 8 hour shift. Based on tests from eleven industrial plants making a variety of end products it appears that a great

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majority of them are in compliance with the present airborne asbestos dust limits. They are also within or moving rapidly towards the 1976 level of two fibers/cc. At these low usage rates hoods do not seem to be necessary to reach two fibers/cc as long as care in handling is exercised.

If the allowable TWA should be reduced to one fiber/cc, the use of respirators during the asbestos dumping and/or a good hood would be required.

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KEUFFEL & ESSER CO.

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CEILING EXPOSURES

INTERMITTENT DUMPING OF CHRYSOTILE ASBESTOS

Key
X No Hood
θ Fair or Poor Hood
0 Good Hood

OSHA LIMIT

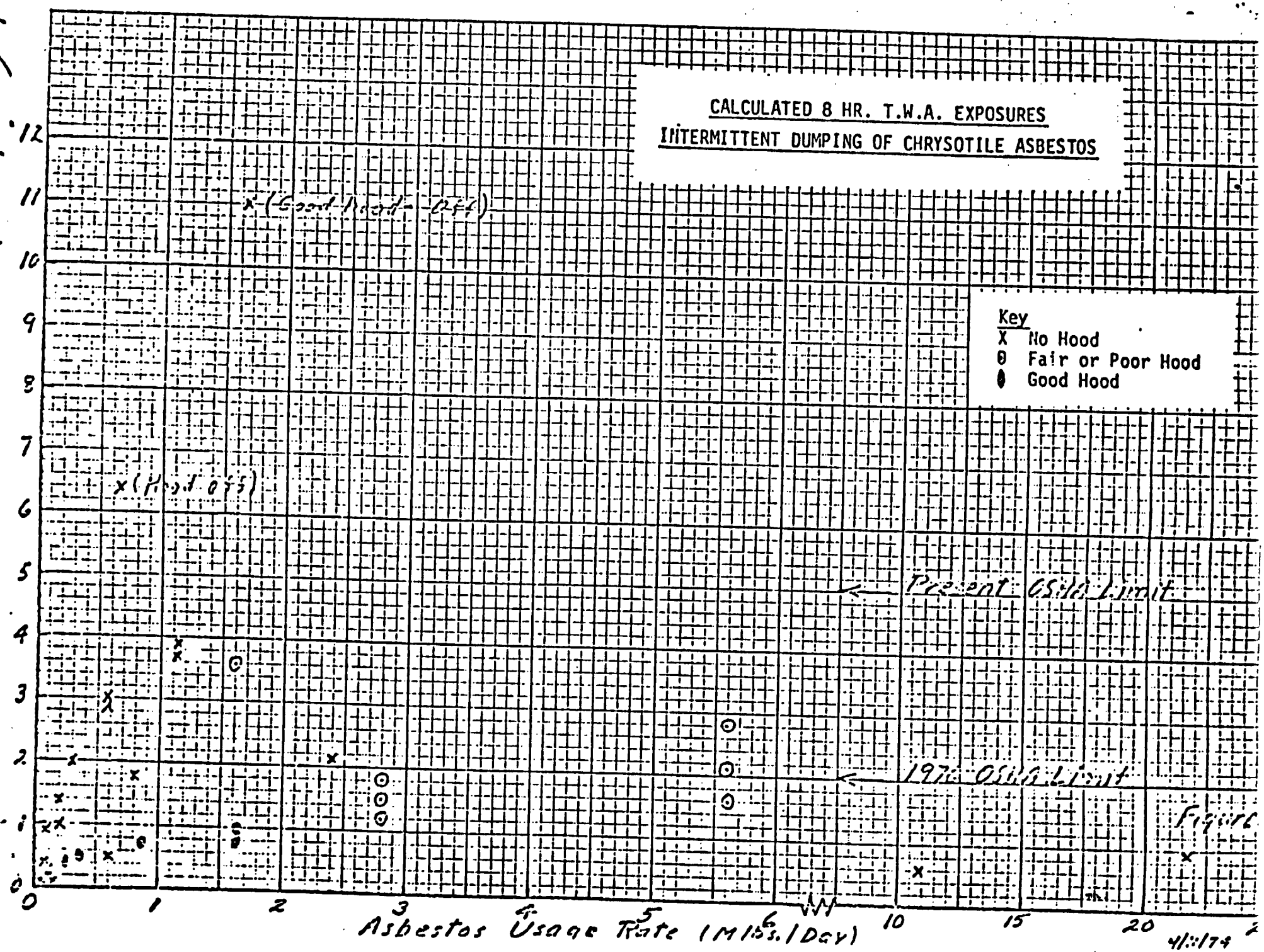
Figure 1

Asbestos Usage Rate (Mil. lbs/Day)

4/11/74

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REUPPEL & ESSER CO.



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TABLE I

AIRBORNE ASBESTOS FIBER COUNTS

DUMPING OF CALIDRIA ASBESTOS PELLETS

End Use	Asbestos Type	Pounds Dumped	Dump Time (Min.)	Sample Time (Min.)	Airborne Asbestos Fiber Concentration (Fibers/cc >5μ)	Notes
Average Concentrations[1]						
Rubber Compounding	HPP	30	~2	33	0.4	Operator A
" "	"	30	~2	14	0.9	" "
" "	"	30	~2	42	0.9	" "
" "	"	30	~2	32	0.2	Operator B
" "	"	30	~2	10	0.5	" "
" "	"	30	~2	49	0.3	" "
Rubber Compounding	HPP	37	~2	38	1.0	
" "	"	37	~2	60	1.2	
" "	"	37	~2	33	1.3	
" "	"	37	~2	23	1.1	
Paper Manufacture	HPP	25	~1	70	0.1	
" "	"	25	~1	87	0.1	
Ceiling Concentrations[2]						
Roof Coating Manufacture	HPP	200	7	7	1.5	
Paint Manufacture	SG-200X	114	3	3	7.4	
Paper Manufacture	HPP	100	16	16	0.3	
" "	"	50	9	9	0.6	
Ceiling Tile Manufacture	HPP	100	3	3	1.0	
Dumping Test	HPP	500	5	10	2.4	
Oil Well Drilling Mud	SG-200X	500	59	59	0.5	
Oil Well Drilling Mud	SG-200X	1000	26	26	0.4	
Oil Well Drilling Mud	SG-200X	1500	29	29	1.0	
" " " "	"	1500	29	30	1.0	
Oil Well Drilling Mud	SG-200X	1050	15	15	1.4	

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(1) Air sample collected during the addition of several ingredients. Asbestos handled for only short period but operator is in the immediate area. The results approximate time-weighted average concentrations during continuing operating cycles.

(2) Air samples collected only during the direct handling of asbestos and emptied bags. For these uses asbestos is handled at separated intervals. These results are ceiling concentrations.

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AIRBORNE ASBESTOS FIBER LEVELS

DUMPING OF "OPEN" CHRYSOTILE ASBESTOS FIBER

USAGE RATE 70-21,600 LBS./8 HR. DAY

Industrial Operation	Date	I.D. Code	Asbestos Type	Asbestos lbs/Day [1]	Ventilation [2]	Housekeeping [3]	Process Description	During Dumping Operations: Other Dry Ingredients	Asbestos: Number	Asbestos: Dump Time (Min.)	Asbestos: Sample Time (Min.)	Fiber Counts (fibers/cc >5μ): Chrysotile Asbestos	Fiber Counts (fibers/cc >5μ): Total I/D[1]	Between Times: Time (Min.)	Between Times: Fiber Counts (fibers/cc >5μ): Chrysotile Asbestos	Between Times: Fiber Counts (fibers/cc >5μ): Total I/D[1]	Estimated 8 Hour TWA: As Run: Batches Per Day	Estimated 8 Hour TWA: As Run: Fiber Counts (fibers/cc >5μ): Chrysotile Asbestos	Estimated 8 Hour TWA: As Run: Fiber Counts (fibers/cc >5μ): Total I/D[1]	Estimated 8 Hour TWA: If Run Steadily: Batches Per Day	Estimated 8 Hour TWA: If Run Steadily: Fiber Counts (fibers/cc >5μ): Chrysotile Asbestos	Estimated 8 Hour TWA: If Run Steadily: Fiber Counts (fibers/cc >5μ): Total I/D[1]
Latex Texture Paint	9/11/73	01-1A	56-130	120 & 360	Good	Excellent	Cowles with ½ lid. Hood on back half. 3 bags asbestos dumped in 1.5 min. Total dumping 32 minutes.	Clay, mica, CMC	120	1.5	1.5	11.0	11.0	142 4 332.5	0.1 1.2 0.2	0.3 0.8 1.9 0.2	.1	0.2	0.3	0	0.2	0.3
Caulk Mfg.	11/7/73	02-1A	7X	2500 & 5600	Poor	Good	Hood over hopper to open shaker table. Asbestos in paper covered blocks.	None	1400	19	19	---	9	101	---	0.8	2	---	1.5	4	---	2.1
" "	3/12/74	02-1B	7X	2800 & 5600	Poor	Good	Same as above except hood partially closed, table covered.	None	1400	25	25	10.0	10.2	91	(0.8)[4]	(0.8)[4]	2	1.0	1.0	4	2.7	2.8
" "	3/12/74	02-1C	7X	2800 & 5600	Poor	Good	Repeat of above.	None	1400	19	19	4.3	6.0	101	(0.8)[4]	(0.8)[4]	2	1.1	1.2	4	1.4	1.6
oof Coating Aluminized)	11/7/73	03-2A	7X3 8S-120	560 & 1120	None	Very Poor	Bags dumped into hole in floor. Dump 20 min.	Na Silicate, Filtervald, Silica. Dump 32 minutes.	280 (total)	20	20	---	12.9	100	---	2.1	2	---	3.0	4	---	3.9
" "	3/12/74	02-2B	7X3 8S-120	560 & 1120	None	Poor	Same as above except dumped in 5 minutes.	Same as above Dump in 30 min.	280 (total)	5	25	2.7	7.7	85	(2.1)[4]	(2.1)[4]	2	2.2	2.9	4	2.3	3.7
ray Tumbling xture)	3/27/74	03-1A	8S-144	200 & 200	None	Good	Increments of 5 lb. each dumped into top of stirred 125 gal. tank.	Already in. Not identified.	100	46	46	---	6.1	114	---	0.3	2	---	1.4	3	---	2.0
ray Tumbling xture	6/11/73	03-2A	8S-144	100 & 200	None	Good	50 lbs mixed with EVP in drum. Mixture added to resin.	Already in. Not identified.	50	{4 13	4 13	---	3.9 2.1	103	---	0.8	2	---	0.9	4	---	1.0
yl Plastisol	2/8/73	04-1A	8S-144	70 & 140	None	Good	1 bag dumped slowly into Hockmeyer mixer.	Hydrated alumina pigments.	35	15	30	---	0.3	110	---	0.1	2	---	0.1	4	---	0.1
xture Paint	10/15/73	05-1A	8S-130	100 & 600	None	Fair	3-4 bags slit on side and slowly added to tank of Cowles.	Not identified.	100	15	15	---	1.2	{17 48	--- ---	0.6 0.2	1	---	0.2	6	---	0.8
xture	11/12/73	06-1A	8S-144	220 & 800	Good	Excellent	6.5 bags added slowly to Cowles disperser.	Not identified.	110 110	15 46	15 46	--- ---	2.4 0.6	99	---	0.3	1	---	0.4	4	---	0.7
lent	9/20/73	07-1A	56-144	640	Off	None	4 bags to top of mixer.	Not identified.	160	9	9	---	37.2	58 53	--- ---	6.7 0.8	4	---	6.6	4	---	6.6
ulk	10/10/72	08-1A	7X	10,800 & 21,600	None	Poor	54 bags, 100 lbs. each into top of mixer.	None	5400	90	90	---	1.2	{18 52	--- ---	2.1 0.3	2	---	0.6	4	---	0.9
xtures	1/23/73	09-1A	56-210	1620	Good	Poor	9 bags dumped into top of mixer.	Clay, limestone	270	11	11	---	2.6	69	---	0.8	6	---	1.0	6	---	1.0
xtures	10/15/73	09-1B	56-48	1620	Good	Poor	9 bags dumped into top of mixer.	Clay, limestone	270	13	13	---	2.4	67	---	0.4	6	---	0.8	6	---	0.8
xtures	1/23/73	09-1C	56-210	1620	Off	Poor	9 bags dumped into top of mixer.	Clay, limestone	270	13	13	---	91.1	12 55	--- ---	14.3 0.8	6	---	11.0	6	---	11.0
ber Compound	2/8/73	010-1A	7X	1600	Fair	Poor	23 lb. removed from bin with scoop every 6 min. Dry sweep at end of day 20 min.	Not identified	1600	contin-uous	85	---	3.3	315 20	--- ---	3.3 10.6	cont-inuous	---	3.6	cont-inuous	---	3.6
lent	11/7/72	011-1A	?	800 & 2400	None	Fair	4 bags 100 lbs each dumped into mixer tank.	Clay, etc.	400	4	4	---	5.1	3 14 9 90	--- --- --- ---	6.3 2.0 2.2 1.6	2	---	1.8	6	---	2.1

xcept on production schedule. Values shown for both "As Run" and "If Run Steadily".
ated on visual observations. Rated Excellent, Good, Poor, None.
ated on visual observations. Rated Excellent, Good, Poor, None.
timated from previous tests.