INDUSTRIAL HYGIENE STUDY OF THE ENGELHARD MINERALS AND CHEMICALS CORPORATION

Attapulgus, Georgia

Report Prepared By
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Survey Date
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Introduction

The National Institute for Occupational Safety and Health (NIOSH) has underway industry-wide studies to assess the chronic health hazards from occupational exposure to respirable fibers. These studies include epidemiological studies of exposed worker populations to determine health effects which may be attributed to the work environment, medical studies to assess chronic health effects, and detailed industrial hygiene studies to characterize the various agents to which these workers have been exposed.

During the week of March 22-26, 1976, Ralph Zumwalde, Robert Wheeler (ALOSH), Robert Delmage, Terry Boyle, Dennis Roberts, and Robert Phillips conducted an industrial hygiene survey of Engelhard Minerals and Chemicals Corporation, Attapulgite Clay facility, in Attapulgus, Georgia. The purpose of the survey was to evaluate worker exposures by collecting samples of airborne attapulgite clay and characterizing the dust composition. Approximately 200 airborne samples were collected at the various milling operations. Of these 200 samples 150 were personal breathing zone samples collected for the determination of respirable and total dust concentrations. In addition, for each of the job categories a representative number of personal samples were randomly selected for free silica determinations. The remaining 50 airborne samples were general area samples collected at various mill processing operations. These samples were analyzed for free silica, trace metals, (Cd, Co, Cr, Fe, Mn, Ni, Zn) and electron microscopy characterization. In addition to the airborne samples, settled dust samples were also collected at different processing operations. These samples were analyzed in the same manner as the airborne. Some high noise levels were apparent due to mill processing operations; consequently, sound level measurements were taken at various locations within the mill.

The following paragraphs describe the sampling and analytical methods employed, sample results, conclusions and recommendations drawn for workplace improvements and worker safety. To help reduce duplication of information, a copy of the August 26, 1975 Preliminary Industrial Hygiene Survey Report of the Engelhard Minerals and Chemicals Corporation facility is attached. (Appendix I) This report documents the mining and milling processes, medical, industrial hygiene and safety practices at the facility and discusses the potential problems with the inhalation of airborne attapulgite clay.

Survey Procedures

The major portion of the survey was devoted to the collection of personal breathing zone samples for documenting employee exposures at various milling processes. Personal air samples were collected on the employees to determine time-weighted average (TWA) exposures to respirable and total dust in addition to free silica. Samples for airborne respirable and total dust were collected at a flow rate of 1.7 liters per minute (lpm) on 37 mm diameter pre-weighed MSA Type FWS (polyvinyl chloride) filters. Total dust samples were collected open faced with respirable dust samples collected with 10 mm nylon cyclone

separators. Total dust samples were also collected for trace metal analysis on 37 mm diameter pre-weighed Millipore Type AA (cellulose ester) filters. At various milling operations total dust samples were collected on Millipore Type AA filters and analysed by transmission electron microscopy using selected area electron diffraction and energy dispersive X-ray analysis for characterization of particulate morphology and chemical composition.(1)

Free silica concentrations were determined using X-ray diffraction as specified in the NIOSH Silica Criteria Document.(2) Trace metal analyses for Cd, Co, Cr, Fe, Mn, Ni, and Zn were performed by atomic absorption spectroscopy on selected air and settled dust samples. Samples collected for transmission electron microscopy evaluation were performed on a JEOL JEM 100-B side entry transmission electron microscope with an attached EDAX energy dispersive X-ray analyzer.

Sound level measurements were taken at various milling operations for identifying potential excessive noise sources. These measurements were made using a General Radio 1565A sound level meter on the dBA-weighted scale.

Sample Results

Attached in Appendix II is a brief description of each job within the mill and also the mine, a description of sampling and analytical methods utilized, results of all individual samples, and appropriate summary statistics. All job categories have been identified by a 4 digit job code. The first 2 digits represent the general work area while the last 2 digits correspond to specific jobs within those areas. Tabular summaries of time-weighted average exposures by job category for free silica and respirable and total mass dust samples (attapulgite) are given in Table 1. Presented in Table 2 is a summary of the trace metal analyses of settled dust samples collected at various locations within the mill.

Time-weighted average (TWA) free silica exposures calculated for each job category were within acceptable limits as recommended by NIOSH.(2) Some individual personal respirable samples indicated free silica exposures exceeding the NIOSH recommended TWA standard of 0.050 mg/m^3. However, there is some questions as to the interpretation of these concentrations since the analysis for free silica on each sample was reported near the lower detection limit of the analytical method (0.02 mg per filter). All trace metal analyses performed on collected airborne samples resulted in levels comparable to the lower detection limit of the analytical method; hence, air sample concentrations (ppm) for trace metals reported in Appendix II reflect less than detectable values. The trace metal (Cd, Co, Cr, Fe, Mn, Ni, Zn) analyses of the settled dust samples, as indicated in Table 2, substantiates the low values found in the air samples. Iron was the only trace metal found in any appreciable quantity (1.0-2.4%).

Reported in Table 1 are time-weighted average (TWA) airborne exposures of total and respirable dust (attapulgite clay). All TWA concentrations for respirable dust were below 5 mg/m^3, however, some TWA concentrations for total dust exceeded 10 mg/m^3. Since there is currently no specific occupational health standard for attapulgite clay the standards for inert or nuisance dusts are applicable. At present the Mine Enforcement and Safety

Administration (MESA) dust standard is 5 mg/m^3 respirable and 10 mg/m^3 total, while the Occupational Safety and Health Administration (OSHA) dust standard is 5 mg/m^3 respirable and 15 mg/m^3 total.

Selected airborne samples, which were collected at various locations within the mill, were prepared for particulate characterization by transmission electron microscopy (TEM). These samples demonstrated attapulgite clay at varying concentrations. The morphology of the particulates was similar on all samples with individual clay fibers being more numerous on samples collected near the dryers and at the Raymond Mills. Figures 1,2, and 3 are typical TEM photo micrographs of airborne attapulgite. Illustrated in Figure 4 is a microchemical X-ray spectrum of attapulgite. This spectrum was obtained from a 5 micrometer diameter attapulgite particulate. This spectrum (Mg, Al, Si, trace of Fe) substantiates the chemical composition as attapulgite clay.

All TEM samples were prepared in a clean hood utilizing 200 mesh formvar/carbon coated grids. The dissolution of the sample onto a TEM grid was prepared with a modified Ortiz Jaffe Technique.[3] Samples were evaluated at 17,000X, 20,000X and 50,000X magnification with an accelerated electron voltage of 100 kv.

Illustrated in Table 3 is a summary of airborne attapulgite fiber size data. These measurements (diameter and length) were determined at 20,000X magnification. As indicated in Table 3, fibers demonstrated lengths of 0.1 to 2.5 micrometers and diameters of 0.02 to 0.1 micrometers. There appeared to be an affinity for fiber conglomeration into jagged particulates that ranged in diameter from 0.5 to 5.0 micrometers. This characteristic is demonstrated in Figure 2.

Sound level measurements ranged from 103-105 dBA near the crusher to 73-75 dBA inside the control room at the dryers. All sound level measurements are reported in Appendix II.

Discussion

The data shows that time-weighted average total dust concentrations for milling and bagging operations were sometimes excessive. Although free silica concentrations were within acceptable limits, there is a potential for excessive airborne concentrations for millers, shippers, laborers, and screen operators. With a moderate free silica content (3% to 4%) associated with high dust levels, the potential for inducing respiratory health problems is enhanced. Because of the mobility of the employees within some of the job catogories these high concentrations were not demonstrated in their time-weighted averages.

It was noted during this survey that changes were being made to improve the exhaust ventilation at some bagging stations and that a new bagging system was being installed on one of the product lines. These improvements should help reduce dust concentrations in these immediate areas, but additional

measures to reduce spills, improve clean-up procedures, and maximize exhaust ventilation systems appears waranted.

Some areas within the mill had sound level measurements exceeding 90 dBA. Most job duties in these areas did not necessitate the need for employees to be present any appreciable amount of time. It was observed, however, that most employees did wear hearing protection when working in these areas. There were some work areas (i.e. bagging at Raymond Mill, near dryers, pugmill, etc.) that had sound level measurements between 85 and 90 dBA. It has been documented in the NIOSH Noise Criteria Document[4] that 8 to 10 hour time-weighted average exposures to sound levels between 85 and 90 dBA can induce hearing impairments. Therefore, it is recommended that employees exposed to these levels be requested to wear hearing protection. It is also suggested that employees be made aware of areas which have excessive noise levels. Because of the range of sound levels found throughout the mill it would be advisable to initiate a hearing conservation program with periodic hearing examinations.

Because of the radiant heat emitted from the dryers there is a potential for heat stress for those employees working in this area. Although employees are furnished with an enclosed work station near the dryers there is a considerable amount of time spent working around the dryers. Employees working in this area should be made aware of the potential heat stress problems along with information on how to prevent and recognize abnormal health symptoms, as well as how to treat employees suffering from heat stress. It would be feasible to reduce the radiant heat from the dryers by insulating the dryers' exterior. The initial cost for adding insulation could be recovered from the reduced energy needed to maintain a given temperature within the dryers.

As was discussed in our preliminary survey report of November 13, 1975 (Appendix I) there is some concern regarding the respiratory health hazards associated with the inhalation of fibrous minerals. Documented in that report was the research performed by some investigators who demonstrated tumorigenic effects of fibrous dusts in experimental animals.[5,6] In another study which was performed by Davis,[7] a series of mineral dusts were injected into the pleural cavities of mice in order to test their relative fibergenicity. It was demonstrated that the degree of cellular granulomata adhesions which were found between the lungs, diaphragm and chest wall were dependent upon particulate size and morphology. The highest degree of fibrosis within the granulomata was demonstrated using long fibrous minerals with a decreasing amount of fibrosis with shorter fibers and particles. Pott[8], in a recent assessment of his research, has concluded that fibers with diameters less then 1 micrometer and lengths greater than 5 micrometers are more likely to stimulate tumor formation. In an ongoing research study by Stanton[9] it has been demonstrated that fibrous minerals can produce pleural sarcomas when implanted in the pleural of female Osborne-Mendel rats. Like the Davis and Pott studies, the incidence of pleural sarcomas is dependent upon fiber size rather than physicochemical properties. Preliminary animal results by Stanton using attapulgite clay suggest a lower probability of pleural sarcomas than that demonstrated with asbestos or micro-fine fibrous glass. However, current animal research dictates that all respirable fibers be viewed with caution and that airborne exposures be kept at a minimum.

References

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7. Davis, J.M.G. The Fibrogenic Effects of Mineral Dusts Injected into the Pleural Cavity of Mice. Br. J. Exp. Path. (1972) 53, 190.

8. Pott, F., Dolgner, R., Friedricks, K.H., and Hoth, F., "Oncological Effect of Fibrous Dusts". Annales d'anotomie Pathologique. Vol. 21, No. 2, pp. 237-246, Paris, 1976.

9. Telephone conversation with Dr. Mearl Stanton, National Cancer Institute, on December 10, 1976. Conversation pertained to ongoing animal research with fibrous minerals.

Table 1

Engelhard Minerals and Chemicals Corporation
Summary of Time-Weighted Average Exposures
by Job Title

Job Title	Respirable Mass Free SiO_2 mg/m^3	Total Mass Free SiO_2 mg/m^3	Dust Concentrations (attapulgite)	
			Respirable Mass mg/m^3	Total Mass mg/m^3
0200 Stationary Samples (Milling Operations)	—	—	9.90*	15.94
0201 Crane Operator	<0.030*	<0.030*	0.16	0.52
0202 Hammer Mill Oper.	<0.031	<0.033*	0.41	0.46*
0203 Pugmill Oper.	<0.028	<0.122	1.40	6.45
0204 Dryer Oper.	<0.028*	--	0.57	--
0205 Dryer Oiler	<0.030*	0.030*	0.74	6.57*
0206 Crusher Oiler	<0.029*	0.029*	0.52	1.90*
0207 Miller No. 1	<0.029	0.084*	1.15	21.47*
0208 Miller No. 2	<0.028*	—	2.10	15.54*
0210 Raymond Miller	<0.028*	—	1.42*	9.12*
0213 Screen Oper.	<0.027	0.110*	3.24	22.34
0300 Stationary Samples (Bagging Operations)	—	—	2.04	12.62
0301 Lead Person	<0.074	0.248*	1.01	9.78*
0302 Shipper	<0.031	0.145	1.72	16.30
0303 Laborer	<0.029	0.183	1.90	22.51
0305 Bag Press Oper.	<0.029*	—	0.72*	

Note: (*) Represents one sample
(—) No sample collected

Lower limit of detection for SiO_2 was 0.02 mg per filter

NIOSH recommended time-weighted average standard for free silica in respirable dust is 0.050 mg/m^3.

Table 2

Engelhard Minerals and Chemicals Corporation
Summary of the Trace Metal Analyses
Settled Dust Samples

Sample Location	Trace Metals (ppm)						
	Cadmium	Cobalt	Chromium	Iron	Maganese	Nickel	Zinc
#1, Near Bagging Operation at Raymond Mill	1.3	3.0	105.0	18000.0 (1.8%)	443.0	52.0	72.0
#2, Same Area as #1	0.9	6.0	103.0	15100.0	240.0	24.0	74.0
#3, Settled Dust Behind Dryers	1.7	38.0	66.0	21500.0	481.0	1190.0	80.0
#4, Settled Dust underneath Hammer Mill	4.0	9.0	64.0	10000.0	689.0	17.0	60.0
#5, Settled Dust At Pugmill	2.4	6.0	76.0	16100.0	460.0	165.0	84.0
#6, Settled Dust at Bagging Operation Number 3 Mill	1.7	16.0	113.0	21000.0	322.0	20.0	107.0
#7, Same Area as #6	3.2	25.0	113.0	23600.0	438.0	25.0	94.0

Table 3

Engelhard Minerals and Chemicals Corporation
Summary of Airborne Attapulgite Fiber
Size Data as Determined by Electron
Microscopy

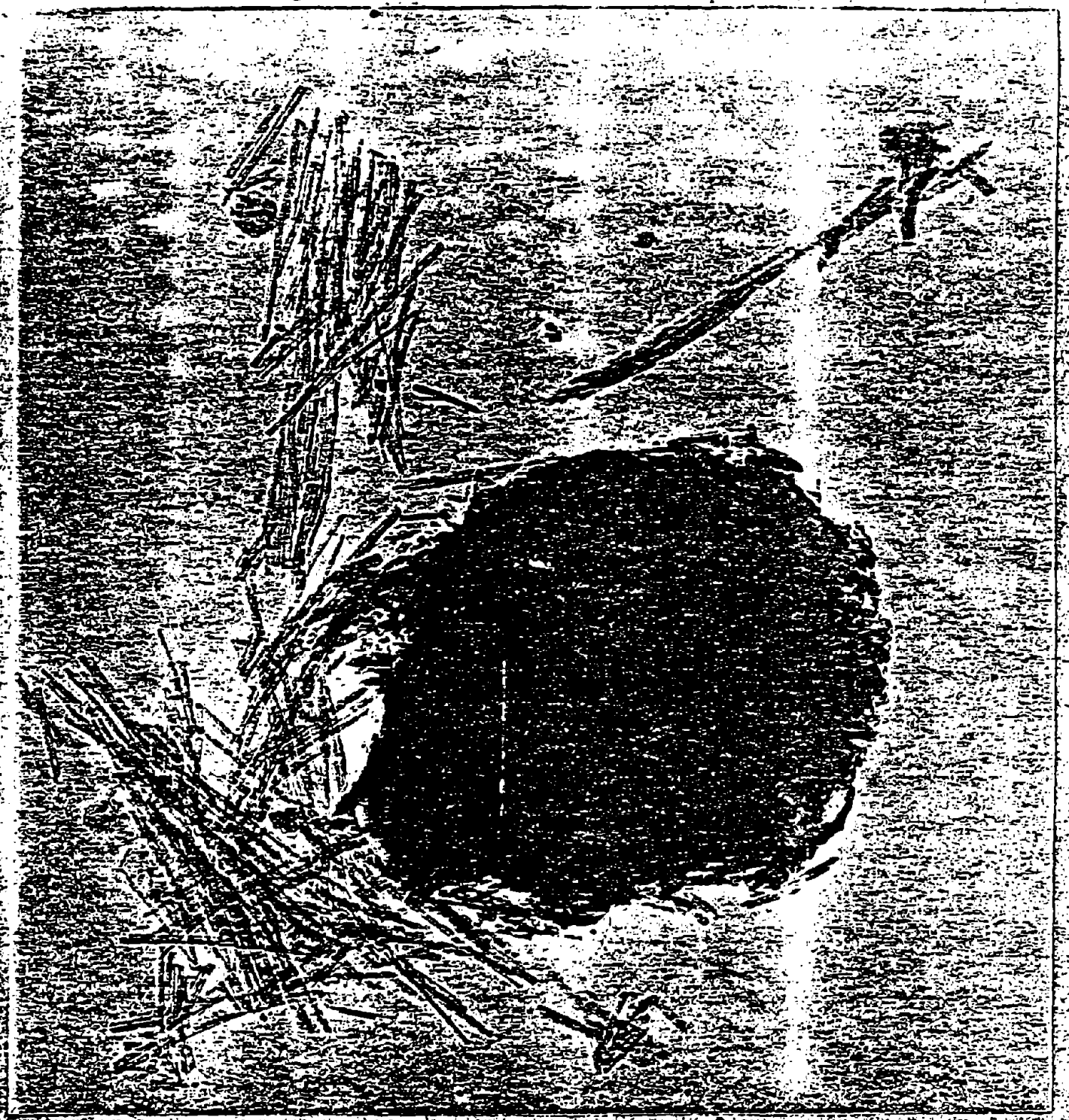
Fiber Measured	Count Median Micrometer (μm)	Range Micrometer (μm)	Geometric Standard Deviation
Diameter	0.07	0.02-0.1	3.14
Length	0.4	0.1 -2.5	3.0

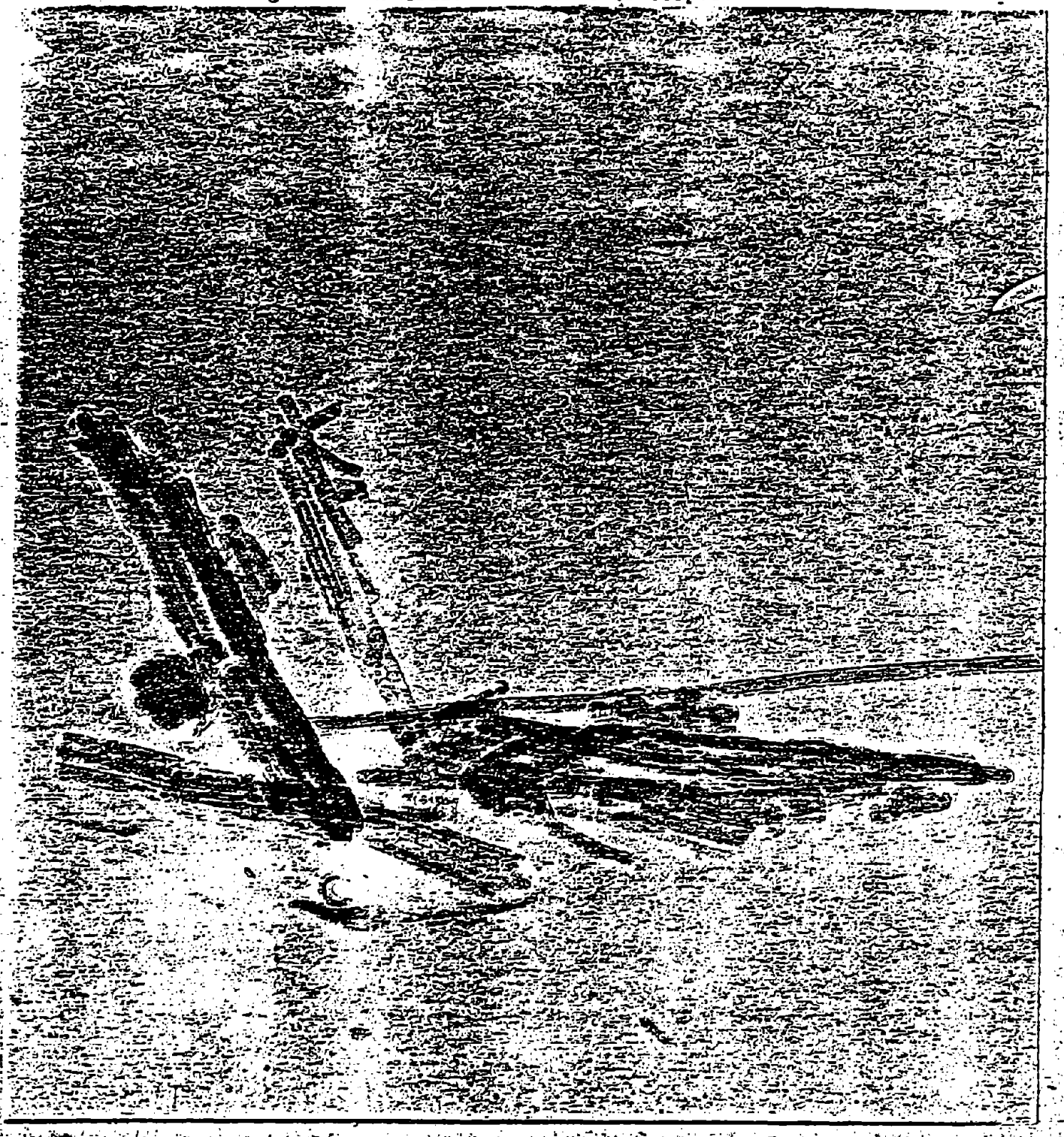
Figure 1
Engelhard Minerals and Chemicals Corporation

ATTAPULGITE
17,000X MAGNIFICATION

1 MICRON (UM)

Figure 2
Engelhard Minerals and Chemicals Corporation

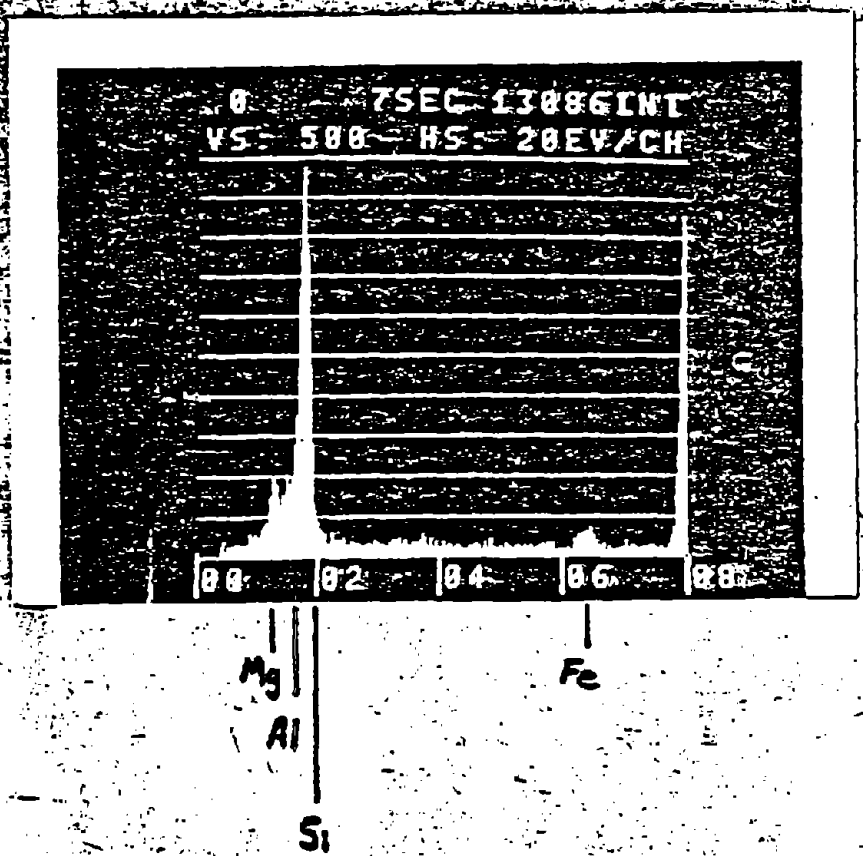




ATTAPULGITE
50,000X MAGNIFICATION

0.5 MICRON (UM)

Figure 4
Engelhard Minerals and Chemicals Corporation



ATTAPULGITE
X-RAY SPECTRA

APPENDIX I

PRELIMINARY INDUSTRIAL HYGIENE SURVEY

Engelhard Minerals and
Chemical Corporation
Attapulgus, Georgia

SURVEY DATE
August 26, 1975

SURVEY CONDUCTED BY
Dave Bayliss
David Brown
John Dement
Ralph Zumwalde

REPORT PREPARED BY
Ralph Zumwalde

DATE OF REPORT
November 13, 1975

Environmental Investigations Branch
Division of Field Studies and Clinical Investigations
National Institute for Occupational Safety and Health
Cincinnati, Ohio

PLACE VISITED:	Engelhard Minerals and Chemical Corporation Attapulgus, Georgia
DATE OF VISIT:	August 26, 1975
PERSONS MAKING VISIT:	NIOSH DFSCI David Brown Dave Bayliss John Dement Ralph Zumwalde
PERSONS CONTACTED:	Mr. Thomas Malone - Plant Manager Mr. R.D. Oulton - Research Department Mr. Gordon Searcy - Safety Manager
PURPOSE OF VISIT:	To observe the mining and milling of attapulgite clay and to take preliminary air samples for characterization of airborne attapulgite dust. An evaluation of personnel records was also performed for possible inclusion in future NIOSH mortality studies.

INTRODUCTION

As part of the National Institute for Occupational Safety and Health industry wide studies of industries producing and utilizing naturally occurring mineral fibers, a preliminary industrial hygiene survey was conducted of the attapulgite clay operations of the Engelhard Minerals and Chemical Corp., Attapulgus, Georgia. This visit was made by David Brown, Dave Bayliss, John Dement and Ralph Zumwalde of the Division of Field Studies and Clinical Investigations on August 26, 1975. During this visit observations were made of manufacturing processes and control measures in addition to preliminary air sampling for characterization of attapulgite clay. Also, Mr. Bayliss and Mr. Brown evaluated personnel records for possible inclusion in future mortality studies.

The following paragraphs include a discussion of attapulgite clay, processes in the facility, industrial hygiene practices, air sampling procedures and results.

Discussion of Attapulgite Clay

Attapulgus clay, commonly called attapulgite after the principal mineral it contains, is a crystalline hydrated magnesium-aluminum silicate with a unique chain structure that gives it unusual colloidal and sorptive properties. It is the principal member of a group of sorptive clays known collectively as fuller's earth.

Attapulgite has a wide variety of industrial applications. Colloidal grades are well known thickening, gelling, stabilizing, and thixotropic agents in products as paint and drilling muds. Sorptive grades find use as decolorizing and clarifying agents, filter aids, floor absorbents, animals litter, pesticide carriers, components of no-carbon copy papers, and catalysts and refining aids.

In comparison with other clays used in chemical process industries, attapulgite is characterized by high surface area sorptivity, and decolorizing properties. Slips or slurries made with attapulgite are viscous and thixotropic. However, unlike bentonite, attapulgite is not flocculated by electrolytes.

Attapulgite is found in economic quantities only in the Georgia - Florida area of the United States, in India and in the Soviet Union. In the Soviet Union the mineral has been given the name palygorskite. United States production is estimated at 300,000 to 400,000 tons a year.

As mined, attapulgus clay contains 70% to 80% attapulgite; 10% to 15% montmorillonite, sepiolite, and other clays; 4% to 8% quartz; and 1%

to 5% calcite or dolomite. Much of the non-clay fractions are removed during processing so that commercial products can contain up to 85% to 90% attapulgite. Because of its high sorptivity in its natural form, it can take up water rapidly to 200% of its own weight. This value is surpassed only by that of montmorillonite and sepiolite. (Most of this water is loosely held by Van der Waals forces.[1])

DESCRIPTION OF THE FACILITIES

Production at this plant started around 1920 using two mills, designated #1 and #2, which produced only granular (large particle size) attapulgite clay. The plant was named the Attapulgus Clay Company, which was jointly owned by Standard Oil of New Jersey and Atlantic Refining Company. In 1933 a third mill (#3) was built to increase the production of granular clay. The clay was primarily produced for the decolorization of petroleum. It was not until the early 1940's that the company started manufacturing the finer particle size clay products. In the mid 1950's the company was bought by the Mineral and Chemical Corporation of America and subsequently taken over by the Mineral and Fill Corporation.

In 1967 the #2 mill was revamped for the installation of the Raymond Mill. With this new air separation mill a finer clay was produced. According to Mr. Malone, plant manager, the Engelhard Mineral Company purchased the company in 1968.

The company owns a substantial amount of acreage in both Georgia and Florida. At this time there are 3 active strip mines, one in Florida and the other two in Georgia.

At the present time, the company employs approximately 395 people, 79 of which are salaried, 70 are employed in a catalyst plant, 44 work in the mines with the remaining being employed in the milling and shipment of attapulgite clay. The employment turnover varies but tends to be higher for non-whites; between 1968 and 1974 approximately 200 non-whites terminated employment. The company consists of 60% white and 40% non-white employees with both past and present workers tending to live within a 30 mile radius. The company operates on 3 shifts/day working 5 and sometimes 7 days a week. The employees were originally organized by the United Stone and Allied Products Workers in the late 1940's. This union eventually merged in the early 1960's with the United States Steel Workers Union (AFL-CIO).

DESCRIPTION OF THE PROCESSES

The attapulgite clay deposits are found within approximately a 15 mile radius of the milling facility. The clay beds vary in thickness from perhaps 4 feet to as much as 12 feet or more and may occur in two distinct layers separated by a stratum of sand calcite (limerock) varying from a few inches to a foot or more in thickness.

In all three of Engelhards active mines, the conventional open pit strip mining methods are used. In the mining of the clay the overburden is first removed by dragline or by Euclid earthmovers until a substantial area of the clay has been exposed. Since the quality characteristics of attapulgite clay vary both laterally and vertically through its stratum, this variability is taken advantage of in order to increase the range of product types and applications. Because of this variability core-hole samples are taken on close centers to determine the specific applications most suitable for the finished product. Based on these tests, the clay is selectively mined, stockpiled, and processed through the plant. The clay is usually mined with power shovels and loaded into covered trucks for transportation to storage clay sheds at the mill.

The different stratums of clay are stored separately in the shed for easy removal to the crusher. Depending on the product line, a stratum of clay is removed from the shed by overhead cranes and deposited in the crushers. This crude clay contains about 50% volatile matter, principaly free and combined water. Once the clay has been conveyed to the crusher (hammermills and/or rolls) it is reduced to granules or flakes of approximately 1/2 inch size or smaller.

If the clay is to be extruded (extrusions improves absorptivity) it proceeds from the roll crusher to a pugmill where sufficient water is added to yield an extrudable mass. The pugmill discharge is fed to a screw-type extruder to produce an extrudate in the form of rods averaging roughly 1/2 inch in diameter. This extrudate is next dried in one of the several counter-current rotary dryers. These dryers operate over a range of 300 to 1200°F, depending on the grade being produced.

For the unextruded grades of clay the discharge from the crusher bypasses the pugging and extruding steps and goes directly to the same dryer as the extruded clay.

Once the clay is dried the remaining steps in the process consist of size reduction and classification. The combination of grinding roll mills and sifters yields a variety of granular product grades coarser than 100 mesh, while the undersized material is classified into a

variety of fine grades. The most common granular grades classified by the sifters are in the 15/30, 30/60, and 60/90 mesh size ranges. In certain cases, the granular products may be recycled to the dryer for further calcination. The fine grades which are in the 100 to 325 mesh range are classified and sent to the finish product bins. If still finer grades are needed, the 100/325 mesh clay is sent through the Raymond Mill where it is air separated into a product which is 95% finer than 10 microns.

Because of the diverse recycling system between all stages of milling, sifting, grinding, and drying; all waste material and dust from the bag house collectors can be reused by reconstitution through the extruding process.

After all size reduction and classification the finished product is conveyed to a storage area where it is bagged or shipped in bulk by truck or rail.[2]

A schematic flow sheet for attapulgite clay milling is given in Figure 1.

MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAM

The company has recently started giving pre-employment examinations consisting of a chest x-ray and physical examination, however, there are no periodic physical exams. All medical examinations are handled through local physicians (Drs. Charles Bellville and Abby Woods) retained as consultants. It was indicated that the company plans an extensive medical program for 1976 including hearing and pulmonary function tests with periodic x-rays.

According to corporation personnel, no work induced respiratory problems have been noted. The only medical attention needed at the plant has been a result of accidental injuries.

The company does not have an industrial hygienist on the staff; however, the company does have the services of Mr. T.D. Oulton, who handles all environmental problems of Engelhard Minerals and Chemical Corp. Some air sampling has been performed by the company to determine free silica exposures. Total dust samples indicate free silica exposures around 3 mg/m^3. According to management, additional ventilation and bag house collectors have been installed within the last few years. Some noise measurements have been taken indicating some areas with A-weighted sound levels approaching 90 dB.

The safety program at the facility is coordinated through Mr. Gordon Searcy, Safety Manager. There is an established monthly safety meeting in which an alternating representative from each department attends along with three Union representatives. The employees are required to wear hard hats and are encouraged to wear safety shoes and protective eye glasses.

INSPECTION OF THE PLANT

Potential Safety and Health Hazards

The following are potential health and safety hazards noted during this survey:

1) Eye and respiratory exposures to airborne attapulgite clay.
2) High noise exposure in some areas.
3) Possible heat stress in dryer oven area.
4) Possible free silica exposures.

Housekeeping

In general, the environment through out the milling operations was fairly dusty. Areas around the Raymond mill and hammer mill appeared to be dustier than others. Most of the airborne clay appeared to be contributed by leaks in the clay conveyor system. Nearly all floor cleaning in the mills was performed with hand brooms.

SURVEY PROCEDURES

The major portion of the survey was devoted to observation of manufacturing procedures, exposure control practices and plant personnel record accessment. Bulk samples of the finished products along with a limited number of air samples were collected for the purpose of characterizing attapulgite clay. The air samples were collected in the areas of the Raymond Mill and the bottom floor of the #3 mill. The collection mediums used were 37 mm Millipore type AA celloluse ester membrane filters (0.8 µm pore size), simultaneously with a 37 mm nucleopore membrane filter (0.8 µm pore size) both of which were calibrated at a flow rate of 2.0 LPM.

Laboratory evaluation of the collected air samples was performed using a JEOL 100-B side entry transmission electron microscope along with an attached EDAX energy dispersive x-ray analyzer. The collected samples were on a 200 mesh, formvar/carbon coated grid for observation by transmission electron microscopy. Utilizing this method, the collected attapulgite clay was analyzed at 10,000, and 20,000x magnification to determine its morphology. To document and verify the observed fibrous clay at these magnifications, simultaneous energy dispersive x-ray analysis was performed to determine the elemental make-up.

RESULTS AND DISCUSSION

Industrial Hygiene

Due to problems in preparing the air samples for analysis, difficulty was experienced in ascertaining the relative "free" clay fiber exposure. Since individual clay fibers are physically attracted to each other, it is difficult to determine if the clusters of clay fibers were originally airborne as conglomerates or if, through handling, preparation and/or static electricity, the individual fibers readhered with one another. Relative free (individual) fibers as well as many small clusters of 3-10 fibers were observed in the samples. Average fiber diameters for the free fibers appeared to be less than 0.1 µm with an average length of approximately 1.0 µm. An elemental analysis was performed by energy dispersive x-ray to substantiate the presence of attapulgite clay. Figure 2 shows a micrograph of typical fibers seen in these samples in addition to the attapulgite x-ray spectrum. These fibers were compared with standards for attapulgite obtained from the Smithsonian Institute.

Our specific concern with attapulgite clay is its potential to form fibrous crystal structures of approximately <0.1 µm dia. and 1.0 µm length which if airborne, may be respirable and harmful to health. Although the respirability of airborne fibers is not clearly understood it is thought to be mainly dependent on the fiber diameter. Timbrell's [3] work suggests that the two major mechanisms of fiber deposition in the upper airways (settlement induced by gravity and inertial deposition) are chiefly dependent upon particle free falling speed (i.e. equivalent Stokes' diameter). Fibers with densities less than 3.5 g/cm^3 and less than 3.5 µm in diameter may escape deposition by these two mechanisms and penetrate deeply into the lungs. Free airborne attapulgite fibers satisfy both the density and fiber diameter requirements as stated above and may be considered potentially respirable.

Animal studies performed by Pott[4] have shown that the fibrous structure of chrysotile, with lengths of 2-3 μm, are carcinogenic. Pott concluded that fiber shape and size was a more important factor in carcinogenesis than trace metal contamination. A recent study conducted by Pott, et.al.,[5] demonstrated the tumorigenic effect of other fibrous dusts in experimental animals. One of the fibrous dusts, palygorskite, was demonstrated to be carcinogenic when injected into the pleural cavity of rats. In this study the incidence of induced tumors with polygorskite was equivalent to that produced by the same dose of chrysotile.

A mineralogical study performed by Huggins[6] has shown that attapulgite and palygorskite are structurally and chemically the same, differing only in fiber length. It may be concluded that since (1) animal studies with palygorskite have demonstrated carcinogenic activity and (2) palygorskite and attapulgite are structurally and chemically the same differing only in fiber length, attapulgite may be suspected as a potential carcinogene. These conclusions indicate the need for epidemiological evaluation of the relation of worker exposure to attapulgite and potential adverse health effects.

Personnel Assessment

During our survey an inspection of the past and present employment records were made for possible inclusion into our mortality study. It was determined that the personnel records prior to 1940 appeared to be sketchy and often contained only the name of the employee. Those records after 1940 contained the employees name, job classification, address, social security number, birthdate, and etc. Both active and terminated employment records were available from 1940. It was estimated that 1200 records of terminated employees and 400 records of active employees were on file.

CONCLUSION AND RECOMMENDATIONS

From the observations made during this survey and the results of the measurements made, the following conclusions are drawn and recommendations for improvement made:

1. There appears to be significant exposure to respirable attapulgite clay in various processing areas. While no human data presently exists to indicate respiratory problems due to such exposure, it must be emphasized that human experience with clay minerals is limited. It would appear prudent that exposures to respirable clay fibers be kept at an absolute minimum by the use of good work practices and engineering controls. The use of brooms and hand brushes for cleaning should be eliminated in favor of much cleaner vacuum methods. In addition, those persons working in areas of excessively high dust exposure should be requested to wear respiratory protection unless they have an existing health problem which prohibits this, in which case, they probably

should be removed from this work environment.

2. It was noted that in some milling areas, fans were being used as air movers, for personnel cleaning. Consequently, the dustiness of the operation was intensified in the immediate environment.

3. Good medical practice dictates close medical surveillance of those involved in these operations. It is recommended that the proposed medical surveillance program for 1976 include the procedures indicated in the current asbestos standard (Federal Register, Volume 37, October 18, 1972, Section 1910.93a). This program includes both pre-employment and annual examinations, consisting of chest roentgenogram (14" x 17" posterior - anterior), a history to elicit symptomatology of respiratory disease, and pulmonary function tests (FVC and FEV_1).

4. Based on the environmental exposures and the quality of existing records, the Englehard facility in Attapulgus, Georgia is suitable for indepth environmental study and mortality study.

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Figure 1

Engelhard Minerals and Chemical Corporation

PROCESSING FLOW SHEET FOR
ATTAPULGITE CLAY

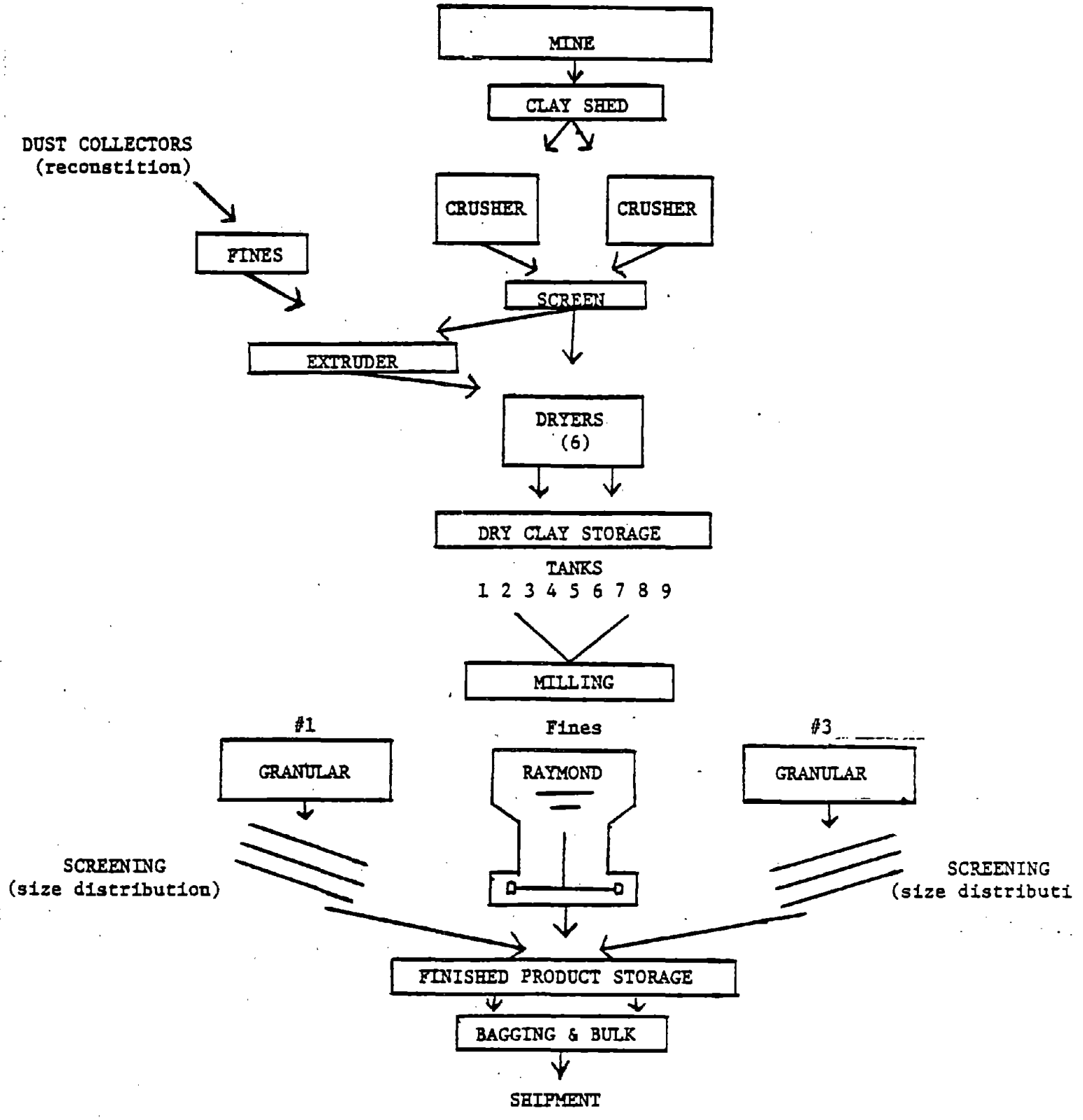
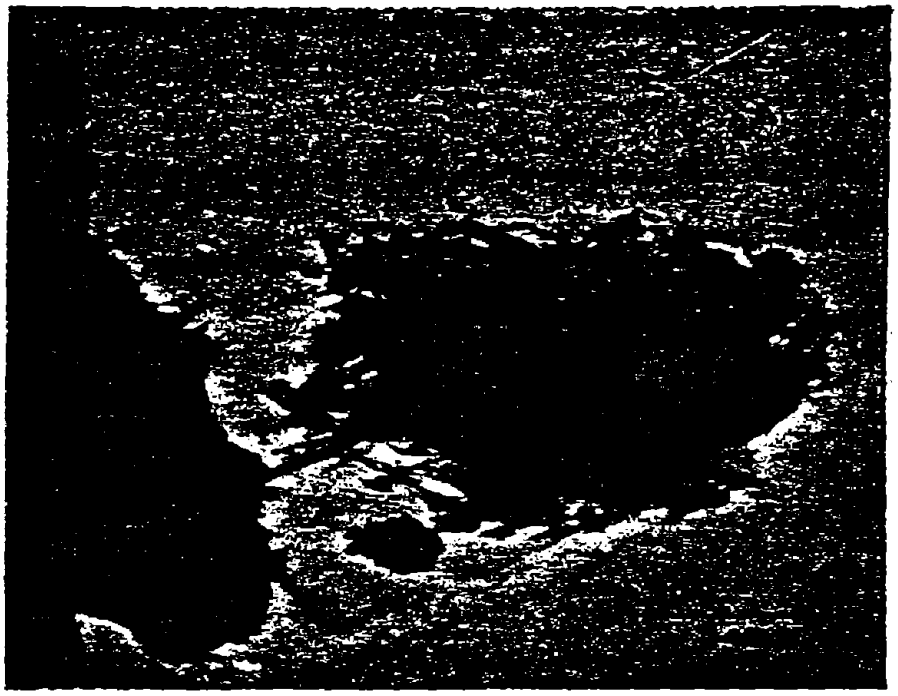
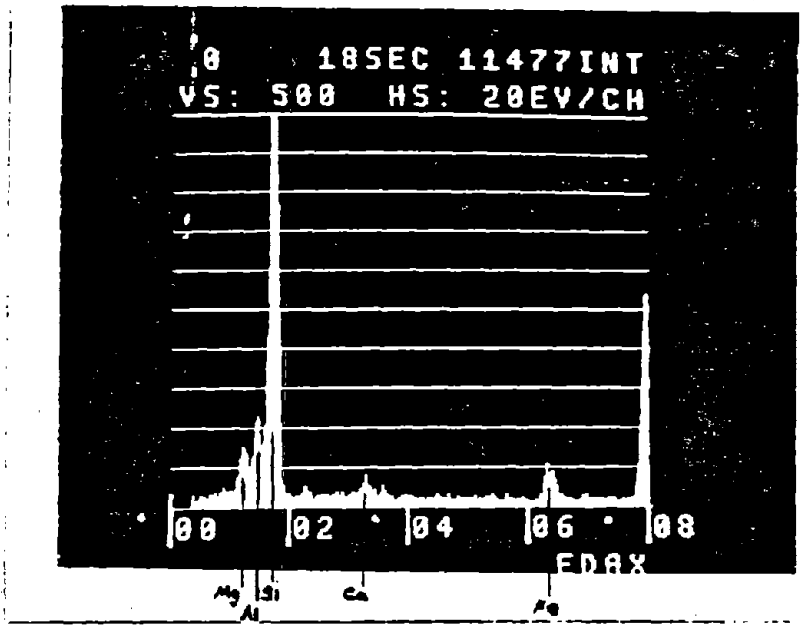


Figure 2

Engelhard Minerals and Chemical Corporation



Cluster of Attapulgite Fibers
20,000X Magnification



Attapulgite x-ray Spectrum

APPENDIX II

INDUSTRIAL HYGIENE SURVEY RESULTS

Engelhard Minerals and Chemicals Corporation
Attapulgus, Georgia

Survey Date
March 22-26, 1976

ATTAPULGUS GEORGIA

DATE OF STUDY: 03/22/76 - 03/26/76

AGENT STUDIED: ATTAPULGITE

SIC CODE: 0160 COUNTY: DECATUR

PRODUCTION AT THIS FACILITY STARTED AROUND 1920. PRESENT OWNERSHIP WAS ACQUIRED IN 1968. COMPANY EMPLOYS APPROX. 395 PEOPLE, 79 OF WHICH ARE SALARIED. 78 ARE EMPLOYED IN THE CATALYST PLANT, 44 WORK AT THE MINES WITH THE REMAINING BEING EMPLOYED IN THE MILLING AND SHIPMENT OF ATTAPULGITE CLAY.

CODE	JOB TITLE	DUTIES
0101	HOSTLER	OILS AND GREASES MOVING PARTS OF MECHANICAL EQUIPMENT, FILLS WELLS AND SUMPS OF LUBRICATING SYSTEMS WITH OIL, MAY RUN DEWATERING PUMP, CLEAN MACHINES, CHANGE AIR CLEANER ELEMENTS AND OIL BATH FILTERS
0102	TRACTOR - SCRAPER OPERATOR	OPERATES SELF-PROPELLED TRACTOR-SCRAPER TO MOVE, HAUL, GRADE, SPREAD AND DUMP EARTH
0103	DRAGLINE OPERATOR	OPERATES POWER DRIVEN CR ARE EQUIPPED WITH DRAGLINE BUCKET TO EXCAVATE, MOVE OR LOAD INTO TRUCKS, SAND, GRAVEL, CLAY AND OTHER MATERIALS,
0104	DRAGLINE OILER	OILS AND GREASES MOVING PARTS OF FRICTION SURFACES OF DRAGLINES, SUCH AS SHAFTS AND MOTOR BEARINGS, SPROCKETS, DRIVE CHAINS, GEAR PULLEYS, SHEAVES,
0105	DUMP TRUCK DRIVER	OPERATES DUMP TRUCK TO T RANSPORT MATERIALS AND EQUIPMENT, UNLOADS THICK BY USE OF HOISTING JACK, LUBRICATES, CLEANS AND PERFORMS MINOR REPAIRS TO TRUCK,
0106	FUEL TRUCK DRIVER	OPERATES TRUCK TO TRANSP ORT WATER, GAS, DIESEL FUEL AND REPAIR ITEMS TO DESIGNATED PLACES AND EQUIPMENT,
0107	SHED TRACTOR OPERATOR	DUMPS CLAY TRUCKS AT DES IGNATED AREAS, OPERATES TRACTOR EQUIPPED WITH BLADE OR BUCKET TO LEVEL OR STACK CLAY INTHE SHED OR STOCKPILES, ALSO SERVICES TRACTOR,
0108	CORE DRILL OPERATOR	OPERATES PORTABLE ROTARY RIG TO DRILL SHALLOW BORE HOLES TO OBTAIN SAMPLES OF EARTH FORMATIONS, ALSO OPERATES A PORTABLE AUGER DRILLING RIG TO BORE BLAST HOLES, SERVICES AND CLEANS EQUIPMENT,
0109	CORE DRILL HELPER	ASSISTS CORE DRILL OPERA TOR, CLEANS WORK AREA OF BRUSH, ADDS POSITIONS AND REPLACES DRILL STEM, CASING AND CABLES, DIGS WATER HOLE , SERVICES AND CLEANS EQUIPMENT, OPERATES WATER TRUCK
0110	FIELD ENGINEER HELPER	DRILLS WITH HAND AUGERS, LOADS BLAST HOLES, CUTS SURVEY LINES, CLEARS CORE DRILL STATIONS, BURNS BRUSH, PAICHES ROADS, ASSISTS IN SETTING CULVERTS AND FUEL TANKS, ASSISTS PLANTING PINE SEEDLINGS AND GRASS, AND IN ALL TYPES OF MINE CONST

CODE	JOB TITLE	DUTIES
		RUCTION.
0111	LABORER	DRILLS WITH HAND AUGERS, LOADS BLAST HOLES, CUTS SURVEY LINES, CLEARS CORE DRILL STATIONS, BURNS BRUSH, SET DEWATERING PUMPS AND DISCHARGE LINES, PATCH ROADS, ASSIST IN SETTING CULVERTS AND FUEL TANKS, ASSISTS IN PLANTING PINE SEEDLINGS AND GRASS, ASSISTS IN ALL TYPES OF MINE CONSTRUCTION
0200	STATIONARY SAMPLES	GENERAL ANES
0201	CRANE OPERATOR	OPERATES CRANES TO TRANS FER CRUDE CLAY FROM CLAY SHED TO CRUSHING DEPARTMENT, PERFORMS OTHER DUTIES AS INSTRUCTED.
0202	HAMMER MILL OPERATOR	STARTS AND STOPS ALL ELE VATORS, CONVEYORS, FEEDERS, ELECTRIC SCREENS AND CRUSERS IN CRUSHING DEPARTMENT. OTHER DUTIES AS ASSIGNED.
0203	PUGMILL OPERATOR	LUBRICATES PUGMILL AND E XTRUDER, ASSISTS IN CHANGING AUGERS, DIES, SHEER PINS, O PERATES BONNET MILL DUST WASH OUT SYSTEM.
0204	DRYER OPERATOR	STARTS AND STOPS ALL DRY ING, POLLUTION CONTROL, AND OIL PUMPING EQUIPMENT, DIRE CTS FLOW OF DRIED CLAY TO STORAGE TANK ELEVATORS.
0205	DRYER OILER	PERFORMS ALLLUBRICATION IN DRYING DEPARTMENT, ROUTES PRODUCTS TO DRY TANKS OR STOCK BINS, ASSISTS CLEANING CHOKEDOWNS, ETC, CLEAN UP.
0206	CRUSHER OILER	LUBRICATES ALL CRUSHING DEPARTMENT EQUIPMENT. ASSISTS IN CLEANING CLAY ELEVATORS, CHUTES, ETC, CHANGING AUGERS, DIES, SHEARED PINS.
0207	MILLER NO. 1	STARTS AND STOPS MILLS E LEVATORS AND SIFTERS, DRAWS FEED TO MILLS FROM COOLING TANKS AND ROUTS ALL GRADES TO ELEVATORS AND SCREENIN G UNITS, CARES FOR AND OPERATES MILLS, LUBRICATES ALL EQUIPMENT ON MILL AND MOTOR FLOORS, DOES ALL HOUSEKE EPING ON MILL FLOOR, DIRECTS LUBRICATION, CLEANING, S CREEN CHANGES ETC, OF SIFTERS, OTHER DUTIES ASNEEDED.
0208	MILLER NO. 2	ROUTES ALL MATERIAL TO S CREENING AND RESCREENING UNITS, THEN TO BIN* DRYERS, LUBRICATES AND CLEANS ALL PRODUCING AND RESCREENING E LEVATORS AND THE 100/200 SIFTER, STARTS AND STOPS ALL EQ UIPMENT ABOVE SIFTER FLOOR, CONVEYERS TO AND ON STORAGE BINS, ALSO TRUCK LOADING AND STOCK ELEVATORS, SCREEN CONVEYORS, ASSISTS IN DIRECTING FEED TO HOUSES, SIFTERS, AND MILL FEED BINS, AND WITH SCREEN CHANGES, KEEPS ALL TOP FLOOR AND RESCREENING FLOOR CLEAN.

CODE	JOB TITLE	DUTIES
0209	MILLER - NO. 1 MILLS	STARTS AND STOPS ALL EQU IPMENT WITH SWITCHES ON MILL AND SIFTER FLOORS, ASSIS TS IN EQUIPMENT CHECKS, DRAWS FEED FROP TANKS AND ROU TES TO MILLING EQUIPMENT AND SCREENING. LUBRICATES AL L EQUIPMENT ON MILL FLOOR, ASSISTSIN CHANGING SCREENS , AND CLEANS ALL SCREENING UNITS, ASSISTS IN KEEPING DUST CONTROL EQUIPMENT OPERATING PROPERLY. PERFORMS G ENERAL HOUSEKEEPING DUTIES ON MILLFLOOR, AND OTHER DU TIES AS DIRECTED.
0210	RAYMOND MILLER - NO. 1	STARTS AND STOPS ALL RAY MOND MILL, FLUID ENERGY AND DUST COLLECTING EQUIPMENT , FEEDS STOCK TO EACH UNIT, GENERAL HOUSEKEEPING ON G ROUND FLOOR RAYMOND MILL AND FLUID ENERGY MILL ROOMS AND ALL COMPRESSORS, RAYMOND MILLS AND ENERGY MILLIN G EQUIPMENT.
0211	RAYMOND MILLER - NO. 2	LUBRICATES ALL RAYMOND M ILLING, FLUID ENERGY MILLING AND DUST COLLECTOR EQUIP MENT USED IN THESE OPERATIONS. ASSISTS STARTING AND S TOPPING EQUIPMENT AND HAULS REJECTS TO DUMP PCKES, OB TAINS SUPPLIES NEEDED FROM STOREHOUSE ON DAY SHIFT, H ELPS ROUTE STOCK AND PRODUCTS TO RESPECTIVE BINS, MEA SURES BINS, AND OBTAINS SAMPLES FOR SPECIAL TESTS,ASS ISTS IN CLEANING.
0212	SCREEN MENDER	REPAIRS SIFTER SCREENS A ND BUILDS NEW SCREENS AS NEEDED FOR NO. 3 MILLS, OBTA INS SUPPLIES NEEDED FROM STORE HOUSE AND CARES FOR AL L TOOLS AND EQUIPMENT USED. GENERAL HOUSEKEEPING IN A ORK AREA.
0213	SCREEN OPERATOR	RESPONSIBLE FOR ALL SIFT ERS AND SCREENS AND LUBRICATION OF ALL EQUIPMENT ON S IFTER FLOOR, OBTAINS ALL SUPPLIES NEEDED EACH DAY ON DAY SHIFT, SEES THAT PROPER SCREENS ARE IN SIFTERS AN D IN GOOD CONDITION, CLEANED, AND CHANGED FOR GRADES, CLEANS ALL SCREENS BEFORE PLACING IN RACKS, AND ALL HOUSEKEEPING OF SIFTERFLOOR.
0214	POLLUTION CONTROL OPERATOR	LUBRICATES EQUIPMENT, RE STARTS WHEN TRIPPED-OFF, CLEANS OUT CHOKE-UPS AND ASS ISTS WITH BY-PASSING DUST COLLECTORS WHEN NECESSARY, CLEANS AREA AROUND POLLUTION CONTROL PANEL AND UNDER BONNET MILL.
0215	GENERAL AREA-PUGMILL	GENERAL PUGMILL AREA
0300	STATIONARY SAMPLES	GENERAL AREAS
0301	LEAD PERSON	SUPPLY BAGS FROM STORAGE AREA TO PACKAGE UNITS

TABLE 1. JOB DICTIONARY

CODE	JOB TITLE	DUTIES
0302	SHIPPER	ANY DETAIL OR OPERATION HAVING TO DO WITH BAGGING, LOADING, CAR PREPARATION, AND OPERATING OF MACHINERY ON THE SHIPPING FLOOR.
0303	LABORER	ASSIGNED TO A SPECIFIC J OB, SUCH AS HOUSEKEEPING, SOCK MENDING, ERRANDS, AND OTHER DUTIES AS ASSIGNED
0304	FORK TRUCK OPERATOR	OPERATES FORK TRUCK FOR LOADING AND UNLOADING OF CARS AND TRUCKS ON SHIPPING FLOOR
0305	BAG PRESS OPERATOR	OPERATES, MAKES MINOR AD JUSTMENTS, LINES UP PLATES, AND SETS TYPE FOR THE SCH MUTZ PRESS, KEEPS PLATES CLEAN AND PERFORMS DUTIES AS REQUIRED IN SHIPPING.
0306	GENERAL AREA-BAGGERS	GENERAL BAGGING AREA
0401	MECHANIC HELPER	ASSISTS IN REPAIRING AND MAINTAINING MECHANICAL AND ELECTRICAL EQUIPMENT. OPE RATES POWER TOOLS.
0402	ELECTRICIAN	REPAIRS, MAINTAINS AND I NSTALLS ELECTRICAL EQUIPMENT AS REQUIRED. LOCATES AND DETERMINES CAUSE OF ELECTRICAL MALFUNCTION USING EQU IPMENT DESIGNED FOR THIS PURPOSE.
0403	MECHANIC-I (HEAVY EQUIPMENT)	REPAIRS AND MAINTAINS MA CHINERY AND MECHANICAL EQUIPMENT SUCH AS CRANES, PUMP S, ENGINES, MOTORS, DRAGLINES, DOZERS, SCRAPERS, PNE UMATIC TOOLS, CONVEYER SYSTEMS, PRODUCTION MACHINES A ND HEAVY CONSTRUCTION EQUIPMENT.
0404	WELDER MECHANIC	REPAIRS WORN OR DAMAGED MACHINED, FABRICATED, CAST, FORGED OR WELDED METAL PA RTS USING ARC OR GAS WELDING EQUIPMENT.
0405	MACHINIST	SETS UP AND OPERATES LAT HE, MILLING MACHINE, SHAPER OR GRINDER, AND USES HAND TOOLS SUCH AS FILES, SCRAPERS AND WRENCHES.
0406	MILLWRIGHT - CARPENTER	INSTALLS AND REPAIRS MAC HINERY AND EQUIPMENT.
0407	TRUCK - AUTOMOTIVE MECHANIC	REPAIRS AND OVERHAULS AU TOMOBILES, BUSES, TRUCKS, FORKLIFTS, PUMPS AND OTHER GAS ENGINE DRIVEN EQUIPMENT.

TABLE 2. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.	
ATTAPULGITE	TOTAL MASS	GRAVIMETRIC	TOTAL MASS SAMPLES ARE COLLECTED ON MSA POLYVINYL CHLORIDE FILTERS (5.0 UM PORE SIZE), 37 MM DIAMETER FILTER A FLOW RATE OF 1.7 LITERS PER MINUTE. FILTERS ARE WEIGHED TO THE NEAREST 0.1 MG USING A CAHN GRAM ELECTROBALANCE AND DUST CONCENTRATIONS REPORTED AS MG/M3.
ATTAPULGITE	RESPIRABLE MASS	GRAVIMETRIC	RESPIRABLE MASS SAMPLES ARE COLLECTED ON MSA POLYVINYL CHLORIDE FILTERS (SUMPORE SIZE) WITH FLOW 1.7 LITERS PER MINUTE. NYLON CYCLONES (10MM) ARE USED FOR SIZE SEPERATION. FILTERS ARE WEIGHED TO THE NEAREST 0.1MG USING A CAHN GRAM ELECTROBALANCE AND DUST CONCENTRATIONS REPORTED AS MG/M3.

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT= ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE= TOTAL MASS /GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0200	11	EE6	03/24/76	0810	1452	0.6833	9.072	MG/M3	MF FILTER. DUST DUE TO CLEAN OUT. RAYMOND MILL
TIME WEIGHTED AVE.= 9.072									
0200	12	EE13	03/25/76	922	1447	0.5524	1.086	MG/M3	PUGMILL = RECONSTITUTION. MF FILTER
TIME WEIGHTED AVE.= 1.086									
0200	13	E110	03/24/76	0750	1452	0.5524	31.700	MG/M3	STATIONARY NEXT TO RAYMOND MILLS SAMPLED WITH E109
TIME WEIGHTED AVE.= 31.700									
0200	21	EE5	03/24/76	1638	2236	0.6085	34.036	MG/M3	PACKING STATION NO. 3 MILL. WITH E61 ANDE60 MF FILTER
TIME WEIGHTED AVE.= 34.036									
0200	22	EE4	03/23/76	1647	2242	0.6034	17.730	MG/M3	ABOVE HAMMER MILL. MF FILTER
TIME WEIGHTED AVE.= 17.730									
0200	23	EE1	03/23/76	1645	2239	0.6017	13.293	MG/M3	OUTSIDE OF DRYER CONTROL ROOM. MF FILTER
TIME WEIGHTED AVE.= 13.293									
0200	24	EE2	03/23/76	1641	2238	0.6068	0.494	MG/M3	PACKING STATION = RAYMOND MILL. MF FILTER
TIME WEIGHTED AVE.= 0.494									
0201	14	E105	03/24/76	0819	1454	0.6714	0.596	MG/M3	
TIME WEIGHTED AVE.= 0.596									
0201	24	E2	03/22/76	1611	2256	0.6084	0.436	MG/M3	SAMPLED WITH E23
TIME WEIGHTED AVE.= 0.436									
0202	21	E21	03/22/76	1650	2250	3.0879	0.463	MG/M3	STATIONARY CART SAMPLE WITH E20.
TIME WEIGHTED AVE.= 0.463									
0203	11	E106	03/24/76	0751	1445	0.7003	0.714	MG/M3	SAMPLED WITH E96
TIME WEIGHTED AVE.= 0.714									
0203	22	E35	03/22/76	1559	2247	0.6935	12.255	MG/M3	BONNOT OPER. SAMPLED WITH E22
TIME WEIGHTED AVE.= 12.255									

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0205	13	E107	03/24/76	0808	1442	0.6697	6.569	MG/M3	SAMPLED WITH E79
TIME WEIGHTED AVE.= 6.569									
0206	11	E101	03/24/76	0804	1446	0.6833	1.902	MG/M3	SAMPLED WITH E78
TIME WEIGHTED AVE.= 1.902									
0207	11	E102	03/24/76	741	1445	0.7173	21.466	MG/M3	SAMPLED WITH E90
TIME WEIGHTED AVE.= 21.466									
0208	26	E84	03/22/76	1401	2246	0.6884	15.541	MG/M3	SAMPLED WITH E16
TIME WEIGHTED AVE.= 15.541									
0210	21	E43	03/22/76	1545	2238	0.7020	9.116	MG/M3	SAMPLED WITH E28
TIME WEIGHTED AVE.= 9.116									
0213	11	E103	03/24/76	0746	1547	0.8176	8.805	MG/M3	SAMPLED WITH E98
TIME WEIGHTED AVE.= 8.805									
0213	13	E92	03/24/76	750	1447	0.7088	37.946	MG/M3	SAMPLED WITH E89
TIME WEIGHTED AVE.= 37.946									
0213	27	E36	03/22/76	1407	2242	0.7088	0.000	MG/M3	SAMPLED WITH E87
0300	11	EE7	03/24/76	0823	1505	0.7088	33.100	MG/M3	NEXT TO MULTI-BAGGING FLUOR ABSORBENT 50LB. PF FILTER
TIME WEIGHTED AVE.= 33.100									
0300	12	EE8	03/24/76	0829	1503	0.6697	18.513	MG/M3	CAT ABSORBENT BAGGING 10LB. AND 25LB. PF FILTER
TIME WEIGHTED AVE.= 18.513									
0300	13	EE9	03/24/76	0821	1503	0.6833	1.756	MG/M3	NEXT TO BAGGING OF 25LB. ABSORBENT. MF FILTER
TIME WEIGHTED AVE.= 1.756									
0300	14	EE10	03/24/76	0827	1500	0.6680	17.662	MG/M3	CAT ABSORBENT BAGGING 10LB. MF FILTER
TIME WEIGHTED AVE.= 17.662									
0300	15	EE11	03/24/76	0838	1508	0.6629	0.905	MG/M3	

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE MET-OD/ANALYTICAL TECHNIQUE: TOTAL MASS /GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
									NEXT TO PLASTIC WRAPPING OF CAT ABSORBENT BAGS, MF FIL
TIME WEIGHTED AVE.= 0.905									
0300	16	EE12	03/25/76	818	1445	0.6578	5.320	MG/M3	
									NEXT TO WALL IN BAGGING AND SHIPPING ROOM, MF FILTER
TIME WEIGHTED AVE.= 5.320									
0300	17	E139	03/25/76	818	1445	4.1795	11.843	MG/M3	
									STATIONARY NEXT TO 25LB. CAT ABSORBENT SAMPLE W/ E145
TIME WEIGHTED AVE.= 11.843									
0300	21	E60	03/23/76	1430	2236	3.9527	11.283	MG/M3	
									STATIONARY AT BAGGER BELOW NO. 3 MILL SAMPLE WITH E61
TIME WEIGHTED AVE.= 11.283									
0301	21	E49	3/23/76	1540	2247	0.7258	9.781	MG/M3	
									SAMPLED WITH E48
TIME WEIGHTED AVE.= 9.781									
0302	11	E106	3/25/76	748	1448	0.7139	9.804	MG/M3	
									STACK BAGS, SAMPLED WITH E110
TIME WEIGHTED AVE.= 9.804									
0302	13	E131	3/25/76	753	1455	0.7173	24.951	MG/M3	
									LOADS HOPPER CARS, BLOWS OFF TOP OF CAR SAMPLE W/ E119
0302	13	E152	03/25/76	753	1447	0.7037	14.209	MG/M3	
									SEWING OPER, CAT ABSORBENT BAGS, SAMPLED WITH E127
TIME WEIGHTED AVE.= 19.631									
0302	18	E135	03/25/76	0802	1447	0.6884	41.249	MG/M3	
									LOADS BOX CARS, SAMPLED WITH E116
TIME WEIGHTED AVE.= 41.249									
0302	15	E98	03/24/76	804	1450	0.6901	41.872	MG/M3	
									FLUID PACKER, SAMPLED WITH E95
0302	15	E129	3/25/76	800	1453	0.7020	8.831	MG/M3	
									LOADS BOX CARS, SAMPLED WITH E128
TIME WEIGHTED AVE.= 25.210									
0302	16	E148	03/25/76	809	1444	0.6714	1.191	MG/M3	
									FORK LIFT OPERATOR, SAMPLED WITH E132
TIME WEIGHTED AVE.= 1.191									
0302	17	E104	03/24/76	800	1543	0.7870	36.082	MG/M3	
									STACKING BAGS, SAMPLED WITH E84
TIME WEIGHTED AVE.= 36.082									

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0302	2A	E10	03/23/76	1552	2251	0.7122	16,566	MG/M3	STACKING BAGS IN BOX CAR. SAMPLED WITH E91
TIME WEIGHTED AVE.= 16,566									
*0302	2B	E14	03/23/76	1504	2236	0.7122	0,000	MG/M3	SAMPLED WITH E13 HOSE CAME OFF SAMPLER.
0302	2C	E25	03/23/76	1523	2244	0.7496	16,006	MG/M3	BULK LOADS HOPPER CAR,SWEEPS CAR. SAMPLED WITH E56
TIME WEIGHTED AVE.= 16,006									
0302	2D	E57	03/23/76	1535	2241	0.7241	15,880	MG/M3	LOADS BOX CAR. SAMPLED WITH E52
TIME WEIGHTED AVE.= 15,880									
0302	2E	E64	03/23/76	1618	2243	0.6544	4,278	MG/M3	STACK BAGS IN BOX CAR AND TRUCK. SAMPLED WITH E70
TIME WEIGHTED AVE.= 4,278									
0302	2F	E74	03/23/76	1611	1920	0.3212	3,735	MG/M3	SAMPLED WITH E62 LOADING BOX CAR.
TIME WEIGHTED AVE.= 3,735									
0302	21	E6	3/23/76	1513	2248	0.7734	8,016	MG/M3	SAMPLED WITH E46 BAGGING AND LOADING BOX CARS
0302	21	E12	03/23/76	1526	2245	0.7462	4,690	MG/M3	STACKS BAGS IN TRUCK. SAMPLED WITH E11
TIME WEIGHTED AVE.= 6,383									
0302	22	E50	03/23/76	1531	2236	0.7224	10,242	MG/M3	BAGS CAT ABSORBENT. SAMPLED WITH E56
TIME WEIGHTED AVE.= 10,242									
0302	23	E26	03/23/76	1532	2236	0.7207	9,156	MG/M3	SAMPLED WITH E58 BAGS CAT ABSORBENT
0302	23	E47	03/22/76	1549	2237	0.6935	12,832	MG/M3	SAMPLED WITH E15
TIME WEIGHTED AVE.= 10,959									
0302	24	E08	03/22/76	1543	2238	0.7054	17,576	MG/M3	SAMPLED WITH E19
TIME WEIGHTED AVE.= 17,576									
0302	26	E76	03/23/76	1608	2249	0.6816	11,442	MG/M3	HAULS BAGS FROM RAYMOND MILL TO TRUCKS
TIME WEIGHTED AVE.= 11,442									

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0302	27	E03	03/23/76	1610	2240	0.6629	31.976	MG/M3	STACK BAGS IN TRUCKS, SAMPLED WITH E66
TIME WEIGHTED AVE.= 31.976									
0302	28	E69	03/23/76	1612	2248	0.6731	11.141	MG/M3	HAULS BAGS FROM RAYMOND MILL TO TRUCK, SAMPLED W/ E68
TIME WEIGHTED AVE.= 11.141									
0302	29	E1	03/23/76	1519	2238	0.7462	10.720	MG/M3	BAG PACKER, SAMPLED WITH E32
0302	29	E67	03/23/76	1615	2242	0.6578	22.040	MG/M3	STACKS BAGS IN TRUCKS SAMPLED WITH E72
TIME WEIGHTED AVE.= 16.024									
0303	12	E140	3/25/76	751	1444	0.7020	2.279	MG/M3	SAMPLED WITH E125
TIME WEIGHTED AVE.= 2.279									
0303	21	E75	03/23/76	1608	2240	0.6643	43.818	MG/M3	STACK BAGS
TIME WEIGHTED AVE.= 43.818									

TABLE 8, STATISTICS

AGENT= ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE= TOTAL MASS /GRAVIMETRIC

JOB CODE	NO. OF SAMPLES	RANGE MG/M3 (HI-LO=)	MEAN MG/M3	MEDIAN MG/M3	T.W. AVE.	STANDARD DEVIATION	STANDARD ERROR	JOB TITLE
0200	007	030,834-000,498	15,458	13,293	15,944	13,665	5,165	STATIONARY SAMPLES
0201	002	000,596-000,436	0,516	0,516	0,515	0,113	0,080	CRANE OPERATOR
0202	001	000,463-000,463	0,463	0,463	0,463	0,000	0,000	HAMMER MILL OPERATOR
0203	002	012,255-000,716	6,485	6,485	6,456	8,161	5,770	PUGMILL OPERATOR
0205	001	006,569-006,569	6,569	6,569	6,569	0,000	0,000	DRYER OILER
0206	001	001,902-001,902	1,902	1,902	1,902	0,000	0,000	CRUSHER OILER
0207	001	021,466-021,466	21,466	21,466	21,466	0,000	0,000	MILLER NO. 1
0208	001	015,541-015,541	15,541	15,541	15,541	0,000	0,000	MILLER NO. 2
0210	001	009,116-009,116	9,116	9,116	9,116	0,000	0,000	RAYMOND MILLER = NO. 1
0213	002	037,946-008,805	23,376	23,376	22,337	20,606	14,570	SCREEN OPERATOR
AREA 02	019	037,946-000,436	11,790	9,072		12,140	2,785	
0300	008	033,100-000,905	12,548	11,563	12,415	10,627	3,757	STATIONARY SAMPLES
0301	001	009,781-009,781	9,781	9,781	9,781	0,000	0,000	LEAD PERSON
0302	024	041,872-001,191	14,020	12,137	14,299	11,495	2,346	SHIPPER
0303	002	043,818-002,279	23,049	23,049	22,507	29,373	20,769	LABORER
AREA 03	035	043,818-000,905	15,450	11,442		12,023	2,032	
PLANT TOTAL	054	043,818-000,436	14,162	11,312		12,079	1,644	

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0200	11	E109	03/24/76	0750	1452	4.5575	9.896	MG/M3	STATIONARY NEAT TO RAYMOND MILLS SAMPLED WITH E110
TIME WEIGHTED AVE.= 9.896									
*0200	27	E07	03/22/76	1409	2242	4.5575	33.808	MG/M3	SAMPLED WITH E3.
0201	14	E05	03/24/76	0819	1454	0.6714	0.149	MG/M3	CHANE NOT OPERATING
TIME WEIGHTED AVE.= 0.149									
0201	23	E17	03/22/76	1810	2251	0.4776	0.209	MG/M3	
TIME WEIGHTED AVE.= 0.209									
0201	24	E23	03/22/76	1611	2256	0.6884	0.145	MG/M3	SAMPLED WITH E2
TIME WEIGHTED AVE.= 0.145									
0202	11	E93	03/24/76	0746	1444	0.7105	0.281	MG/M3	
TIME WEIGHTED AVE.= 0.281									
0202	21	E46	03/22/76	1555	2244	0.6952	0.719	MG/M3	
TIME WEIGHTED AVE.= 0.719									
0202	22	E30	03/22/76	1650	2250	3.8879	0.206	MG/M3	STATIONARY CART SAMPLE WITH E21
TIME WEIGHTED AVE.= 0.206									
0203	11	E80	03/24/76	0756	1444	0.6935	2.739	MG/M3	PUGMILL BONNET
TIME WEIGHTED AVE.= 2.739									
0203	12	E96	03/24/76	0750	1445	0.7054	0.283	MG/M3	SPENDS MOST OF THE TIME IN CONTROL ROOM, WITH E106
TIME WEIGHTED AVE.= 0.283									
0203	21	E39	03/22/76	1551	2244	0.7020	0.142	MG/M3	STAYS IN CONTROL ROOM MOST OF THE TIME.
TIME WEIGHTED AVE.= 0.142									
0203	22	E22	03/22/76	1559	2247	0.6935	2.451	MG/M3	BONNET OPER. SAMPLED WITH E35
TIME WEIGHTED AVE.= 2.451									
0204	12	E08	03/24/76	0756	1450	0.7037	0.853	MG/M3	
TIME WEIGHTED AVE.= 0.853									

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0200	22	E42	03/22/76	1559	2247	0.6935	0.288	MG/M3	SPENDS TIME NEAR DRYERS.
TIME WEIGHTED AVE.= 0.288									
0205	13	E79	03/24/76	0808	1442	0.6697	0.746	MG/M3	SAMPLED WITH E107
TIME WEIGHTED AVE.= 0.746									
0205	23	E38	03/22/76	1601	2247	0.6901	0.724	MG/M3	SPENDS TIME NEAR DRYERS.
TIME WEIGHTED AVE.= 0.724									
0206	11	E78	03/24/76	0804	1446	0.6833	0.293	MG/M3	SAMPLED WITH E101
TIME WEIGHTED AVE.= 0.293									
0206	24	E24	03/22/76	1613	2245	0.6663	0.750	MG/M3	SWEEPS AROUND CRUSHER.
TIME WEIGHTED AVE.= 0.750									
0207	11	E90	03/24/76	743	1445	0.7173	2.091	MG/M3	SAMPLED WITH E102
TIME WEIGHTED AVE.= 2.091									
0207	12	E77	03/23/76	0748	1547	0.8142	0.491	MG/M3	
TIME WEIGHTED AVE.= 0.491									
0207	23	E85	03/22/76	1619	2240	0.6476	0.618	MG/M3	
TIME WEIGHTED AVE.= 0.618									
0207	25	E37	03/22/76	1556	2243	0.6918	1.445	MG/M3	
TIME WEIGHTED AVE.= 1.445									
0208	12	E83	03/24/76	747	1449	0.7173	1.394	MG/M3	
TIME WEIGHTED AVE.= 1.394									
0208	26	E16	03/22/76	1601	2246	0.6884	2.760	MG/M3	SAMPLED WITH E04
TIME WEIGHTED AVE.= 2.760									
0210	21	E20	03/22/76	1543	2238	0.7054	1.417	MG/M3	SAMPLED WITH E43
TIME WEIGHTED AVE.= 1.417									
*0213	11	E94	03/24/76	0746	1547	0.7054	0.000	MG/M3	SAMPLED WITH E103
0213	13	E89	03/24/76	750	1447	0.7088	5.078	MG/M3	

TABLE 3, INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
									SAMPLED WITH E92
TIME WEIGHTED AVE.= 5.070									
0213	24	E5	03/22/76	1621	2241	0.6459	1.393	MG/M3	
TIME WEIGHTED AVE.= 1.393									
0213	20	E29	03/22/76	1603	2246	0.6850	3.065	MG/M3	
TIME WEIGHTED AVE.= 3.065									
0300	11	E165	03/25/76	818	1445	4.1795	1.196	MG/M3	STATIONARY NEXT TO 8516, CAT ABSORBENT SAMPLE W/ E139
TIME WEIGHTED AVE.= 1.196									
0300	21	E61	03/23/76	1638	2236	3.9527	2.935	MG/M3	STATIONARY AT BAGGER BELOW NO. 3 MILL SAMPLE WITH E68
TIME WEIGHTED AVE.= 2.935									
0301	1A	E134	03/25/76	0805	1447	0.6833	0.585	MG/M3	
TIME WEIGHTED AVE.= 0.585									
0301	11	E128	03/25/76	750	1442	0.7003	0.714	MG/M3	
TIME WEIGHTED AVE.= 0.714									
0301	18	E108	03/24/76	813	1441	0.6595	0.910	MG/M3	
TIME WEIGHTED AVE.= 0.910									
0301	19	E103	03/24/76	0802	1447	0.6884	0.726	MG/M3	BAGGING
TIME WEIGHTED AVE.= 0.726									
0301	22	E41	03/22/76	1515	2242	0.7598	0.790	MG/M3	BAGGING
TIME WEIGHTED AVE.= 0.790									
0301	23	E9	03/23/76	1531	2243	0.7343	1.634	MG/M3	BAGGING ATTAGEL
TIME WEIGHTED AVE.= 1.634									
0301	24	E48	3/23/76	1540	2247	0.7258	1.653	MG/M3	SAMPLED WITH E49 COAT OVER SAMPLE SOME OF THE TIME
TIME WEIGHTED AVE.= 1.653									
0302	1A	E84	03/24/76	810	1544	0.7717	7.904	MG/M3	STACKING BAGS, SAMPLED WITH E104
TIME WEIGHTED AVE.= 7.904									
0302	18	E126	03/24/76	0749	1445	0.7071	2.404	MG/M3	
TIME WEIGHTED AVE.= 2.404									

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0302	10	E102	03/24/76	0754	1455	0.7156	1.118	MG/M3	
TIME WEIGHTED AVE.= 1.118									
0302	8K	E133	03/24/76	0757	1444	0.6918	0.578	MG/M3	
TIME WEIGHTED AVE.= 0.578									
0302	11	E114	3/25/76	748	1448	0.7139	0.560	MG/M3	
									STACK BAGS. SAMPLED WITH E140
0302	11	E123	03/25/76	0748	1444	0.7071	1.131	MG/M3	
TIME WEIGHTED AVE.= 0.844									
0302	12	E137	03/25/76	754	1439	0.6816	0.440	MG/M3	
									FOREMAN
TIME WEIGHTED AVE.= 0.440									
0302	13	E99	03/25/76	0759	1458	0.7122	1.264	MG/M3	
0302	13	E115	03/25/76	753	1455	0.7173	0.976	MG/M3	
									LOADS HOPPER CARS,BLOWS OFF TOP OF CAR SAMPLE W/ E131
0302	13	E127	03/25/76	753	1447	0.7037	0.995	MG/M3	
									BEING OPER. CAT ABSORBENT BAGS. SAMPLED WITH E132
TIME WEIGHTED AVE.= 1.078									
0302	14	E92	03/24/76	759	1443	0.6867	2.038	MG/M3	
0302	14	E97	3/25/76	0755	1450	0.7054	0.567	MG/M3	
									LOADING BOX CARS
0302	14	E112	03/25/76	800	1445	0.6884	0.436	MG/M3	
									WRAPS PLASTIC AROUND BAGS
0302	14	E116	03/25/76	0802	1447	0.6884	4.503	MG/M3	
									LOADS BOX CARS. SAMPLED WITH E139
TIME WEIGHTED AVE.= 1.878									
0302	15	E95	03/24/76	804	1450	0.6901	2.173	MG/M3	
									FLUID PACKER. SAMPLED WITH E98
0302	15	E124	03/25/76	800	1453	0.7020	1.139	MG/M3	
									LOADS BOX CARS. SAMPLED WITH E129
0302	15	E136	03/25/76	805	1443	0.6765	0.443	MG/M3	
0302	15	E138	03/25/76	0807	1445	0.6765	1.478	MG/M3	
									HAULS BAGS WORK COAT OVER SAMPLER FOR APPROX. 1HR.
TIME WEIGHTED AVE.= 1.311									

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0302	16	E06	03/24/76	806	1442	0.6731	1.337	MG/M3	PUMP TURNED OFF FOR 20 MINUTES
0302	16	E113	3/25/76	802	1447	0.6884	1.017	MG/M3	HOSE CAME OFF FOR APPROX. 1HR.
0302	16	E132	03/25/76	809	1444	0.6714	0.447	MG/M3	FORK LIFT OPERATOR, SAMPLED WITH E149
TIME WEIGHTED AVE.= 0.935									
0302	17	E07	03/24/76	810	1437	0.6578	4.864	MG/M3	CYCLONE CAME OFF FOR A SHORT TIME.
0302	17	E111	3/25/76	806	1450	0.6867	0.728	MG/M3	LOADS BOX CARS
TIME WEIGHTED AVE.= 2.752									
0302	18	E130	3/25/76	810	1455	0.6884	2.329	MG/M3	STACKING BAGS
TIME WEIGHTED AVE.= 2.329									
0302	19	E01	03/24/76	808	1543	0.7870	2.287	MG/M3	
TIME WEIGHTED AVE.= 2.287									
0302	2A	E13	03/23/76	1544	2236	0.7003	0.857	MG/M3	SAMPLED WITH E14 CLEANING FLOOR AND BOX CAR & BAGGING
TIME WEIGHTED AVE.= 0.857									
0302	2B	E27	03/23/76	1543	2238	0.7054	0.567	MG/M3	DROVE FORK LIFT TRUCK
TIME WEIGHTED AVE.= 0.567									
0302	2C	E31	03/23/76	1529	2243	0.7377	0.813	MG/M3	HELPS LOAD HOPPER CAR.
TIME WEIGHTED AVE.= 0.813									
0302	2D	E32	03/23/76	1519	2238	0.7462	1.206	MG/M3	BAG PACKER, SAMPLED WITH E1
TIME WEIGHTED AVE.= 1.206									
0302	2E	E51	03/23/76	1552	2251	0.7122	1.685	MG/M3	STACKING BAGS IN BOXCAR, SAMPLED WITH E18
TIME WEIGHTED AVE.= 1.685									
0302	2F	E52	03/23/76	1535	2241	0.7241	1.933	MG/M3	LOADS BOX CAR, SAMPLED WITH E97
TIME WEIGHTED AVE.= 1.933									

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0302	2G	E51	3/23/76	1541	2243	0.7173	0.418	MG/M3	STACKING BAGS
TIME WEIGHTED AVE.= 0.418									
0302	2H	E54	03/23/76	1523	2244	0.7496	5.602	MG/M3	BULK LOADS HOPPER CAR, SWEEPS CAR. SAMPLED WITH E55
TIME WEIGHTED AVE.= 5.602									
0302	2I	E62	03/23/76	1611	1920	0.3212	0.622	MG/M3	SAMPLED WITH E74 LOADING BOX CAR.
TIME WEIGHTED AVE.= 0.622									
0302	2J	E70	03/23/76	1610	2243	0.6544	1.375	MG/M3	STACK BAGS IN BOX CAR AND TRUCK. SAMPLED WITH E64
TIME WEIGHTED AVE.= 1.375									
0302	2I	E11	03/23/76	1526	2243	0.7462	0.804	MG/M3	STACKS BAGS IN TRUCK. SAMPLED WITH E12
0302	2I	E19	03/22/76	1543	2238	0.7094	2.835	MG/M3	SAMPLED WITH E08
0302	2I	E46	3/23/76	1513	2240	0.7734	0.776	MG/M3	SAMPLED WITH E6, BAGGING AND LOADING BOX CARS.
0302	2I	E55	03/23/76	1519	2238	0.7462	2.412	MG/M3	BAG PACKER
TIME WEIGHTED AVE.= 1.603									
0302	2J	E40	03/22/76	1545	2241	0.7071	3.252	MG/M3	
0302	2J	E56	03/23/76	1531	2236	0.7224	1.246	MG/M3	BAGS CAT ABSORBENT. SAMPLED WITH E58
0302	2J	E59	03/23/76	1528	2249	0.7496	3.601	MG/M3	BAG PACKER
TIME WEIGHTED AVE.= 2.707									
0302	2J	E15	03/22/76	1549	2237	0.6935	1.298	MG/M3	CYCLONE FELL APART. SAMPLED WITH E47
0302	2J	E28	03/23/76	1534	2237	0.7190	0.417	MG/M3	BAGS CAT ABSORBENT.
0302	2J	E58	03/23/76	1532	2236	0.7207	0.416	MG/M3	SAMPLED WITH E26 BAGS CAT ABSORBENT
TIME WEIGHTED AVE.= 0.703									

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/GRAVIMETRIC

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS	
0302	24	E18	03/22/76	1553	2240	0.6918	4.191	MG/M3	
0302	24	E33	03/23/76	1539	2239	0.7139	0.560	MG/M3	SEWING OPER. CAT ABSORBENT BAGS.
TIME WEIGHTED AVE.= 2.347									
0302	25	E34	03/23/76	1555	2247	0.7003	0.143	MG/M3	RAYMOND MILL BAGGER.
TIME WEIGHTED AVE.= 0.143									
0302	26	E63	03/23/76	1608	2249	0.6816	2.054	MG/M3	HAULS BAGS FROM RAYMOND MILL TO TRUCKS.
TIME WEIGHTED AVE.= 2.054									
0302	27	E66	03/23/76	1610	2240	0.6429	1.659	MG/M3	STACK BAGS IN TRUCKS. SAMPLED WITH E63
TIME WEIGHTED AVE.= 1.659									
0302	28	E68	03/23/76	1612	2240	0.6731	1.634	MG/M3	HAULS BAGS FROM RAYMOND MILL TO TRUCK. SAMPLED W/ E69
TIME WEIGHTED AVE.= 1.634									
0302	29	E72	03/23/76	1615	2242	0.6578	2.888	MG/M3	STACKS BAGS IN TRUCK. SAMPLED WITH E67
TIME WEIGHTED AVE.= 2.888									
0303	12	E125	03/25/76	0751	1444	0.7028	0.142	MG/M3	HOSE CAME OFF SAMPLE FOR A SHORT TIME SAMPLED W/ E140
TIME WEIGHTED AVE.= 0.142									
0303	23	E73	03/23/76	1608	2240	0.6663	3.752	MG/M3	
TIME WEIGHTED AVE.= 3.752									
0305	12	E117	03/25/76	0752	1443	0.6986	0.716	MG/M3	
TIME WEIGHTED AVE.= 0.716									

= SAMPLE WAS DELETED FROM THE STATISTICAL RESULTS(TABLE4) AND THE TIME WEIGHTED AVERAGES

TABLE 4. STATISTICS

AGENT: ATTAPULGITE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/GRAVIMETRIC

JOB CODE	NO. OF SAMPLES	RANGE MG/M3 (HI-LOW)	MEAN MG/M3	MEDIAN MG/M3	T.W.A. AVE.	STANDARD DEVIATION	STANDARD ERROR	JOB TITLE
0200	001	009.896-009.896	9.896	9.896	9.896	0.000	0.000	STATIONARY SAMPLES
0201	003	000.289-000.145	0.168	0.149	0.163	0.036	0.021	CRANE OPERATOR
0202	003	000.719-000.206	0.402	0.281	0.409	0.277	0.160	HAMMER MILL OPERATOR
0203	004	002.719-000.142	1.404	1.367	1.395	1.382	0.691	PUGMILL OPERATOR
0204	002	000.853-000.288	0.571	0.571	0.573	0.400	0.282	DRYER OPERATOR
0205	002	000.746-000.724	0.735	0.735	0.735	0.016	0.011	DRYER OILER
0206	002	000.750-000.293	0.522	0.522	0.519	0.323	0.228	CRUSHER OILER
0207	004	002.091-000.491	1.161	1.032	1.149	0.750	0.375	MILLER NO. 1
0208	002	002.760-001.394	2.077	2.077	2.063	0.966	0.683	MILLER NO. 2
0210	001	001.417-001.417	1.417	1.417	1.417	0.000	0.000	RAYMOND MILLER # NO. 1
0213	003	005.870-001.393	3.179	3.065	3.235	1.845	1.065	SCREEN OPERATOR
AREA 02	027	009.896-000.142	1.505	0.744		2.052	0.395	
0300	002	002.935-001.196	2.066	2.066	2.041	1.230	0.869	STATIONARY SAMPLES
0301	007	001.653-000.585	1.002	0.798	1.010	0.449	0.170	LEAD PERSON
0302	052	007.904-000.143	1.700	1.224	1.723	1.519	0.211	SHIPPER
0303	002	003.752-000.142	1.947	1.947	1.900	2.553	1.805	LABORER
0305	001	000.716-000.716	0.716	0.716	0.716	0.000	0.000	BAG PRESS OPERATOR
AREA 03	064	007.904-000.142	1.628	1.168		1.444	0.180	
PLANT TOTAL	091	009.896-000.142	1.591	1.118		1.637	0.172	

END OF REPORT

TABLE 2. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.	
SILICA	TOTAL MASS	X-RAY DIFFRACT.	TOTAL MASS SAMPLES ARE COLLECTED ON MSA POLYVINYL CHLORIDE FILTERS (5.0 UM PORE SIZE) 37MM DIAMETER WITH A FLOW RATE OF 1.7 LITERS PER MINUTE. FILTERS ARE WEIGHED TO THE NEAREST 0.1 MG USING A CAHN GRAM ELECTROBALANCE. FREE SILICA DETERMINATIONS ARE MADE USING QUANTITATIVE X-RAY DIFFRACTION WITH SILICA CONCENTRATIONS REPORTED AS MG/M3.
SILICA	RESPIRABLE MASS	X-RAY DIFFRACT.	RESPIRABLE MASS SAMPLES ARE COLLECTED ON MSA POLYVINYL CHLORIDE FILTERS (5.0UM PORE SIZE) 37MM DIAMETER WITH A FLOW RATE OF 1.7 LITERS PER MINUTE. NYLON CYCLONES (10MM) ARE USED FOR SIZE SEPERATION. FILTERS ARE WEIGHED TO THE NEAREST 0.1MG USING A CAHN GRAM ELECTROBALANCE. FREE SILICA DETERMINATIONS ARE MADE USING QUANTITATIVE X-RAY DIFFRACTION WITH SILICA CONCENTRATIONS REPORTED AS MG/M3.

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: SILICA
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /X-RAY DIFFRACT.

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
0200	21	EE1	03/23/76	1645	2239	0.6017	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0201	11	E105	03/24/76	0819	1454	0.6714	< 0.030	MG/M3
TIME WEIGHTED AVE.= <0.030								
0202	21	E21	03/22/76	1650	2250	0.6119	< 0.033	MG/M3
TIME WEIGHTED AVE.= <0.033								
0203	11	E104	03/24/76	0753	1445	0.7003	< 0.029	MG/M3
TIME WEIGHTED AVE.= <0.029								
0203	21	E35	03/22/76	1559	2247	0.6935	0.216	MG/M3
TIME WEIGHTED AVE.= 0.216								
0205	11	E107	03/24/76	0808	1442	0.6697	0.030	MG/M3
TIME WEIGHTED AVE.= 0.030								
0206	11	E101	03/24/76	0804	1446	0.6833	0.029	MG/M3
TIME WEIGHTED AVE.= 0.029								
0207	11	E102	03/24/76	0743	1445	0.7173	0.084	MG/M3
TIME WEIGHTED AVE.= 0.084								
0213	11	E103	03/24/76	0746	1547	0.8176	0.110	MG/M3
TIME WEIGHTED AVE.= 0.110								
0301	21	E49	03/23/76	1540	2247	0.7258	0.248	MG/M3
TIME WEIGHTED AVE.= 0.248								
0302	11	E146	03/25/76	0748	1448	0.7139	0.308	MG/M3
TIME WEIGHTED AVE.= 0.308								
0302	21	E4	03/23/76	1513	2248	0.7734	0.155	MG/M3
TIME WEIGHTED AVE.= 0.155								
0302	22	E14	03/23/76	1544	2236	0.7003	0.057	MG/M3
TIME WEIGHTED AVE.= 0.057								
0302	23	E26	03/23/76	1532	2236	0.7207	0.097	MG/M3
TIME WEIGHTED AVE.= 0.097								
0302	24	E74	03/23/76	1611	1920	0.3212	0.062	MG/M3
TIME WEIGHTED AVE.= 0.062								
0303	11	E140	03/25/76	0751	1444	0.7020	0.057	MG/M3

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: SILICA
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /X-RAY DIFFRACT.

JOB CODE	SHIFT	SAMPLE VAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME ML	CONC.	UNITS
TIME WEIGHTED AVE.= 0.057									
0303	81	E75		03/23/76	1800	2240	0.6663	0.315	MG/M3
TIME WEIGHTED AVE.= 0.315									

TABLE 4, STATISTICS

AGENT: SILICA
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS -- X-RAY DIFFRACT.

JOB CODE	NO. OF SAMPLES	RANGE MG/M3 (HI-LOW)	MEAN MG/M3	MEDIAN MG/M3	T.W. AVE.	STANDARD DEVIATION	STANDARD ERROR	JOB TITLE
0200	001	000.000-000.000	0.000	0.000	0.000	0.000	0.000	STATIONARY SAMPLES
0201	001	000.030-000.030	0.030	0.030	<0.030	0.000	0.000	CRANE OPERATOR
0202	001	000.033-000.033	0.033	0.033	<0.033	0.000	0.000	HAMMER MILL OPERATOR
0203	002	000.216-000.029	0.123	0.123	<0.122	0.132	0.093	PUGMILL OPERATOR
0205	001	000.030-000.030	0.030	0.030	0.030	0.000	0.000	DRYER OILER
0206	001	000.029-000.029	0.029	0.029	0.029	0.000	0.000	CRUSHER OILER
0207	001	000.084-000.084	0.084	0.084	0.084	0.000	0.000	MILLER NO. 1
0213	001	000.110-000.110	0.110	0.110	0.110	0.000	0.000	SCREEN OPERATOR
AREA 02	009	000.216-000.000	0.062	0.216		0.067	0.022	
0301	001	000.248-000.248	0.248	0.248	0.248	0.000	0.000	LEAD PERSON
0302	005	000.304-000.057	0.134	0.057	0.145	0.104	0.046	SHIPPER
0303	002	000.315-000.057	0.186	0.186	0.182	0.182	0.129	LABORER
AREA 03	008	000.315-000.057	0.162	0.077		0.112	0.040	
PLANT TOTAL	017	000.315-000.000	0.109	0.110		0.102	0.025	

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: SILICA
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/X-RAY DIFFRACT.

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
0201	11	E85	03/24/76	0819	1454	0.6718	<0.030	MG/M3
TIME WEIGHTED AVE.= <0.030								
0202	21	E44	03/22/76	1555	2244	0.6952	<0.029	MG/M3
TIME WEIGHTED AVE.= <0.029								
0202	22	E30	03/22/76	1650	2250	0.6119	<0.033	MG/M3
TIME WEIGHTED AVE.= <0.033								
0203	11	E96	03/24/76	0750	1445	0.7058	<0.028	MG/M3
TIME WEIGHTED AVE.= <0.028								
0203	22	E22	03/22/76	1559	2247	0.6935	<0.029	MG/M3
TIME WEIGHTED AVE.= <0.029								
0204	11	E88	03/24/76	0756	1450	0.7037	<0.028	MG/M3
TIME WEIGHTED AVE.= <0.028								
0205	11	E79	03/24/76	0808	1442	0.6497	<0.030	MG/M3
TIME WEIGHTED AVE.= <0.030								
0206	11	E78	03/24/76	0804	1446	0.6833	<0.029	MG/M3
TIME WEIGHTED AVE.= <0.029								
0207	11	E90	03/24/76	0743	1445	0.7173	<0.028	MG/M3
TIME WEIGHTED AVE.= <0.028								
0207	21	E45	03/22/76	1619	2240	0.6476	0.031	MG/M3
TIME WEIGHTED AVE.= 0.031								
0208	11	E83	03/24/76	0747	1449	0.7173	<0.028	MG/M3
TIME WEIGHTED AVE.= <0.028								
0210	21	E20	03/22/76	1543	2238	0.7058	<0.028	MG/M3
TIME WEIGHTED AVE.= <0.028								
0213	11	E98	03/24/76	0746	1547	0.8176	<0.024	MG/M3
TIME WEIGHTED AVE.= <0.024								
0213	21	E5	03/22/76	1621	2241	0.6459	<0.031	MG/M3
TIME WEIGHTED AVE.= <0.031								
0301	11	E100	03/24/76	0813	1441	0.6595	<0.030	MG/M3
TIME WEIGHTED AVE.= <0.030								
0301	21	E48	03/23/76	1540	2247	0.7258	0.207	MG/M3

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: SILICA
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/X-RAY DIFFRACT.

JOB CODE	SHIFT MAN-NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
TIME WEIGHTED AVE.= 0.207								
0301	22	E48	03/23/76	1940	2247	0.7258	< 0.028	MG/M3
TIME WEIGHTED AVE.= < 0.028								
0301	23	E9	03/23/76	1351	2243	0.7343	< 0.027	MG/M3
TIME WEIGHTED AVE.= < 0.027								
0302	11	E130	03/25/76	0807	1445	0.6765	< 0.030	MG/M3
TIME WEIGHTED AVE.= < 0.030								
0302	12	E130	03/25/76	0810	1455	0.6884	< 0.029	MG/M3
TIME WEIGHTED AVE.= < 0.029								
0302	13	E113	03/25/76	0802	1447	0.6884	< 0.029	MG/M3
TIME WEIGHTED AVE.= < 0.029								
0302	14	E97	03/25/76	0755	1450	0.7056	< 0.028	MG/M3
TIME WEIGHTED AVE.= < 0.028								
0302	24	E48	03/25/76	1513	2240	0.7734	< 0.026	MG/M3
TIME WEIGHTED AVE.= < 0.026								
0302	25	E58	03/25/76	1932	2256	0.7207	< 0.028	MG/M3
TIME WEIGHTED AVE.= < 0.028								
0302	26	E62	03/25/76	1411	1920	0.3218	0.062	MG/M3
TIME WEIGHTED AVE.= 0.062								
0303	15	E125	03/25/76	0751	1444	0.7020	< 0.028	MG/M3
TIME WEIGHTED AVE.= < 0.028								
0303	21	E73	03/25/76	1608	2240	0.6663	< 0.030	MG/M3
TIME WEIGHTED AVE.= < 0.030								
0305	11	E117	03/25/76	0752	1443	0.6906	< 0.029	MG/M3
TIME WEIGHTED AVE.= < 0.029								

TABLE 6. STATISTICS

AGENT: SILICA
SAMPLE METHOD/ANALYTICAL TECHNIQUE: RESPIRABLE MASS/X-RAY DIFFRACT.

JOB CODE	NO. OF SAMPLES	RANGE MG/M3 (HI-LOW)	MEAN MG/M3	MEDIAN MG/M3	T.W.A. AVE.	STANDARD DEVIATION	STANDARD ERROR	JOB TITLE
0201	001	000.030-000.030	0.030	0.030	<0.030	0.000	0.000	CRANE OPERATOR
0202	002	000.033-000.029	0.031	0.031	<0.031	0.002	0.002	HAMMER MILL OPERATOR
0203	002	000.029-000.028	0.029	0.029	<0.028	0.000	0.000	PUGMILL OPERATOR
0204	001	000.028-000.028	0.028	0.028	<0.028	0.000	0.000	DRYER OPERATOR
0205	001	000.030-000.030	0.030	0.030	<0.030	0.000	0.000	DRYER OILER
0206	001	000.029-000.029	0.029	0.029	<0.029	0.000	0.000	CRUSHER OILER
0207	002	000.031-000.028	0.030	0.030	<0.029	0.002	0.001	MILLER NO. 1
0208	001	000.028-000.028	0.028	0.028	<0.028	0.000	0.000	MILLER NO. 2
0210	001	000.028-000.028	0.028	0.028	<0.028	0.000	0.000	RAYMOND MILLER - NO. 1
0213	002	000.031-000.024	0.028	0.028	<0.027	0.005	0.003	SCREEN OPERATOR
AREA 02	014	000.033-000.024	0.029	0.030		0.002	0.001	
0301	006	000.207-000.027	0.093	0.110	<0.074	0.089	0.045	LEAD PERSON
0302	007	000.062-000.026	0.033	0.028	<0.031	0.013	0.005	SHIPPER
0303	002	000.030-000.028	0.029	0.029	<0.029	0.001	0.001	LABORER
0305	001	000.029-000.029	0.029	0.029	<0.029	0.000	0.000	BAG PRESS OPERATOR
AREA 03	016	000.207-000.026	0.060	0.029		0.068	0.017	
PLANT TOTAL	028	000.207-000.024	0.036	0.031		0.034	0.006	

END OF REPORT

TABLE 2. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.	
CADMIUM	TOTAL MASS	ATOMIC ABSORP.	TOTAL MASS SAMPLES ARE COLLECTED ON AA MILLIPORE FILTERS (0.8UM PORE SIZE) 37MM DIAMETER WITH A FLOW RATE OF 1.7 LITERS PER MINUTE. FILTERS ARE PRE AND POST DESICATED AND WEIGHED TO THE NEAREST 0.1MG USING A CAHN GRAM ELECTROBALANCE. TRACE METAL DETERMINATIONS ARE MADE BY ATOMIC ABSORPTION WITH CONCENTRATIONS REPORTED AS MG/M3.

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: CADMIUM
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /ATOMIC ABSORP.

JOB CODE	SHIFT PAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
0200	15	EE6	03/24/76	810	1452	0.6833	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	16	EE13	03/25/76	922	1447	0.5524	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	22	EE2	03/23/76	1641	2238	0.6068	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	23	EE3	03/24/76	1638	2236	0.6085	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	24	EE4	03/23/76	1647	2242	0.6034	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	11	EE9	03/24/76	821	1503	0.6833	0.000	MG/M3
0300	11	EE12	03/25/76	818	1445	0.6578	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	12	EE7	03/24/76	823	1505	0.6833	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	13	EE8	03/24/76	829	1503	0.6697	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	14	EE10	03/24/76	827	1500	0.6680	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	15	EE11	03/24/76	838	1508	0.6629	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								

TABLE 2. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.	
CHROMIUM	TOTAL MASS	ATOMIC ABSORP.	TOTAL MASS SAMPLES ARE COLLECTED ON AA MILLIPORE FILTERS (0.8UM PORE SIZE) 37MM DIAMETER WITH A FLOW RATE OF 1.7 LITERS PER MINUTE. FILTERS ARE PRE AND POST DESICATED AND WEIGHED TO THE NEAREST 0.1MG USING A CAHN GRAM ELECTROBALANCE. TRACE METAL DETERMINATIONS ARE MADE BY ATOMIC ABSORPTION WITH CONCENTRATIONS REPORTED AS MG/M3.

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: CHROMIUM
SAMPLE METHOD: ANALYTICAL TECHNIQUE: TOTAL MASS /ATOMIC ABSORP.

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
0200	11	EE6	03/24/76	810	1452	0.6833	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	12	EE13	03/26/76	922	1447	0.5524	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	21	EE1	03/23/76	1645	2239	0.6017	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	22	EE2	03/23/76	1641	2238	0.6068	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	23	EE3	03/24/76	1638	2236	0.6085	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	24	EE4	03/23/76	1647	2242	0.6034	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	11	EE7	03/24/76	823	1505	0.6833	0.000	MG/M3
0300	11	EE9	03/24/76	821	1503	0.6833	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	12	EE8	03/24/76	829	1503	0.6697	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	13	EE10	03/24/76	827	1500	0.6680	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	14	EE11	03/24/76	838	1508	0.6629	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	15	EE12	03/25/76	618	1445	0.6570	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								

TABLE 2. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.	
COBALT	TOTAL MASS	ATOMIC ABSORP.	TOTAL MASS SAMPLES ARE COLLECTED ON AA MILLIPORE FILTERS (0.8UM-PORE-SIZE) 37MM-DIAMETER WITH A FLOW RATE OF 1.7 LITERS PER MINUTE. FILTERS ARE PRE AND POST DESICATED AND WEIGHED TO THE NEAREST 0.1MG USING A CAHN GRAM ELECTROBALANCE. TRACE METAL DETERMINATIONS ARE MADE BY ATOMIC ABSORPTION WITH CONCENTRATIONS REPORTED AS MG/M3.

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: COBALT
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS -- ATOMIC ABSORP.

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
0200	11	EE13	03/25/76	922	1447	0.5524	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	12	EE6	03/24/76	818	1452	0.6833	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	21	EE2	03/23/76	1641	2238	0.6068	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	22	EE1	03/23/76	1645	2239	0.6017	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	25	EE4	03/23/76	1647	2242	0.6034	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	28	EE3	03/24/76	1638	2236	0.6085	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	11	EE7	03/24/76	823	1505	0.6833	0.000	MG/M3
0300	11	EE9	03/24/76	821	1503	0.6833	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	12	EE8	03/24/76	829	1503	0.6697	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	13	EE10	03/24/76	827	1500	0.6680	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	18	EE11	03/24/76	838	1508	0.6629	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	15	EE12	03/25/76	818	1445	0.6578	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								

TABLE 8. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.	
IRON	TOTAL MASS	ATOMIC ABSORP.	TOTAL MASS SAMPLES ARE COLLECTED ON AA MILLIPORE FILTERS (0.8UM PORE SIZE) 37MM DIAMETER WITH A FLOW RATE OF 1.7 LITERS PER MINUTE. FILTERS ARE PRE AND POST DESICATED AND WEIGHED TO THE NEAREST 0.1MG USING A CAHN GRAM ELECTROBALANCE. TRACE METAL DETERMINATIONS ARE MADE BY ATOMIC ABSORPTION WITH CONCENTRATIONS REPORTED AS MG/M3.

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: IRON
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /ATOMIC ABSORP.

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
0200	11	EE6	03/24/76	810	1452	0.6833	0.029	MG/M3
TIME WEIGHTED AVE.= 0.029								
0200	12	EE13	03/25/76	922	1447	0.5524	0.018	MG/M3
TIME WEIGHTED AVE.= 0.018								
0200	21	EE1	03/23/76	1645	2239	0.6017	0.017	MG/M3
TIME WEIGHTED AVE.= 0.017								
0200	22	EE2	03/23/76	1641	2238	0.6068	0.188	MG/M3
TIME WEIGHTED AVE.= 0.188								
0200	23	EE3	03/24/76	1638	2236	0.6085	0.016	MG/M3
TIME WEIGHTED AVE.= 0.016								
0200	24	EE4	03/23/76	1647	2242	0.6034	0.017	MG/M3
TIME WEIGHTED AVE.= 0.017								
0300	11	EE7	03/24/76	823	1505	0.6833	0.015	MG/M3
0300	11	EE9	03/24/76	823	1503	0.6799	0.015	MG/M3
TIME WEIGHTED AVE.= 0.015								
0300	12	EE8	03/24/76	829	1503	0.6697	0.015	MG/M3
TIME WEIGHTED AVE.= 0.015								
0300	13	EE10	03/24/76	827	1500	0.6680	0.015	MG/M3
TIME WEIGHTED AVE.= 0.015								
0300	14	EE11	03/24/76	838	1508	0.6629	0.015	MG/M3
TIME WEIGHTED AVE.= 0.015								
0300	15	EE12	03/25/76	818	1445	0.6578	0.015	MG/M3
TIME WEIGHTED AVE.= 0.015								

TABLE 4. STATISTICS

AGENT: IRON
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /ATOMIC ABSORP.

JOB CODE	NO. OF SAMPLES	RANGE MG/M3 (HI-LOW)	MEAN MG/M3	MEDIAN MG/M3	T.W. AVE.	STANDARD DEVIATION	STANDARD ERROR	JOB TITLE
0200	006	000.148-000.014	0.081	0.083	0.091	0.053	0.022	STATIONARY SAMPLES
AREA 02	006	000.148-000.014	0.081	0.083		0.053	0.022	
0300	006	000.015-000.015	0.015	0.015	0.015	0.000	0.000	STATIONARY SAMPLES
AREA 03	006	000.015-000.015	0.015	0.015		0.000	0.000	
PLANT TOTAL	012	000.148-000.015	0.028	0.014		0.038	0.011	

END OF REPORT

TABLE 2. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.	
MANGANESE	TOTAL MASS	ATOMIC ABSORP.	TOTAL MASS SAMPLES ARE COLLECTED ON AA MILLIPORE FILTERS (0.8UM PORE SIZE) 37MM DIAMETER WITH A FLOW RATE OF 1.7 LITERS PER MINUTE. FILTERS ARE PRE AND POST DESICATED AND WEIGHED TO THE NEAREST 0.1MG USING A CAHN GRAM ELECTROBALANCE. TRACE METAL DETERMINATIONS ARE MADE BY ATOMIC ABSORPTION WITH CONCENTRATIONS REPORTED AS MG/M3.

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: MANGANESE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /ATOMIC ABSORP.

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
0200	11	EE6	03/24/76	810	1452	0.6833	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	12	EE13	03/25/76	922	1447	0.5528	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	21	EE1	03/23/76	1645	2239	0.6017	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	22	EE2	03/23/76	1641	2238	0.6068	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	23	EE3	03/24/76	1638	2236	0.6085	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	24	EE4	03/23/76	1647	2242	0.6034	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	11	EE7	03/24/76	823	1505	0.6833	0.000	MG/M3
0300	11	EE9	03/24/76	823	1503	0.6799	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	12	EE8	03/24/76	829	1503	0.6697	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	13	EE10	03/24/76	827	1500	0.6680	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	14	EE11	03/24/76	838	1508	0.6629	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	15	EE12	03/25/76	818	1449	0.6578	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								

TABLE 3. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.	
NICKEL	TOTAL MASS	ATOMIC ABSORP.	TOTAL MASS SAMPLES ARE COLLECTED ON AA MILLIPORE FILTERS (0.8UM PORE SIZE) 37MM DIAMETER WITH A FLOW RATE OF 1.7 LITERS PER MINUTE. FILTERS ARE PRE AND POST DESICATED AND WEIGHED TO THE NEAREST 0.1MG USING A CAHN GRAM ELECTROBALANCE. TRACE METAL DETERMINATIONS ARE MADE BY ATOMIC ABSORPTION WITH CONCENTRATIONS REPORTED AS MG/M3.

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: NICKEL
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /ATOMIC ABSORP.

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
0200	11	EE6	03/26/76	810	1452	0.6833	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	12	EE13	03/25/76	922	1447	0.5524	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	21	EE1	03/23/76	1645	2239	0.6017	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	22	EE2	03/23/76	1641	2238	0.6048	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	23	EE3	03/26/76	1638	2236	0.6085	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	24	EE8	03/23/76	1647	2242	0.6034	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	11	EE7	03/24/76	823	1505	0.6833	0.000	MG/M3
0300	11	EE9	03/26/76	823	1503	0.6799	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	12	EE8	03/24/76	829	1503	0.6697	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	13	EE10	03/24/76	0827	1500	0.6680	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	14	EE11	03/24/76	838	1508	0.6629	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	15	EE12	03/25/76	818	1445	0.6578	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								

TABLE 8. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.	
ZINC	TOTAL MASS	ATOMIC ABSORP.	TOTAL MASS SAMPLES ARE COLLECTED ON AA MILLIPORE FILTERS (0.8UM PORE SIZE) 37MM DIAMETER WITH A FLOW RATE OF 1.7 LITERS PER MINUTE. FILTERS ARE PRE AND POST DESICATED AND WEIGHED TO THE NEAREST 0.1MG USING A CAHN GRAM ELECTROBALANCE. TRACE METAL DETERMINATIONS ARE MADE BY ATOMIC ABSORPTION WITH CONCENTRATIONS REPORTED AS MG/M3.

TABLE 3. INDIVIDUAL SAMPLE RESULTS

AGENT: ZINC
SAMPLE METHOD/ANALYTICAL TECHNIQUE: TOTAL MASS /ATOMIC ABSORP.

JOB CODE	SHIFT MAN NO.	SAMPLE NO.	DATE	TIME ON	TIME OFF	VOLUME M3	CONC.	UNITS
0200	11	EE6	03/24/76	810	1452	0.6833	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	12	EE13	03/25/76	922	1447	0.5524	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	21	EE1	03/23/76	1645	2239	0.6017	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	22	EE2	03/23/76	1641	2238	0.6068	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	23	EE3	03/24/76	1638	2236	0.6085	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0200	24	EE4	03/23/76	1647	2242	0.6034	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	11	EE7	03/24/76	823	1505	0.6833	0.000	MG/M3
0300	11	EE9	03/24/76	823	1503	0.6799	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	12	EE8	03/20/76	829	1503	0.6697	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	13	EE10	03/24/76	827	1500	0.6680	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	14	EE11	03/24/76	838	1508	0.6629	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								
0300	15	EE12	03/25/76	818	1445	0.6578	0.000	MG/M3
TIME WEIGHTED AVE.= 0.000								

ATTAPULGUS GEORGIA

DATE OF STUDY: 03/22/76 - 03/26/76

AGENT STUDIED: CADMIUM

SIC CODE: 9160 COUNTY: DECATUR

SETTLED DUST ANALYSIS FOR CADMIUM. NO.1 NEAR BAGGING OPER. RAYMOND MILL 1.3 PPM, NO.2 SAME AREA 0.9 PPM, NO.3 DUST BEHIND DRYERS 1.7 PPM, NO.4 UNDER HAMMER MILL 4.0 PPM, NO.5 DUST AT PUGMILL 2.4 PPM, NO.6 BAGGING A T NO.3 MILL 1.7 PPM, NO.7 SAME AREA 3.2 PPM.

ATTAPULGUS GEORGIA

DATE OF STUDY: 03/22/76 - 03/26/76

AGENT STUDIED: CHROMIUM

SIC CODE: 9140 COUNTY: DECATUR

SETTLED DUST ANALYSIS FOR CHROMIUM, NO.1 NEAR BAGGING OPER, RAYMOND MILL 105.0 PPM, NO.2 SAME AREA 103.0 PPM, NO.3 DUST BEHIND DRYERS 66.0 PPM, NO.4 UNDER HAMMER MILL 64.0 PPM, NO.5 DUST AT PUGMILL 76.0 PPM, NO.6 BAGGING AT NO.3 MILL 113.0 PPM, NO.7 SAME AREA 114.0 PPM.

ATTAPULGUS GEORGIA

DATE OF STUDY: 03/22/76 - 03/26/76

AGENT STUDIED: COBALT

SIC CODE: 9160 COUNTY: DECATUR

SETTLED DUST ANALYSIS FOR COBALT, NO.1 NEAR BAGGING OPER. RAYMOND MILL 5.0 PPM, NO.2 SAME AREA 6.0 PPM, NO.3 DUST BEHIND DRYERS 38.0 PPM, NO.4 UNDER HAMMER MILL 9.0 PPM, NO.5 DUST AT PUGMILL 6.0 PPM, NO.6 BAGGING AT NO.3 MILL 16.0 PPM NO.7 SAME AREA 25.0 PPM

ATTAPULGUS GEORGIA

DATE OF STUDY: 03/22/76 - 03/26/76

AGENT STUDIED: IRON

SIC CODE: 9160 COUNTY: DECATUR

SETTLED DUST ANALYSIS FOR IRON, NO.1 NEAR BAGGING OPER, RAYMOND MILL 1800
0.0 PPM, NO.2 SAME AREA 15100.0 PPM, NO.3 DUST BEHIND DRYERS 21500.0 PPM
NO.4 UNDER HAMMER MILL 10000.0 PPM, NO.5 DUST AT PUGMILL 16100.0 PPM, N
0.6 BAGGING AT NO.3 MILL 21000.0 PPM, NO.7 SAME AREA 23600.0 PPM.

ATTAPULGUS GEORGIA

DATE OF STUDY: 03/22/76 - 03/26/76

AGENT STUDIED: MANGANESE

SIC CODE: 9160 COUNTY: DECATUR

SETTLED DUST ANALYSIS FOR MANGANESE. NO.1 NEAR BAGGING OPER, RAYMOND MI-
LL 463 PPM, NO.2 SAME AREA 240 PPM, NO.3 DUST BEHIND DRYERS 481 PPM, NO-
.4 UNDER HAMMER MILL 489 PPM, NO.5 DUST AT PUGMILL 460 PPM, NO.6 BAGGIN-
G AT NO.3 MILL 322 PPM, NO.7 SAME AREA 438 PPM

ATTAPULGUS GEORGIA

DATE OF STUDY: 03/22/76 - 03/26/76

AGENT STUDIED: NICKEL

SIC CODE: 9160 COUNTY: DECATUR

SETTLED DUST ANALYSIS FOR NICKEL, NO.1 NEAR BAGGING OPER. RAYMOND MILL: 52 PPM, NO.2 SAME AREA 26 PPM, NO.3 DUST BEHIND DRYERS 1190 PPM, NO.4 UNDER HAMMER MILL 17 PPM, NO.5 DUST AT PUGMILL 165 PPM, NO.6 BAGGING AT NO.3 MILL 20 PPM, NO.7 SAME AREA 25 PPM.

ATTAPULGUS GEORGIA

DATE OF STUDY: 03/22/78 - 03/28/78

AGENT STUDIED: ZINC

SIC CODE: 9160 COUNTY: DECATUR

SETTLED DUST ANALYSIS FOR ZINC, NO.1 NEAR BAGGING OPER. RAYMOND MILL 72 PPM, NO.2 SAME AREA 78 PPM, NO.3 DUST BEHIND DRYERS 80 PPM, NO.4 UNDER HAMMER MILL 68 PPM, NO.5 DUST AT PUGMILL 84 PPM, NO.6 BAGGING AT NO.3 MILL 107 PPM, NO.7 SAME AREA 94 PPM

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TABLE 2. SAMPLING PROCEDURES

AGENT	SAMPLING METHOD	ANALYTICAL TECH.		
NOISE	GENERAL AREA	SOUND LEVEL DBA	SOUND LEVEL MEASUREMENTS ARE MADE ON THE DBA WEIGHTED SCALE. MEASUREMENTS ARE MADE USING A GENERAL RADIO 1565A SOUND LEVEL METER NEAR THE WORK AREAS.	

TABLE 3, INDIVIDUAL SAMPLE RESULTS

AGENT: NOISE
SAMPLE METHOD/ANALYTICAL TECHNIQUE: GENERAL AREA /SOUND LEVEL DBA

CODE	MAN NO.	SAMPLE NO.	DATE	TIME OF MEASUREMENT	NOISE LEVEL		UNITS	
0215	1A	005	03/25/76	1038	90.0000	0.000	DBA	89-91 DBA AT BAGGER IN RAYMOND MILL.
0215	1B	004	03/25/76	1030	85.0000	0.000	DBA	84-86 DBA UNDERNEATH NUMBER 4 MILL NEAR BAGGING.
0215	11	014	03/25/76	1125	86.0000	0.000	DBA	85-87 DBA AT PUGMILL, RECONSTRUCTION OF PINES.
0215	12	013	03/25/76	1120	85.0000	0.000	DBA	84-86 DBA INSIDE CONTROL ROOM FOR BONNOT PUG MILL.
0215	13	012	03/25/76	1118	85.0000	0.000	DBA	84-86 DBA INSIDE BOOTH AT CRUSHER.
0215	14	011	03/25/76	1115	104.0000	0.000	DBA	103-105 DBA UPSTAIRS NEXT TO CRUSHER.
0215	15	010	03/25/76	1110	91.0000	0.000	DBA	90-92 DBA UNDERNEATH HAMMER MILL.
0215	16	009	03/25/76	1105	87.0000	0.000	DBA	86-88 DBA BETWEEN DRYERS.
0215	17	008	03/25/76	1058	74.0000	0.000	DBA	73-75 DBA INSIDE CONTROL ROOM AT DRYERS.
0215	18	007	03/25/76	1055	93.0000	0.000	DBA	92-94 DBA FRONT OF DRYERS AT CONTROL ROOM.
0215	19	006	03/25/76	1045	83.0000	0.000	DBA	82-84 DBA INSIDE BOOTH IN RAYMOND MILL.
0306	11	003	03/25/76	1020	95.0000	0.000	DBA	94-96 DBA NEAR TRIMMING OF 1&1B, CAT ABSORBENTBAGGER.
0306	12	002	03/25/76	1015	86.0000	0.000	DBA	85-87 DBA NEAR 5&1B, MULTI FLOOR ABSORBENT BAGGER.
0306	13	001	03/25/76	1005	87.0000	0.000	DBA	SOUND LEVEL MEASUREMENT TAKEN DURING NORMAL OPER.

END OF REPORT