Emission Factor Documentation for AP-42
Section 11.26

Talc Processing

Final Report

For U. S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Factor and Inventory Group

EPA Contract 68-D2-0159
Work Assignment No. II-01

MRI Project No. 4602-01

July 1995

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Research Triangle Park, NC 27711

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NOTICE

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PREFACE

This report was prepared by Midwest Research Institute (MRI) for the Office of Air Quality Planning and Standards (OAQPS), U. S. Environmental Protection Agency (EPA), under Contract No. 68-D2-0159, Work Assignment No. II-01. Mr. Ron Myers was the requester of the work.

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EMISSION FACTOR DOCUMENTATION FOR AP-42 SECTION 11.26
Talc Processing

1. INTRODUCTION

The document *Compilation of Air Pollutant Emission Factors* (AP-42) has been published by the U. S. Environmental Protection Agency (EPA) since 1972. Supplements to AP-42 have been routinely published to add new emission source categories and to update existing emission factors. AP-42 is routinely updated by EPA to respond to new emission factor needs of EPA, State and local air pollution control programs, and industry.

An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors usually are expressed as the weight of pollutant divided by the unit weight, volume, distance, or duration of the activity that emits the pollutant. The emission factors presented in AP-42 may be appropriate to use in a number of situations, such as making source-specific emission estimates for areawide inventories for dispersion modeling, developing control strategies, screening sources for compliance purposes, establishing operating permit fees, and making permit applicability determinations. The purpose of this report is to provide background information from test reports and other information to support preparation of AP-42 Section 11.26, Talc Processing.

This background report consists of five sections. Section 1 includes the introduction to the report. Section 2 gives a description of the talc processing industry. It includes a characterization of the industry, a description of the different process operations, a characterization of emission sources and pollutants emitted, and a description of the technology used to control emissions resulting from these sources. Section 3 is a review of emission data collection (and emission measurement) procedures. It describes the literature search, the screening of emission data reports, and the quality rating system for both emission data and emission factors. Section 4 details how the new AP-42 section was developed. It includes the review of specific data sets and a description of how candidate emission factors were developed. Section 5 presents the AP-42 Section 11.26, Talc Processing.

2. INDUSTRY DESCRIPTION

2.1 INDUSTRY CHARACTERIZATION[1-4,17]

Talc, which is a soft, hydrous magnesium silicate ($3MgO \cdot 4SiO_2 \cdot H_2O$), is used in a wide range of industries including the manufacture of ceramics, paints, paper, and asphalt roofing. The end uses for talc are determined by variables such as chemical and mineralogical composition, particle size and shape, specific gravity, hardness, and color. The Standard Industrial Classification (SIC) code for talc mining is 1499 (miscellaneous nonmetallic minerals, except fuels), and the SIC code for talc processing is 3295 (minerals and earths, ground or otherwise treated). There is no Source Classification Code (SCC) for the source category.

The word talc refers to a wide variety of rocks and rock products. Soapstone is a massive, impure, talcose rock that has a variable talc content that can exceed 50 percent. It has a slippery feeling and can be carved by hand. Steatite contains a high-purity talc suitable for making electrical insulators. These talc-containing rocks (soapstone and steatite) will be treated as talc in this section. The color of talc varies from snow-white to greenish-gray and various shades of green. The specific gravity of talc ranges from 2.6 to 2.8.

In theory, talc is composed of 63.4 percent silicon dioxide (SiO_2), 31.9 percent magnesium oxide (MgO), and 4.7 percent water (H_2O). The actual composition of commercial talc may vary widely from these levels. Talcose rocks may contain mineral impurities that are composed of one or more of the following oxides, ranging in concentration from a trace to several percent: iron, titanium, aluminum, calcium, chromium, cobalt, manganese, nickel, phosphorus, potassium, or sodium. For most end-uses, these impurities are undesirable and are removed to the extent feasible. Tremolite, anthophylite, and actinolite, may be found in talc deposits, but are rarely fibrous in such deposits. Chrysotile also can be found in some talc deposits, but is extremely rare.

Talc deposits can be found in many parts of the world. In 1992, talc minerals were mined and processed at 19 mines in 8 States, and domestic production amounted to 997,000 megagrams (Mg) (1,099,000 tons). Talc mines in Montana, New York, Texas, and Vermont accounted for about 98 percent of total domestic production in 1992.

The largest use of talc-group minerals is for manufacturing of ceramics (31 percent of total 1992 U.S. production), which includes sanitary ware, floor and wall tile, dinnerware glazes, and electrical porcelains. For these end-products, adding talc to the usual clay-silica-feldspar body mixtures facilitates the firing of the ware and improves the quality. The second largest user of talc minerals is the paper industry (20 percent). The third major use of talc is as a filler or a pigment for paints (18 percent), followed by roofing applications (9 percent), plastics (5 percent), and cosmetics (5 percent). Talc also is used in the production of synthetic rubber, insecticides, and pharmaceuticals.

Grades of talc are most frequently identified with the end use. Some of the important desirable properties are softness and smoothness, color, luster, high slip tendency, moisture content, oil and grease absorption, chemical inertness, fusion point, heat and electrical conductivity, and high dielectrical strength.

2.2 PROCESS DESCRIPTION[1-2,4-7,16-17]

Most domestic talc is mined from open-pit operations; over 95 percent of the talc ore produced in the United States comes from open-pit mines. Mining operations usually consist of conventional drilling and blasting methods.

Figure 2-1 is a process flow diagram for a typical domestic talc plant. Talc ore generally is hauled to the plant by truck from a nearby mine. The ore is crushed, typically in a jaw crusher, and screened. The coarse (oversize) material then is returned to the crusher. Rotary dryers may be used to dry the material. Secondary grinding is achieved with pebble mills or roller mills, producing a product that is 44 to 149 micrometers (μm) (325 to 100 mesh) in size. Some roller mills are designed to use heated air to dry the material as it is being ground. Hammer mills or steam- or compressed air-powered jet mills may be used to produce additional fine products. Air classifiers (separators), generally in closed-circuit with the mills, separate the material into coarse, coarse-plus-fine, and fine fractions. The coarse and coarse-plus-fine fractions then are stored as products. The fines may be concentrated using a shaking table (tabling process) to separate product containing small quantities of nickel, iron, cobalt, or other minerals, and then undergo a one-step flotation process. The resultant talc slurry is dewatered and filtered prior to passing through a flash dryer. The flash-dried product is then stored for shipment, or it may be further ground to meet customer specifications. The classified material may also be pelletized prior to packaging for specific applications. In the pelletizing step, processed talc is mixed with water to form a paste and then extruded as pellets.

2.3 EMISSIONS[1-2,4-5,9-17]

The primary pollutant of concern in talc processing is particulate matter (PM) and PM less than 10 μm (PM-10). Particulate matter is emitted from drilling, blasting, crushing, screening, grinding, drying, calcining, classifying, materials handling and transfer operations, packaging, and storage. Although pelletizing is a wet process, PM may emitted from the transfer and feeding of processed talc to the pelletizer. Depending on the purity of the talc ore body, PM emissions may include trace amounts of several inorganic compounds that are listed hazardous air pollutants (HAP), including arsenic, cadmium, chromium, cobalt, manganese, nickel, and phosphorus.

The emissions from dryers and calciners include products of combustion, such as carbon monoxide, carbon dioxide, nitrogen oxides, and sulfur oxides, in addition to filterable and condensible PM. Volatile organic compounds (VOC) also are emitted from the drying and calcining of southwestern United States talc deposits, which generally contain organic impurities. Products of combustion and VOC may also be emitted from roller mills that use heated air and from the furnaces that provide the heated air to the mill.

In the mid to late 1970's, the suspected presence of asbestos in the talc deposits located in upper New York State was a major controversy. The National Institute for Occupational Health and Safety (NIOSH) reported that the talc deposits in that region contained significant quantities of tremolite and anthophylite asbestos and reported elevated rates of lung cancer among those exposed to the talc. Later studies funded by the company mining the talc concluded that the material identified as asbestos in the NIOSH report was amphibole cleavage fragments rather than asbestos. The studies also concluded that the elevated cancer rates did not appear to be related to exposure to the talc dust mined from the deposits in question. Although some disagreement remains, the preponderance of evidence does not support the conclusion that the talc from those deposits contains asbestos.

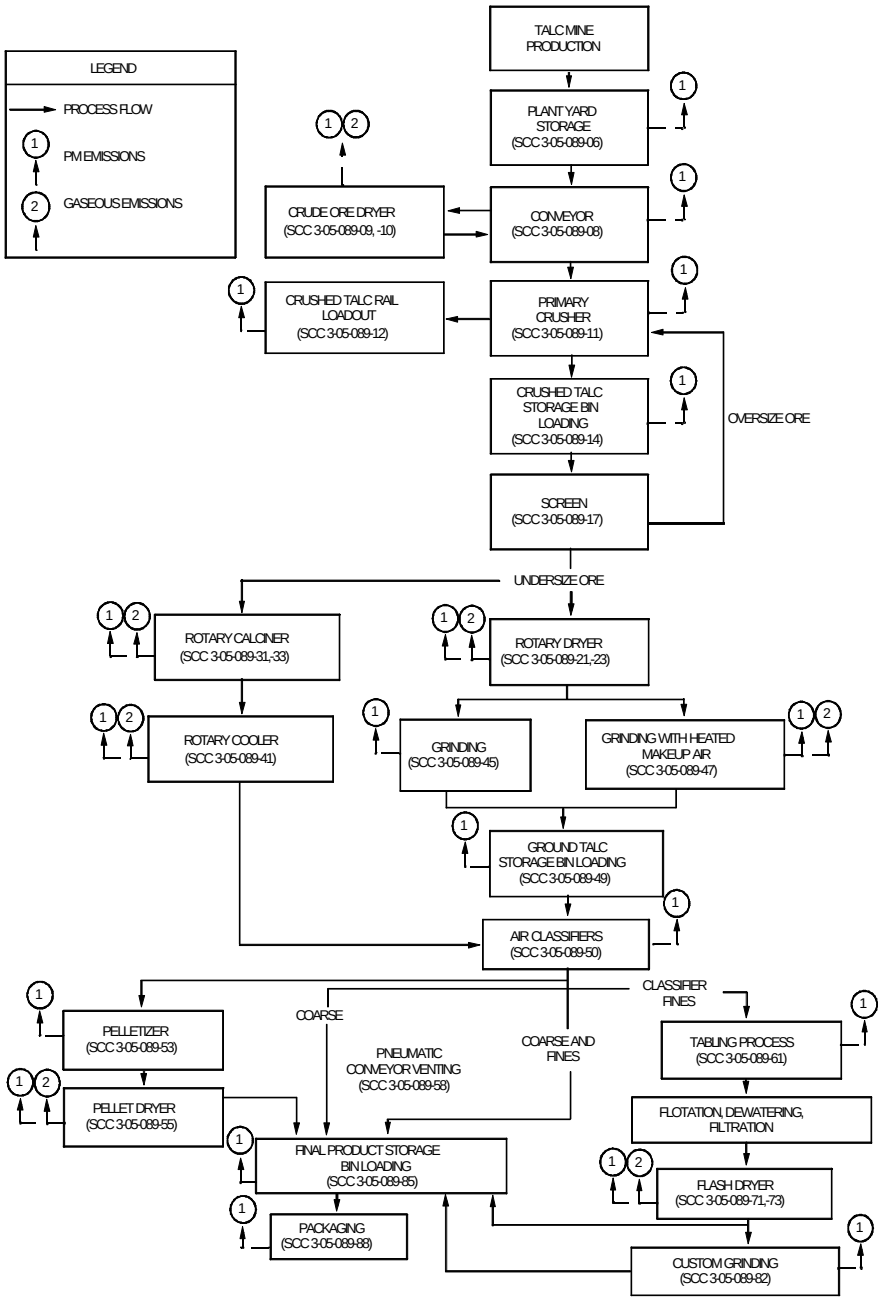

Figure 2-1. Process flow diagram for talc processing.[1,4,6]

2.4 EMISSION CONTROL TECHNOLOGY[1,11-15]

Because of the need for product recovery, most emission sources at talc processing plants are equipped with PM control devices. Fabric filters are commonly used to control emissions from crushing, grinding, screening, conveying, classifying, storage silo loading, and bagging operations. Cyclones also are used to capture particles in emission streams from some processing units.

REFERENCES FOR SECTION 2

1. *Calciners and Dryers in Mineral Industries--Background Information for Proposed Standards*, EPA-450/3-025a, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1985.

2. L. A. Roe and R. H. Olson, "Talc", *Industrial Rocks and Minerals, Volume I*, Society of Mining Engineers, New York, NY, 1983.

3. R. L. Virta, "Talc in 1992", *Mineral Industry Surveys, Annual, Preliminary*, Bureau of Mines, U.S. Department of the Interior, Washington, DC, January 1993.

4. Written communication from B. Virta, Bureau of Mines, U.S. Department of the Interior, Washington, D.C., to R. Myers, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 28, 1994.

5. Written communication from J. Kelse, R. T. Vanderbilt Company, Inc., Norwalk, Connecticut, to R. Myers, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 21, 1994.

6. Written communication from S. Harms, Montana Talc Company, Three Forks, Montana, to R. Myers, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 1994.

7. R. L. Virta, *The Talc Industry--An Overview*, Information Circular 9220, Bureau of Mines, U.S. Department of the Interior, Washington, DC, 1989.

8. *Emission Study at a Talc Crushing and Grinding Facility, Eastern Magnesia Talc Company, Johnson, Vermont, October 19-21, 1976*, Report No. 76-NMM-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, 1977.

9. *Occupational Exposure to Talc Containing Asbestos*, DHEW (NIOSH) Publication No. 80-115, National Institute for Occupational Safety and Health, U.S. Department Of Health, Education, and Welfare, Washington, DC, February 1980.

10. *An Evaluation of Mineral Particles at Governeur Talc Company, 1975 and 1982: A Comparison of Mineralogical Results Between NIOSH and DGC*, Dunn Geoscience Corporation, Latham, NY, January 4, 1985.

11. R. A. James and K. Ganesan, *Particulate Emissions from Montana Talc Company, Sappington, Montana, December 1986*, Whitehall, MT, December 1986.

12. *Emission Test Report--Plant A, Test No. 1, July 1990*, Document No. 4602-01-01, Confidential Business Information Files, Contract No 68-D2-0159, Assignment No. 2-01, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 2, 1995.

13. *Emission Test Report--Plant A, Test No. 2, September 1990*, Document No. 4602-01-01, Confidential Business Information Files, Contract No 68-D2-0159, Assignment No. 2-01, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 2, 1995.

14. *Initial Compliance Test for Particulate Emissions, Luzenac America, Three Forks Mill, Montana Air Quality Permit #2282-02, January/February 1995*, Bison Engineering, Inc., Helena, MT, April 25, 1995.

15. *Particulate Emissions Compliance Test, Luzenac America, Sappington Mill, Montana Air Quality Permit 1996-03, December 1994-March 1995*, Bison Engineering, Inc., Helena, MT, March 29, 1995.

16. Written communication from J. Parks, Barretts Minerals Incorporated, Dillon, Montana, to R. Myers, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 23, 1995.

17. Written communication from R. Virta, Bureau of Mines, U. S. Department of Commerce, Washington, D.C., to R. Myers, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 13, 1995.

3. GENERAL DATA REVIEW AND ANALYSIS PROCEDURES

3.1 LITERATURE SEARCH AND SCREENING

Data for this investigation were obtained from a number of sources within the Office of Air Quality Planning and Standards (OAQPS) and from outside organizations. The AP-42 background files located in the Emission Factor and Inventory Group (EFIG) were reviewed for information on the industry, processes, and emissions. The Factor Information and Retrieval (FIRE), Crosswalk/Air Toxic Emission Factor Data Base Management System (XATEF), and VOC/PM Speciation Data Base Management System (SPECIATE) data bases were searched by SCC code for identification of the potential pollutants emitted and emission factors for those pollutants. A general search of the Air CHIEF CD-ROM also was conducted to supplement the information from these data bases.

Information on the industry, including number of plants, plant location, and annual production capacities, was obtained from the Bureau of Mines and other sources. The Aerometric Information Retrieval System (AIRS) data base also was searched for data on the number of plants, plant location, and estimated annual emissions of criteria pollutants. A number of sources of information were investigated specifically for emission test reports and data. A search of the Test Method Storage and Retrieval (TSAR) data base was conducted to identify test reports for sources within the talc processing industry. Copies of these test reports were obtained from the files of the Emissions, Monitoring, and Analysis Division (EMAD). The EPA library was searched for additional test reports. Using information obtained on plant locations, State and Regional offices were contacted about the availability of test reports. Publications lists from the Office of Research and Development (ORD) and Control Technology Center (CTC) were also searched for reports on emissions from the talc processing industry. In addition, information about the industry and emissions was obtained from several talc processing facilities.

To screen out unusable test reports, documents, and information from which emission factors could not be developed, the following general criteria were used:

1. Emission data must be from a primary reference:

a. Source testing must be from a referenced study that does not reiterate information from previous studies.

b. The document must constitute the original source of test data. For example, a technical paper was not included if the original study was contained in the previous document. If the exact source of the data could not be determined, the document was eliminated.

2. The referenced study should contain test results based on more than one test run. If results from only one run are presented, the emission factors must be down rated.

3. The report must contain sufficient data to evaluate the testing procedures and source operating conditions (e.g., one-page reports were generally rejected).

A final set of reference materials was compiled after a thorough review of the pertinent reports, documents, and information according to these criteria.

3.2 DATA QUALITY RATING SYSTEM[1]

As part of the analysis of the emission data, the quantity and quality of the information contained in the final set of reference documents were evaluated. The following data were excluded from consideration:

1. Test series averages reported in units that cannot be converted to the selected reporting units;

2. Test series representing incompatible test methods (i.e., comparison of EPA Method 5 front-half with EPA Method 5 front and back-half);

3. Test series of controlled emissions for which the control device is not specified;

4. Test series in which the source process is not clearly identified and described; and

5. Test series in which it is not clear whether the emissions were measured before or after the control device.

Test data sets that were not excluded were assigned a quality rating. The rating system used was that specified by EFIG for preparing AP-42 sections. The data were rated as follows:

A — Multiple tests that were performed on the same source using sound methodology and reported in enough detail for adequate validation. These tests do not necessarily conform to the methodology specified in EPA reference test methods, although these methods were used as a guide for the methodology actually used.

B — Tests that were performed by a generally sound methodology but lack enough detail for adequate validation.

C — Tests that were based on an untested or new methodology or that lacked a significant amount of background data.

D — Tests that were based on a generally unacceptable method but may provide an order-of-magnitude value for the source.

The following criteria were used to evaluate source test reports for sound methodology and adequate detail:

1. Source operation. The manner in which the source was operated is well documented in the report. The source was operating within typical parameters during the test.

2. Sampling procedures. The sampling procedures conformed to a generally acceptable methodology. If actual procedures deviated from accepted methods, the deviations are well documented. When this occurred, an evaluation was made of the extent to which such alternative procedures could influence the test results.

3. Sampling and process data. Adequate sampling and process data are documented in the report, and any variations in the sampling and process operation are noted. If a large spread between test results

cannot be explained by information contained in the test report, the data are suspect and are given a lower rating.

4. Analysis and calculations. The test reports contain original raw data sheets. The nomenclature and equations used were compared to those (if any) specified by EPA to establish equivalency. The depth of review of the calculations was dictated by the reviewer's confidence in the ability and conscientiousness of the tester, which in turn was based on factors such as consistency of results and completeness of other areas of the test report.

3.3 EMISSION FACTOR QUALITY RATING SYSTEM[1]

The quality of the emission factors developed from analysis of the test data was rated using the following general criteria:

A — Excellent: Developed only from A-rated test data taken from many randomly chosen facilities in the industry population. The source category is specific enough so that variability within the source category population may be minimized.

B — Above average: Developed only from A-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industries. The source category is specific enough so that variability within the source category population may be minimized.

C — Average: Developed only from A- and B-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. In addition, the source category is specific enough so that variability within the source category population may be minimized.

D — Below average: The emission factor was developed only from A- and B-rated test data from a small number of facilities, and there is reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source category population. Limitations on the use of the emission factor are noted in the emission factor table.

E — Poor: The emission factor was developed from C- and D-rated test data, and there is reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population. Limitations on the use of these factors are footnoted.

The use of these criteria is somewhat subjective and depends to an extent upon the individual reviewer. Details of the rating of each candidate emission factor are provided in Section 4.

REFERENCE FOR SECTION 3

1. *Technical Procedures for Developing AP-42 Emission Factors and Preparing AP-42 Sections*, EPA-454/B-93-050, Office of Air Quality Planning and Standards, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1993.

4. REVIEW OF SPECIFIC DATA SETS

4.1 INTRODUCTION

This section describes the references that were reviewed for data on emissions from talc processing sources and how the data was used to develop candidate emission factors for this source category. A total of 11 emission test reports were reviewed. The following paragraphs summarize the information presented in those reports.

4.2 REVIEW OF SPECIFIC DATA SETS

4.2.1 Reference 1

This report documents an emission test at a talc processing plant conducted in 1976. Uncontrolled and controlled filterable and condensible inorganic PM emissions and particle size distribution were measured. The PM emissions were measured using a modified Method 17. The particle size distribution was measured using an Alundum thimble connected to the nozzle by a 12-in. steel probe, followed by a 47-millimeter-type SGA filter. The particle size distribution of the portion of the sample found to be less than 45 μm was determined using electronic particle counter methods. Table 4-1 summarizes the particle size distribution. Because the test report did not include process operating rates, emission factors could not be developed from the emission data. Because optical procedures rather than inertial separators were used to determine the particle size distribution, the data are rated E.

4.2.2 Reference 2

This report documents the results of emission tests conducted on a talc processing impact mill and a ground talc storage bin loading operation. The tests were conducted in 1986 to demonstrate compliance with State regulations.

The sources tested were each ducted to a separate fabric filter, and only controlled emissions were measured. Filterable PM emissions were quantified using Method 5. Although three test runs were conducted, the report includes only the average production rates and filterable PM emission concentrations for the tests. In addition, due to the configuration of the stack, measurements could be made along one traverse only.

Emission factors were developed for filterable PM emissions from the sources tested. Because of the lack of adequate detail in the report and the deviation in sampling procedures described above, the emission data are assigned a rating of D.

4.2.3 Reference 3

This report documents measurement of filterable PM emissions from a talc primary crusher, crushed ore screen, roller mill, and bagging operation. The sources tested were each ducted to a separate fabric filter, and only controlled emissions were measured. The tests were conducted in 1990 to demonstrate compliance with State regulations.

TABLE 4-1. SUMMARY OF PARTICLE SIZE DISTRIBUTION DATA FROM A TALC CRUSHING AND GRINDING FACILITY[a]

Process	Diameter, μm[b]	Cumulative weight, g	Cumulative percent less than diameter
Primary/secondary crushing	55.4	1.564	91.3
	34.9	3.932	78.2
	22.0	7.822	56.7
	17.4	9.546	47.2
	11.0	11.063	38.8
	6.9	14.197	21.4
	3.0	17.521	3.0
	2.0	17.898	0.94
	1.0	18.049	0.11
Vertical mill	29.0	0.002	100.0
	18.8	0.017	99.7
	14.9	0.031	99.4
	11.9	0.144	97.1
	9.4	0.943	80.8
	7.5	2.792	43.3
	4.7	4.554	7.5
	3.0	4.821	2.1
	1.9	4.908	0.28
	1.0	4.920	0.04
Storage, bagging, air classification	43.9	0.014	99.9
	27.7	0.339	97.9
	17.4	2.141	86.6
	13.8	4.289	73.2
	11.0	6.922	56.8
	6.9	12.108	24.5
	4.4	14.847	7.4
	3.0	15.534	3.1
	2.0	15.885	0.92
	1.0	16.016	0.10

[a]Reference 1. Data rated D.

The primary crusher reduces material up to 100 centimeters (cm) (40 in.) in size to less than 14.6 cm (5.75 in.). Emissions from the crusher are collected at the ore feed point, at the crushed ore discharge point, and along the skirted conveyor that transports crushed material to the screen. The emission stream is ducted to a cartridge type fabric filter. The material exiting the screen is deposited through a chute onto a conveyor. Emissions from the screen are combined with emissions collected from two pickup points along the conveyor located on the discharge side of the screen and ducted to a cartridge type fabric filter. In the roller mill, crushed talc ore is ground to a fine powder. The roller mill system includes a furnace to provide heated makeup air to entrain the fine particles, which are passed through a product recovery cyclone. The recovered product is classified by means of a pair of vibrating screens. Undersize material is pneumatically conveyed to storage and oversize material is returned to the roller mill. In the bagging operation, talc of four different grades (Grades 36, 85, and 100, and a special order) is bagged separately. Emissions from the bagging operation are ducted to two fabric filters.

Filterable PM emissions were quantified using a Method 5 sampling train with an unheated filter, and three test runs were conducted. In addition, carbon dioxide (CO_2) concentrations in the exhaust stream from the roller mill were measured using fyrite. Although no problems were identified in the report, the information provided in Reference 4 indicates that the fabric filter that controlled emissions from the roller mill was malfunctioning during the test.

Emission factors were developed for filterable PM emissions from all sources and for CO_2 emissions from the roller mill. The emission factors for the primary crushing, screening, and bagging operations were rated B; the test method was sound and no problems were reported but run-by-run process rates were not provided. The filterable PM data for the roller mill is rated D due to the problem with the control device. Finally, the CO_2 data for the roller mill was downrated to C because of the test method used and the lack of run-by-run process data.

4.2.4 Reference 4

This report documents the results of a retest of the roller mill subsequent to the test documented in Reference 3. Emissions from the mill were tested after repairs were made to the fabric filter that controls emissions from the mill. The test was conducted in 1990, three months after the test documented in Reference 3.

Filterable PM emissions were quantified using Method 17 with an in-stack filter, and three test runs were conducted. In addition, carbon dioxide (CO_2) concentrations in the exhaust stream from the roller mill were measured using fyrite. No problems were identified in the test report.

Emission factors were developed for emissions of filterable PM and CO_2 from the roller mill. The filterable PM emission factor was rated B; the test method was sound and no problems were reported but run-by-run process rates were not provided. The CO_2 data for the roller mill was downrated to C because of the test method used and the lack of run-by-run process data.

4.2.5 Reference 5

This report documents measurements of emissions of filterable PM and four metals from a talc roller mill. Emissions from the mill are controlled with a fabric filter, and only controlled emissions were measured. The tests were conducted in 1993 to demonstrate compliance with State regulations.

Filterable PM emissions were quantified using a modified Method 17 to allow measurement of metals emissions also. The modification consisted of the stainless steel sampling train equipment being replaced with teflon coated equipment. The sample was analyzed for four metals (arsenic, cadmium, hexavalent chromium, and nickel) using National Institute for Occupational Safety and Health (NIOSH) Method 7300. Two runs were conducted. The talc product and fabric filter catch also were analyzed for the same metals. Table 4-2 summarizes the results of those analyses.

TABLE 4-2. SUMMARY OF METALS ANALYSIS OF TALC PRODUCT AND FABRIC FILTER CATCH[a]

Reference No.	5	6	7
Analyte	Concentration, mg/kg		
Talc product			
Arsenic	802	699	1.55
Cadmium	<0.50	0.964	0.408
Total chromium	NA	NA	6.53
Hexavalent chromium	1.96	<4.03	<0.094
Nickel	522	965	207
Fabric filter catch			
Arsenic	55.1	658	3.32
Cadmium	<0.431	0.984	0.339
Total chromium	NA	NA	12.6
Hexavalent chromium	4.88	<4.06	<0.100

Emission factors were developed for emissions of filterable PM, arsenic, and nickel; hexavalent chromium and cadmium were not detected in the samples. The filterable PM emission data were rated C because only two test runs were conducted and average rather than run-by-run process rates were provided in the report. The metals data are not rated because data from other tests indicate that metal emission rates are inconsistent and dependent on the mineralogy of the talc deposit. Therefore, emission factors based on the metals emission data may not be representative of the industry.

4.2.6 Reference 6

This report documents measurements of emissions of filterable PM and four metals from a talc roller mill. Emissions from the mill are controlled with a fabric filter, and only controlled emissions were measured. The tests were conducted in 1993 to demonstrate compliance with State regulations.

Filterable PM emissions were quantified using a modified Method 17 to allow measurement of metals emissions also. The modification consisted of the stainless steel sampling train equipment being replaced with teflon coated equipment. The sample was analyzed for four metals (arsenic, cadmium, hexavalent chromium, and nickel) using NIOSH Method 7300. Two runs were conducted. The talc product and fabric filter catch also were analyzed for the same metals. Table 4-2 includes the results of those analyses.

Emission factors were developed for emissions of filterable PM, hexavalent chromium, and nickel; arsenic and cadmium were not detected in the samples. The filterable PM emission data were rated C because only two test runs were conducted and average rather than run-by-run process rates were provided in the report. The metals data are not rated because data from other tests indicate that metal emission rates are inconsistent and dependent on the mineralogy of the talc deposit. Therefore, emission factors based on the metals emission data may not be representative of the industry.

4.2.7 Reference 7

This report documents measurements of emissions of filterable PM and four metals from a talc roller mill. The roller mill was located at the same facility for the test documented in Reference 15. Emissions from the mill are controlled with a fabric filter, and only controlled emissions were measured. The tests were conducted in 1993 to demonstrate compliance with State regulations.

Filterable PM emissions were quantified using a modified Method 17 to allow measurement of metals emissions also. The modification consisted of the stainless steel sampling train equipment being replaced with teflon coated equipment. The sample was analyzed for five metal analytes (arsenic, cadmium, hexavalent chromium, total chromium, and nickel) using NIOSH Method 7300. Only one test run was conducted. The talc product and fabric filter catch also were analyzed for the same metals. Table 4-2 includes the results of those analyses.

Emission factors were developed for emissions of filterable PM, cadmium, total chromium, and nickel; arsenic and cadmium were not detected in the samples. However, the filterable PM emission data were not rated because only one test run was conducted. The metals data are not rated because data from other tests indicate that metal emission rates are inconsistent and dependent on the mineralogy of the talc deposit. Therefore, emission factors based on the metals emission data may not be representative of the industry.

4.2.8 Reference 8

This report documents measurements of PM emissions from two silos used in talc processing. The silos are used to store crushed and ground intermediate product prior to classification. The silos are fed intermittently and the stored material is withdrawn continuously. The emission test runs were conducted during periods when the silos were being fed with the crushed and ground talc. Emissions were controlled by fabric filters. The test was conducted in January and February 1995 to demonstrate compliance with State regulations. Process rates were provided on the basis of material feed.

Particulate emissions were measured using Method 5 with a back-half inorganic analysis. Three test runs were conducted on each silo. Although some PM was caught in the impinger (back-half) portion of the sampling train, that material is unlikely to be condensible PM because the emission source operates at ambient temperatures. Therefore, the mass collected in both the front and back halves of the sampling train were totaled and used to develop an emission factor for total PM. Emission factors were developed for total PM emissions from the silos. The emission data are rated B; the test methodology was sound, and no problems were reported, but run-by-run process rates were not provided.

4.2.9 Reference 9

This report documents measurements of PM emissions from several emission sources associated with talc processing. Emissions from all sources were controlled by fabric filters. The test was conducted from December 1994 to March 1995 to demonstrate compliance with State regulations. Process rates were provided on the basis of production.

The following emission sources were tested: a primary crusher and discharge conveyor; the screening and transfer of primary crushed ore; the loading of coarse crushed and screened ore into two storage bins (2 tests); a fluid bed pellet dryer; two air classifying mills that grind and classify crushed material (2 tests); a classifying cyclone that further classifies material discharged from the air classifying mills; the loading of fine product into storage silos (2 tests); a pneumatic conveyor vent located on a pneumatic line that transfers finished product from storage silos to a bagging operation; a bagging operation that dispenses product into 2,000-lb bulk bags; and a central vacuum system that is used collection floor dust.

Particulate matter emissions were measured using Method 5 with a back-half inorganic analysis. Three test runs were conducted for each source. Although some PM was caught in the impinger (back-half) portion of the sampling train, that material is unlikely to be condensible PM because the emission source operates at ambient temperatures. Therefore, the mass collected in both the front and back halves of the sampling train were totaled and used to develop an emission factor for total PM. Emission factors were developed for total PM emissions from all of the sources tested with the exception of the central vacuum system and the pellet dryer. Emission factors could not be developed from the vacuum system data because there are no process rates associated with the vacuuming operation. Because a pellet dryer operates at elevated temperatures, it is possible for material to volatilize within the dryer and condense in the impingers of the sampling train. Therefore, for the pellet dryer, the front- and back-half data were used to derive emission factors for filterable and condensible inorganic PM, respectively. With the exception of the data for the pellet dryer, the emission data are rated B; the test methodology was sound, and no problems were reported, but run-by-run process rates were not provided. The pellet dryer data are rated C because the report did not include complete data for one of the three test runs.

4.2.10 Reference 10

This report documents measurements of PM emissions from a crushed talc rail loadout system equipped with a fabric filter. The test was conducted in May 1995 to demonstrate compliance with State regulations. Process rates were provided on the basis of production (material loaded into rail cars).

Particulate matter emissions were measured using Method 5 with a back-half inorganic analysis, and three test runs were conducted. Although some PM was collected in the impinger (back-half) portion of the sampling train, that material is unlikely to be condensible PM because the emission source operates at ambient temperatures. Therefore, the mass collected in both the front and back halves of the sampling train was totaled and used to develop an emission factor for total PM. The emission data are rated B; the test methodology was sound, and no problems were reported, but run-by-run process rates were not provided.

4.2.11 Reference 11

This report documents measurements of PM emissions from a crude ore dryer (loading, exhaust, and unloading) and a primary crushing system (crusher and loadout). Emissions from both sources were controlled by fabric filters. The testing was conducted in February 1994 to demonstrate compliance with State regulations. Process rates were provided on the basis of material load out from the primary crushing system (equal to dryer output).

Particulate matter emissions were measured using Method 5 with a back-half inorganic analysis, and three test runs were conducted on each source. During the crusher/loadout test, some PM was collected in the impinger (back-half) portion of the sampling train. However, that material is unlikely to be condensible PM because the system operates at ambient temperatures. Therefore, the mass collected in both the front and back halves of the sampling train was totaled and used to develop an emission factor for total PM from the primary crusher system. The filterable and condensible measurements for the dryer were reported separately because dryers are potential sources of condensible PM. The emission data are rated A; the test methodology was sound, and no problems were reported, and adequate detail was provided.

4.3 DEVELOPMENT OF CANDIDATE EMISSION FACTORS

Table 4-3 summarizes the available data on emissions from talc processing, and Table 4-4 presents the candidate emission factors for the proposed AP-42 Section 11.26, Talc Processing. Emission factors were developed for the following sources: crude ore drying, primary crushing, crushed ore rail car loading, screening and transfer, storage bin loading, grinding, classifying, pellet drying, pneumatic conveyor venting, and packaging. The following paragraphs describe how the candidate emission factors were developed from the data presented in Table 4-3.

Emission factors were developed primarily for emissions of total PM. As explained in the descriptions of References 8 and 9, PM was quantified in the back-half of the Method 5 sampling train for some of the emission tests. This material generally is classified as condensible PM. However, because the sources that were tested operate at ambient temperatures, the emission stream should not contain condensible PM. Therefore, in the cases for which PM was quantified in the back-half of the sampling train, the back-half and front-half quantities were totalled and are presented as total PM. For some sources, this total PM factor was combined with filterable PM factors from other emission tests to yield the candidate emission factor. In such cases, the candidate emission factor is presented as total PM.

All of the data are based on emissions from sources controlled with fabric filters. Therefore, with the exception of the factor for CO_2 emissions from heated grinding mills, all factors are for fabric filter-controlled emissions; the CO_2 factor is considered as uncontrolled because fabric filters have no affect on CO_2 emissions.

The candidate emission factors generally are presented in units lb/1,000 lb of production. One lb/1,000 lb is equal to 1 kg/Mg. However, the factors for storage bin loading are in units of material loaded into storage bins.

The candidate emission factors generally were developed from one to three B-rated data sets. These factors were assigned a rating of D to reflect the fact that, although the data were of good quality, the number of data sets was relatively small.

TABLE 4-3. SUMMARY OF TEST DATA FOR TALC PROCESSING

Process	APCD[a]	Pollutant[b]	No. of runs	Data rating[c]	Emission factor[d] lb/1,000 lb			Ref. No.
					Minimum	Maximum	Average	
Grinding (impact mill)	FF	Filterable PM	3	D	NS	NS	0.054	2
Ground talc storage silo loading	FF	Filterable PM	3	D	NS	NS	0.064	2
Product bagging	FF	Filterable PM	3	B	0.0013	0.0049	0.0029	3
Primary crushing	FF	Filterable PM	3	B	0.00039	0.00071	0.00053	3
Grinding (roller mill) and screening	FF	Filterable PM	3	D	0.088	0.11	0.097	3
		CO2	3	C	4.0	7.9	6.6	3
Crushed talc screening and transfer	FF	Filterable PM	3	B	0.0011	0.0085	0.0037	3
Grinding (roller mill) and screening	FF	Filterable PM	3	B	0.0014	0.0023	0.0019	4
		CO2	3	C	8.3	16	12	4
Grinding (roller mill)	FF	Filterable PM	2	C	0.13	0.20	0.16	5
		Arsenic	2	NR	7.3×10^{-6}	1.2×10^{-5}	9.6×10^{-6}	5
		Nickel	2	NR	5.1×10^{-5}	7.7×10^{-5}	6.4×10^{-5}	5
Grinding (roller mill)	FF	Filterable PM	2	C	0.0046	0.0077	0.0062	6
		Cr+6	2	NR	4.1×10^{-6}	9.8×10^{-6}	6.9×10^{-6}	6
		Nickel	2	NR	1.3×10^{-5}	1.3×10^{-5}	1.3×10^{-5}	6
Grinding (roller mill)	FF	Filterable PM	1	NR	NA	NA	0.010	7
		Cadmium	1	NR	NA	NA	2.3×10^{-7}	7
		Chromium	1	NR	NA	NA	4.5×10^{-7}	7
		Nickel	1	NR	NA	NA	6.3×10^{-6}	7
Ground talc storage silo loading	FF	Total PM	3	B	0.0018	0.0038	0.0026	8
		Total PM	3	B	0.00042	0.00057	0.00050	8
Crushed ore screening and transfer	FF	Total PM	3	B	0.0017	0.011	0.0048	9
Primary crushing and discharge	FF	Total PM	3	B	0.0012	0.0019	0.0013	9
Crushed ore storage bin loading	FF	Total PM	3	B	0.00019	0.00030	0.00024	9
		Total PM	3	B	0.0042	0.010	0.0068	9
Grinding and classifying (air classifying mill)	FF	Total PM	3	B	0.016	0.028	0.023	9
		Total PM	3	B	0.035	0.043	0.040	9
Product silo loading	FF	Total PM	3	B	0.0025	0.010	0.0063	9
		Total PM	3	B	0.00023	0.00090	0.00059	9
Pellet drying (fluid bed dryer)	FF	Filterable PM	2	C	0.014	0.022	0.018	9
		Cond. inorg. PM	2	C	0.013	0.015	0.014	9
Product bagging	FF	Total PM	3	B	0.012	0.017	0.015	9
Pneumatic product conveyor venting	FF	Total PM	3	B	0.00086	0.0024	0.0018	9

TABLE 4-3. (continued)

Process	APCD[a]	Pollutant[b]	No. of runs	Data rating[c]	Emission factor[d] lb/1,000 lb			Ref. No.
					Minimum	Maximum	Average	
Ground talc classifying (cyclone)	FF	Total PM	3	B	0.00060	0.0010	0.00077	9
Crushed talc rail car loading	FF	Total PM	3	B	0.00042	0.00058	0.00049	10
Primary crushing and discharge	FF	Total PM	3	A	0.00013	0.00083	0.00040	11
Natural gas-fired rotary dryer (crude ore drying)	FF	Filterable PM	3	A	0.00091	0.0015	0.0012	11
		Cond. inorg. PM	3	A	0.00017	0.0012	0.00079	11

[a]APCD = air pollution control device. FF = fabric filter.
[b]Cr^{+6} = hexavalent chromium. Total PM includes PM collected in front and back halves of Method 5 sampling train.
[c]NR = not rated.
[d]Emission factor units are lb/1,000 lb of production. One lb/1,000 lb = 1 kg/Mg. NS = not specified. NA = not applicable.

TABLE 4-4. SUMMARY OF CANDIDATE EMISSION FACTORS FOR TALC PROCESSING

Process	Control	Pollutant	No. of tests	Average emission factor[a]		
				lb/1,000 lb	Rating	Ref.
Crude ore drying	Fabric filter	Filterable PM	1	0.0012	D	11
Crude ore drying	Fabric filter	Cond. inorg. PM	1	0.00079	D	11
Primary crushing	Fabric filter	Total PM	3	0.00074	D	3,9,11
Screening and transfer[b]	Fabric filter	Total PM	2	0.0043	D	3,9
Crushed talc rail car loading	Fabric filter	Total PM	1	0.00049	D	10
Storage bin loading[b]	Fabric filter	Total PM	2	0.0036	D	9
Grinding	Fabric filter	Total PM	3	0.022	D	4,9
Grinding[c]	None	CO_2	2	9.3	E	3,4
Classifying[d]	Fabric filter	Total PM	1	0.00077	D	9
Storage bin loading[d]	Fabric filter	Total PM	2	0.0016	D	8
Pellet drying	Fabric filter	filterable PM	1	0.018	E	9
Pellet drying	Fabric filter	Cond. inorg. PM	1	0.014	E	9
Storage bin loading[e]	Fabric filter	Total PM	2	0.0035	D	9
Pneumatic conveyor venting[e]	Fabric filter	Total PM	1	0.0018	D	9
Packaging[e]	Fabric filter	Total PM	2	0.0090	D	3,9

[a]Emission factor units are lb/1,000 lb of production. One lb/1,000 lb = 1 kg/Mg.
[b]For crushed talc.
[c]For roller mill using heated makeup air.
[d]For ground talc.
[e]For final product.

4.3.1 Primary Crushing

For talc ore primary crushing, data were available from one A-rated and two B-rated tests for total PM emissions. The factors derived from the data range from 0.00040 lb/1,000 lb to 0.0013 lb/1,000 lb of crushed talc production. The average of these factors is 0.00074 lb/1,000 lb. This candidate emission factor is rated D.

4.3.2 Screening and Transfer

For screening and transferring crushed talc, data were available from two B-rated tests for total PM emissions. The factors derived were 0.0037 lb/1,000 lb and 0.0048 lb/1,000 lb of crushed talc processed. The average of these factors is 0.0043 lb/1,000 lb. This candidate emission factor is rated D.

4.3.3 Storage Bin Loading

For storage bin loading, emission data were available for crushed talc, ground talc, and final product. For crushed talc, data were available from two B-rated tests for total PM emissions. The factors derived were 0.00024 lb/1,000 lb and 0.0068 lb/1,000 lb of crushed talc loaded. The average of these factors is 0.0036 lb/1,000 lb. This candidate emission factor is rated D.

For ground talc, data were available from two B-rated tests for total PM emissions. The total PM factors were 0.0026 lb/1,000 lb and 0.00050 lb/1,000 lb of ground talc loaded. The average of these factors is 0.0016 lb/1,000 lb. This candidate emission factor is rated D.

For storage bin loading of final product, data were available from two B-rated tests for total PM emissions. The factors were 0.0063 lb/1,000 lb and 0.00059 lb/1,000 lb of final talc product loaded. The average of these factors is 0.0035 lb/1,000 lb. This candidate emission factor is rated D.

4.3.4 Grinding

For talc grinding, data were available from 8 data sets for total PM emissions, two data sets for CO_2 emissions, and for 3 data sets for emissions of trace metals. The total PM data consist of three B-rated sets, two C-rated sets, two D-rated sets, and one unrated data set. The factors developed from the C- and D-rated data ranged from 0.0062 lb/1,000 lb to 0.16 lb/1,000 lb, and averaged 0.079 lb/1,000 lb. The factors developed from the B-rated data ranged from 0.0019 lb/1,000 lb to 0.040 lb/1,000 lb, and averaged 0.022 lb/1,000 lb of ground talc produced. Because of the large discrepancy between the factors based on the C-/D-rated data and the factors based on the B-rated data, the C- and D-rated data were discarded. The candidate emission factor is based on the B-rated data only and is rated D.

For CO_2 emissions from a talc grinder mill using heated makeup air, data were available from two C-rated tests. The factors derived from the data are 6.6 lb/1,000 lb and 12 lb/1,000 lb of ground talc produced. The average of these factors is 9.3 lb/1,000 lb. Because this factor is based on C-rated data, it is rated E.

As explained in Section 4.2, the metals data were unrated. Therefore, no candidate emission factors were developed from the metals data for inclusion in AP-42.

4.3.5 Classifying

Data were available from one B-rated test for total PM from classifying ground talc by means of a cyclone. The factor derived from the data is 0.00077 lb/1,000 lb of ground talc classified. This factor is rated D.

4.3.6 Pellet Drying

For filterable PM and condensible inorganic emissions from pellet drying, data were available from one C-rated test. The factor derived from the filterable PM data is 0.018 lb/1,000 lb of dried pellets produced and is rated E. The factor for condensible inorganic PM is 0.014 lb/1,000 lb of dried pellets produced and also is rated E. The sum of these two factors yields a factor of 0.032 lb/1,000 lb for total PM emissions.

4.3.7 Pneumatic Conveyor Venting

Data were available from one test for total PM emissions from venting a pneumatic conveyor for transferring talc product. The data set is rated B. The factor derived from the data is 0.0018 lb/1,000 lb of talc product conveyed. This factor is rated D.

4.3.8 Packaging

For talc product packaging, data were available from two B-rated tests for total PM emissions. The factors derived from the data are 0.0029 lb/1,000 lb and 0.015 lb/1,000 lb of talc packaged. The average of these factors is 0.0090 lb/1,000 lb. This candidate emission factor is rated D.

4.3.9 Crushed Talc Rail Car Loading

Data were available from one test for total PM emissions from crushed talc rail car loading. The data set is rated B. The factor derived from the data is 0.00049 lb/1,000 lb of crushed talc loaded. This factor is rated D.

4.3.10 Crude Ore Dryer

Data were available from one test for filterable and condensible inorganic PM emissions from a natural gas-fired crude ore dryer. The data set is rated A. The factor derived from the filterable PM data is 0.0012 lb/1,000 lb of dried talc produced and is rated D. The factor derived from the condensible inorganic PM data is 0.00079 lb/1,000 lb of dried talc produced and is rated D. The sum of these two factors is 0.0020 lb/1,000 lb for total PM emissions.

REFERENCES FOR SECTION 4

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3. *Emission Test Report--Plant A, Test No. 1, July 1990*, Document No. 4602-01-01, Confidential Business Information Files, Contract No 68-D2-0159, Assignment No. 2-01, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 2, 1995.

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6. *Emission Test Report--Plant A, Test No. 3, February 1994*, Document No. 4602-01-01, Confidential Business Information Files, Contract No 68-D2-0159, Assignment No. 2-01, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 2, 1995.

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8. *Initial Compliance Test for Particulate Emissions, Luzenac America, Three Forks Mill, Montana Air Quality Permit #2282-02, January/February 1995*, Bison Engineering, Inc., Helena, MT, April 25, 1995.

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11. *Particulate Emissions and Visible Opacity, Rotary Dryer and Crusher/Loadout, Permit 2282, Luzenac America, Yellowstone Trail, Three Forks, MT*, Bison Engineering, Inc., Helena, MT, February 15 and 16, 1994.

5. PROPOSED AP-42 SECTION

The proposed AP-42, Section 11.26, Talc Processing, is presented on the following pages as it would appear in the document.