EMISSION FACTOR DOCUMENTATION FOR AP-42 SECTION 11.16 (formerly 8.14)
Gypsum Manufacturing

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 relates the quantity (weight) of pollutants emitted to a unit of activity of the source. The uses for the emission factors reported in AP-42 include:

1. Estimates of areawide emissions;

2. Estimates of emissions for a specific facility; and

3. Evaluation of emissions relative to ambient air quality.

The purpose of this report is to provide background information from test reports and other information to support preparation of AP-42 Section 8.14, Gypsum Manufacturing.

This background report consists of five sections. Section 1 is an introduction to the report. Section 2 gives a description of the gypsum manufacturing. It includes a characterization of the industry, an overview of the different process types, a description of emissions, and a description of the technology used to control emissions. Section 3 is a review of emission data collection and laboratory analysis 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 revisions to the existing AP-42 section narrative and pollutant emission factor development. It includes the review of specific data sets and the results of data analysis. Section 5 presents AP-42 Section 8.14, Gypsum Manufacturing.

2. INDUSTRY DESCRIPTION[1-2]

Gypsum is calcium sulfate dihydrate ($CaSO_4 \cdot 2H_2O$), a white or gray naturally occurring mineral, and is used as a commercial and generic term for all calcium sulfate materials. Raw gypsum ore is processed into a variety of products such as a portland cement additive, soil conditioner, industrial and building plasters, and gypsum wallboard. The Standard Industrial Classification code (SIC) for gypsum processing is 3275. The first six digits of the Source Classification Codes (SCC) identifying pollution sources in gypsum processing are 305015.

2.1 CHARACTERIZATION OF THE INDUSTRY[1]

Between 1983 and 1989, sales of gypsum products increased between 5 and 10 percent annually. The total value of gypsum products sold in the United States during 1988 was $2.1 billion. This value dropped slightly in 1989 because lessening demand from construction industries made the market more competitive and lowered prices. Several new gypsum plants are expected to become operational in the early 1990's, thereby increasing competition even further.

In 1989, crude gypsum was mined by 36 companies at 65 mines in 21 States. The leading producing States, in descending order, were Oklahoma, Iowa, Michigan, Texas, California, Nevada, and Indiana. These seven States accounted for 76 percent of total domestic production. The three companies leading in crude gypsum production were, in descending order, USG Corporation (USG), National Gypsum Company (National Gypsum), and Georgia-Pacific Corporation (Georgia-Pacific). Table 2-1 presents additional information about the geographics of crude gypsum production. Most domestic gypsum is extracted from surface mines using standard open-pit methods.

In 1989, gypsum was calcined by 13 companies at 71 plants in 28 States. Leading States, in descending order, were California, Texas, Iowa, Florida, Nevada, and New York. These six States, with 29 plants, accounted for 48 percent of national output. Leading companies were USG, National Gypsum, and Georgia-Pacific. Table 2-2 presents additional information about the geographics of calcined gypsum production.

The United States is the world's largest miner of gypsum, accounting for about 16 percent of total world output. Other leading countries, in descending order, include Canada, Iran, China, Japan, France, Spain, and Thailand. Imports account for about one-third of crude gypsum processed in the United States, making the United States, by far, the largest producer of gypsum products.

Table 2-3 summarizes, by general use, U.S. consumption of gypsum products in 1988. About 20 percent of consumed gypsum is uncalcined. Uncalcined gypsum ($CaSO_4 \cdot 2H_20$), crushed and screened to specifications, is used mostly in portland cement manufacture (to retard the setting time of concrete) and, to a lesser extent, in agricultural applications. Small amounts of very pure gypsum are used as fillers and in glassmaking, papermaking, and pharmaceutical applications. Most calcined gypsum ($CaSO_4 \cdot \frac{1}{2}H_20$) products are prefabricated. Of the prefabricated products, 62 percent is regular wallboard and 28 percent is fire-resistant wallboard.

2.2 PROCESS DESCRIPTION[2-3]

A flow diagram for a typical gypsum process producing both crude and finished gypsum products is shown in Figure 2-1. In this process, gypsum is crushed, dried, ground, and calcined.

TABLE 2-1. CRUDE GYPSUM MINED IN THE UNITED STATES IN 1988[a]

State	No. of active mines	Quantity mined, 10^3 Mg (10^3 tons)	
Arizona, New Mexico	6	522	(574)
Arkansas, Kansas, Louisiana	5	1,504	(1,654)
California	7	1,355	(1,490)
Colorado, Montana, South Dakota, Washington, Wyoming	9	615	(676)
Indiana, Ohio, New York, Virginia	5	2,035	(2,239)
Iowa	6	1,861	(2,047)
Michigan	5	1,780	(1,958)
Nevada, Utah	7	1,488	(1,637)
Oklahoma	8	1,975	(2,173)
Texas	6	1,766	(1,943)
Total	64	14,900	(16,390)

[a] Reference 1. Data may not add to totals shown because of independent rounding.

TABLE 2-2. CALCINED GYPSUM PRODUCED IN THE UNITED STATES IN 1988[1]

State	Active plants	Quantity calcined, 10^3 Mg (10^3 tons)	
Arizona, Colorado, New Mexico, Utah	5	612	(673)
Arkansas, Louisiana, Oklahoma	7	1,572	(1,729)
California	6	1,773	(1,950)
Delaware, Maryland, North Carolina, Virginia	6	1,528	(1,681)
Florida	3	1,190	(1,309)
Georgia	3	711	(782)
Illinois, Indiana, Kansas	6	1,385	(1,524)
Iowa	5	1,155	(1,271)
Massachusetts, New Hampshire, New Jersey	4	750	(825)
Michigan	4	614	(675)
Washington, Wyoming	4	663	(729)
Nevada	4	1,116	(1,228)
New York	4	1,001	(1,101)
Ohio	3	441	(485)
Texas	7	1,193	(1,312)
Total	72	15,704	(17,274)

TABLE 2-3. GYPSUM PRODUCTS (MADE FROM DOMESTIC, IMPORTED, AND BYPRODUCT GYPSUM) SOLD OR USED IN THE UNITED STATES IN 1988[a]

Use	Quantity, Mg	(tons)	Value, $1,000
Uncalcined:			
Portland cement	3,625	(3,987)	47,622
Agriculture and miscellaneous	1,262	(1,388)	27,851
Total	4,886	(5,375)	75,473
Calcined:			
Plasters	720	(792)	98,411
Prefabricated products	17,414	(19,155)	1,916,901
Total calcined	18,135	(19,948)	2,015,313
Grand total	23,021	(25,323)	2,090,786

[a]Reference 1. Data may not add to totals shown because of independent rounding.

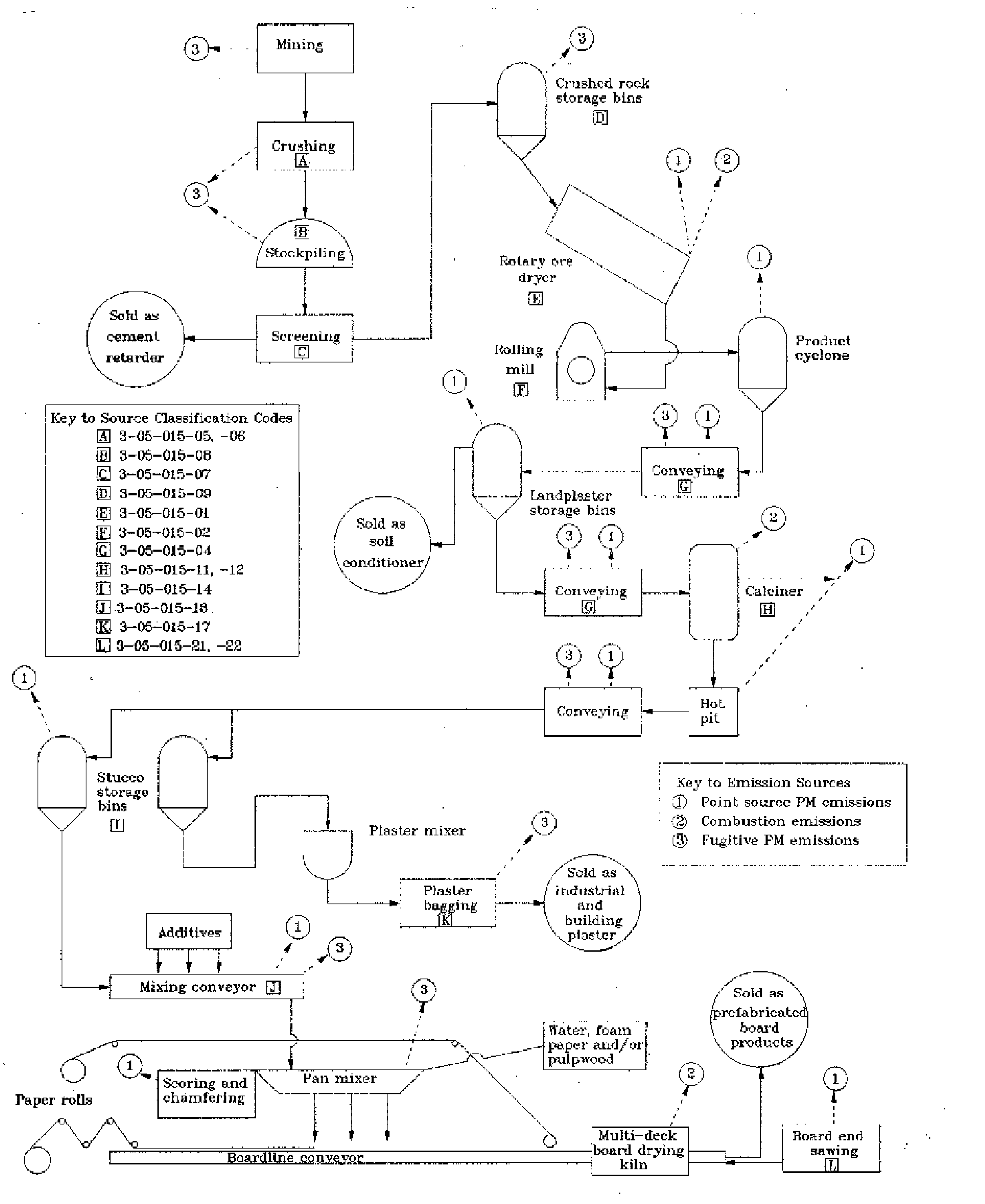

Figure 2-1. Overall process flow diagram for gypsum processing.[2]

Not all of the operations shown in Figure 2-1 are performed at all gypsum plants. Some plants produce only wallboard, and many plants do not produce soil conditioner.

Gypsum ore, from quarries and underground mines, is crushed and stockpiled near a plant. As needed, the stockpiled ore is further crushed and screened to about 50 millimeters (2 inches) in diameter. If the moisture content of the mined ore is greater than about 0.5 weight percent, the ore must be dried in a rotary dryer or a heated roller mill. Ore dried in a rotary dryer is conveyed to a roller mill, where it is ground to the extent that 90 percent of it is less than 149 micrometers (100 mesh). The ground gypsum exits the mill in a gas stream and is collected in a product cyclone. Ore is sometimes dried in the roller mill by heating the gas stream so that drying and grinding are accomplished simultaneously and no rotary dryer is needed. The finely ground gypsum ore is known as landplaster, which may be used as a soil conditioner.

In most plants, landplaster is fed to kettle calciners or flash calciners, where it is heated to remove three-quarters of the chemically bound water to form stucco ($CaSO_4 \cdot ½H_2O$). Calcination occurs at approximately 120° to 150°C (250° to 300°F) and 0.908 megagrams (Mg) (1 ton) of gypsum calcines to about 0.77 Mg (0.85 ton) of stucco.

In kettle calciners, the gypsum is indirectly heated by hot combustion gas passed through flues in the kettle, and the stucco product is discharged into a "hot pit" located below the kettle. Kettle calciners may be operated in either batch or continuous mode. In flash calciners, the gypsum is directly contacted with hot gases, and the stucco product is collected at the bottom of the calciner.

At some gypsum plants, drying, grinding, and calcining are performed in heated impact mills. In these mills hot gas contacts gypsum as it is ground. The gas dries and calcines the ore and then conveys the stucco to a product cyclone for collection. The use of heated impact mills eliminates the need for rotary dryers, calciners, and roller mills.

Gypsum and stucco are usually transferred from one process to another by means of screw conveyors or bucket elevators. Storage bins or silos are normally located downstream of roller mills and calciners but may also be used elsewhere.

In the manufacture of plasters, stucco is ground further in a tube or ball mill and then batch-mixed with retarders and stabilizers to produce plasters with specific setting rates. The thoroughly mixed plaster is fed continuously from intermediate storage bins to a bagging operation.

In the manufacture of wallboard, stucco from storage is first mixed with dry additives such as perlite, starch, fiberglass, or vermiculite. This dry mix is combined with water, soap foam, accelerators, and shredded paper or pulpwood in a pin mixer at the head of a board forming line. The slurry is then spread between two paper sheets that serve as a mold. The edges of the paper are scored, and sometimes chamfered, to allow precise folding of the paper to form the edges of the board. As the wet board travels the length of a conveying line, the calcium sulfate hemihydrate combines with the water in the slurry to form solid calcium sulfate dihydrate, or gypsum, resulting in rigid board. The board is rough-cut to length, and it enters a multideck kiln dryer, where it is dried by direct contact with hot combustion gases or by indirect steam heating. The dried board is conveyed to the board end sawing area and is trimmed and bundled for shipment.

2.3 EMISSIONS[2,4]

Potential emission sources in gypsum processing plants are shown in Figure 2-1. While particulate matter (PM) is the dominant pollutant in gypsum processing plants, several sources may emit gaseous pollutants also. The primary sources of PM emissions include rotary ore dryers, grinding mills, calciners, and board end sawing operations. Other significant PM sources include the following:

- -- Scoring and chamfering
- -- Plaster mixing and bagging
- -- Conveying systems
- -- Storage bins

Uncontrolled PM emissions from these sources are not well quantified. The major sources of gaseous emissions include dryers and calciners.

Other sources of PM emissions resulting from gypsum processing that may not be classified as part of the plant operations are primary and secondary crushers, screens, stockpiles, and roads. If quarrying is part of the mining operation, PM emissions may also result from drilling and blasting.

Gaseous emissions from gypsum processes result from fuel combustion and may include nitrogen oxides, sulfur oxides, carbon monoxide, and carbon dioxide (CO_2). Processes using fuel include rotary ore dryers, heated roller mills, impact mills, calciners, and board drying kilns. Although some plants use residual fuel oil, the majority of the industry uses clean fuels such as natural gas or distillate fuel oil. Emissions from fuel combustion may be estimated using emission factors presented in AP-42 Sections 1.3, 1.4, and 8.14.

2.4 CONTROL TECHNOLOGY[2]

For control of PM, fabric filters are the most prevalent type of technology. Particulate matter emissions from some gypsum sources may be controlled with electrostatic precipitators (ESP's). These sources include rotary ore dryers, roller mills, kettle calciners, and conveying systems. Although rotary ore dryers may be controlled separately, emissions from roller mills and conveying systems are usually controlled jointly with kettle calciner emissions. Moisture in the kettle calciner exit gas improves the ESP performance by lowering the resistivity of the dust.

Equipment for controlling gaseous pollutants is generally not used in gypsum processing. In large part, this is due to the use of clean fuels by the industry.

It is important to note that emission control devices are frequently needed to collect the product from some gypsum processes and, thus, are commonly thought of by the industry as process equipment and not as added control devices.

REFERENCES FOR SECTION 2

1. L. L. Davis, "Gypsum," Minerals Yearbook, Vol. 1, U. S. Department of the Interior, Bureau of Mines, 1989.

2. Gypsum Industry - Background Information for Proposed Standards (Draft), U. S. Environmental Protection Agency, Research Triangle Park, NC, April 1981.

3. Kirk-Othmer Encyclopedia of Chemical Technology, Volume 4, John Wiley & Sons, Inc., New York, 1978.

4. S. Oglesby and G. B. Nichols, A Manual of Electrostatic Precipitation Technology, Part II: Application Areas, APTD-0611, U. S. Environmental Protection Agency, Cincinnati, OH, August 25, 1970.

3. GENERAL DATA REVIEW AND ANALYSIS

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 Inventory Branch (EIB) were reviewed for information on the industry, processes, and emissions. The Crosswalk/Air Toxic Emission Factor Data Base Management System (XATEF) and Volatile Organic Compound (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 two data bases.

Information on the industry, including number of plants, plant location, and annual production capacities, was obtained from the Minerals Yearbook, Census of Minerals, Census of Manufactures, 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 gypsum industry. Copies of these test reports were obtained from the files of the Emission Measurement Branch (EMB). The EPA library was searched for additional test reports. A list of plants that have been tested within the past 5 years was compiled from the AIRS data base. Using this information and information obtained on plant location from the Minerals Yearbook, Census of Manufactures, and Census of Minerals, State and Regional offices were contacted about the availability of test reports. However, the information obtained from these offices was limited. Publications lists from the Office of Research and Development (ORD) and Control Technology Center (CTC) were also searched for reports on emissions from the gypsum industry. In addition, the Gypsum Association, a representative trade association, was contacted for assistance in obtaining information about the industry and emissions.

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 must contain test results based on more than one test run.

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 EMISSION DATA QUALITY RATING SYSTEM

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 EIB 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. <u>Source operation</u>. 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. <u>Sampling procedures</u>. 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

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 always noted.

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 Chapter 4 of this report.

REFERENCES FOR SECTION 3

1. Technical Procedures for Developing AP-42 Emission Factors and Preparing AP-42 Sections (Draft), Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, March 6, 1992.

4. AP-42 SECTION DEVELOPMENT

4.1 REVISION OF SECTION NARRATIVE

Because of the lack of new information on processes and emissions, only editorial changes were made to the narrative of Section 8.14.

4.2 POLLUTANT EMISSION FACTOR DEVELOPMENT

Two major changes were made to the emission factors of Section 8.14. First, new emission factors were developed for CO_2. Second, the quality of all existing emission factors was reevaluated; the results of this reevaluation are given in Section 4.2.4 of this document.

All data reviewed for this revision were taken from the existing background file; no new test reports or emission data could be located. Four test reports were found in the background file that provided information for the development of new emission factors for CO_2. Those four references are described in detail below.

4.2.1 Review of Specific Data Sets

4.2.1.1 Reference 1. This reference is a test report sponsored by EPA's EMB to determine various emission parameters relating to milling, drying, and packaging operations. The tests were conducted by Roy F. Weston, Inc., at the Gold Bond Building Products plant in Wilmington, North Carolina, from May 19 to 27, 1980.

Carbon dioxide emission data were available from four sampling locations: the inlet and outlet of a fabric filter controlling emissions from a flash calciner, and the inlet and outlet of a fabric filter controlling emissions from a rotary ore dryer. Three tests were conducted at each location that yielded CO_2 emission data.

Because all tests followed EPA protocol, no major problems were reported, and sufficient process and analytic information was presented for validation of results, this reference was rated A.

4.2.1.2 Reference 2. This reference is a test report sponsored by EPA's EMB to determine various emission parameters relating to gypsum ore processing. The tests were conducted by Roy F. Weston, Inc., at the U. S. Gypsum Company's plant at Shoals, Indiana, from June 3 to 19, 1980.

Carbon dioxide emission data were available from the inlet and outlet of a fabric filter controlling emissions from a gas-fired rotary ore dryer. No other CO_2 emission data were available.

All tests followed EPA protocol, and no major problems were reported. Ample background data were also presented, with the exception of a detailed process flow diagram. Since PM was the only pollutant of concern, no attempt was made to quantify CO_2 emissions in the calciner combustion gases--the main source of CO_2 emissions in the plant. Overall, the tests and the test report were comprehensive and were rated A.

4.2.1.3 Reference 3. This reference is a test report sponsored by EPA's EMB to gather data to establish standards for new and substantially modified sources. The tests were conducted by York

Research Corporation at the Gold Bond Building Products plant in Richmond, California, from July 15 to 16, 1980.

Carbon dioxide emission data were available from the inlet and outlet of a fabric filter controlling emissions from a gas-fired flash calciner. The quality and level of detail of this reference are identical to those of References 1 and 2. Thus, the data of this report were rated A.

4.2.1.4 Reference 4. This reference is a report of a New Mexico compliance test. The test was conducted in April 1979 at Western Gypsum's Rosario Facility.

Stack gas from a fabric filter controlling the emissions of a gypsum calciner were tested three times for PM and CO_2. The type of calciner was not specified, nor was the process well described. However, because EPA-standardized methods were followed and field and laboratory data were presented, this test report was rated B.

4.2.2 Review of XATEF and SPECIATE Data Base Emission Factors

The XATEF and SPECIATE data bases were searched for emission factors relevant to the gypsum processing industry. No pertinent information was found.

4.2.3 Review of Test Data in AP-42 Background File

As mentioned above, the AP-42 background file was the only source of data for this revision. Four references--all emission test reports--were found in the file that provided emission data for CO_2. Three of these references were sponsored by EPA and were rated A. One reference was a State compliance test and was rated B.

4.2.4 Results of Data Analysis

Section 8.14 was revised because it contained air pollution emission factors for only filterable PM. In this revision, emission test reports in the background file were reviewed for data relevant to CO_2 emissions. Also, the quality of existing emission factors was reevaluated.

Four test reports in the background file were found to contain CO_2 emission data. Table 4-1 presents a summary of this data, and Table 4-2 presents a summary of the emission factors developed from this data. Although the data are of good quality, they do not represent a good sample of the gypsum industry. Thus, all new emission factors developed in this revision are rated D.

Based upon a review of the gypsum processing industry as described in Reference 5, it was determined that the existing emission factors did not represent an accurate sample of the gypsum industry. In the development of any one emission factor, no more than five test reports, representing five different plants, were used. The total number of gypsum plants is at least 73. Therefore, all emission factors previously developed for Section 8.14 were down-rated from either B or C to D. Particle size distribution data in the 1983 version were also down-rated to D.

TABLE 4-1. SUMMARY OF TEST DATA FOR GYPSUM PROCESSING

Source	Control device	Pollutant	No. of runs	EF range, kg/Mg (lb/ton)[a]	EF average kg/Mg (lb/ton)[a]	Data rating	Ref. No.
Flash calciner	None	CO_2	3	60-65 (120-130)	60 (120)	A	1
Flash calciner (fuel unknown)	Fabric filter[b]	CO_2	3	60-65 (120-130)	60 (120)	A	1
Rotary ore dryer	None	CO_2	3	21-25 (41-49)	23 (45)	A	1
Rotary ore dryer	Fabric filter[b]	CO_2	3	15 (29-30)	15 (30)	A	1
Rotary ore dryer (gas-fired)	Cyclone[c]	CO_2	3	3.9-4.8 (7.8-9.6)	4.3 (8.6)	A	2
Rotary ore dryer (gas-fired)	Cyclone/ fabric filter[b,c]	CO_2	3	3.5-4.5 (7.0-8.9)	4.1 (8.1)	A	2
Flash calciner (gas-fired)	None	CO_2	3	42-49 (84-98)	45 (90)	A	3
Flash calciner (gas-fired)	Fabric filter[b]	CO_2	3	48-55 (95-110)	50 (99)	A	3
Calciner	Fabric filter[b]	CO_2	3	55-75 (110-150)	65 (130)	B	4

[a]Emission factors presented as pounds of pollutant emitted per ton of yield.
[b]Fabric filters generally achieve negligible control of CO_2.
[c]Cyclones generally achieve negligible control of CO_2.

TABLE 4-2. SUMMARY OF EMISSION FACTORS FOR GYPSUM PROCESSING

Source	Control device	Pollutant	No. of tests	Average EF, kg/mg (lb/ton)[a]	Emission factor rating	References
Calciner (110)	None	CO_2	5	55	D	1, 3, 4
Rotary ore dryer	None	CO_2	4	12 (23)	D	1, 2

[a]Emission factors presented as pounds of pollutant emitted per ton of yield.

REFERENCES FOR SECTION 4

1. Source Emissions Test Report, Gold Bond Building Products, EMB-80-GYP-1, U. S. Environmental Protection Agency, Research Triangle Park, NC, November 1980.

2. Source Emissions Test Report, United States Gypsum Company, EMB-80-GYP-2, U. S. Environmental Protection Agency, Research Triangle Park, NC, November 1980.

3. Source Emissions Tests, Gold Bond Building Products, EMB-80-GYP-5, U. S. Environmental Protection Agency, Research Triangle Park, NC, December 1980.

4. Particulate Analysis of Calcinator Exhaust at Western Gypsum Company, Kramer, Callahan and Associates, Rosario, NM, April 1979.