Emission Factor Documentation for AP-42
Section 11.10

Coal Cleaning

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

September 1995

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For U. S. Environmental Protection Agency
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Emission Factor and Inventory Group
Research Triangle Park, NC 27711

Attn: Mr. Ron Myers (MD-14)

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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.

Approved for:

MIDWEST RESEARCH INSTITUTE

Roy Neulicht
Program Manager
Environmental Engineering Department

Jeff Shular
Director, Environmental Engineering
Department

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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 revisions to AP-42 Section 11.10, Coal Cleaning.

This background report consists of five sections. Section 1 includes the introduction to the report. Section 2 gives a description of the coal cleaning 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 revised AP-42 section was developed. It includes the review of specific data sets, a description of how candidate emission factors were developed, and a summary of changes to the AP-42 section. Section 5 presents the AP-42 Section 11.10, Coal Cleaning.

2. INDUSTRY DESCRIPTION

Coal cleaning is a process by which impurities such as sulfur, ash, and rock are removed from coal to upgrade its value. Coal cleaning processes are categorized as either physical cleaning or chemical cleaning. Physical coal cleaning processes, the mechanical separation of coal from its contaminants using differences in density, are by far the major processes in use today. Chemical coal cleaning processes are currently being developed, but the performance and cost of various chemical processes are undetermined at this time.[3] Therefore, these processes are not included in this discussion.

Coal cleaning facilities can be classified under several Standard Industrial Classification (SIC) codes, including SIC 1221 (Bituminous Coal and Lignite Surface Mining), 1222 (Bituminous Coal Underground Mining), and 1231 (Anthracite Mining). In addition, a number of other industries, including large power plants (SIC 4911) and steel plants (3312) are engaged in coal cleaning.[1] The 6-digit source classification code (SCC) for coal cleaning is 3-05-010.

2.1 CHARACTERIZATION OF THE INDUSTRY[3]

In 1985, there were an estimated 1,378 coal cleaning facilities in the United States. The majority of these plants are located in Kentucky, West Virginia, and Pennsylvania. A number of plants also are located in States with significant deposits of coal, including Texas, North Dakota, Montana, and Wyoming.

2.2 PROCESS DESCRIPTION[1-3]

The process used in the physical cleaning of bituminous and anthracite coal varies among coal cleaning plants but can generally be divided into four basic phases: initial preparation, fine coal processing, coarse coal processing, and final preparation. Lignite and subbituminous coal are relatively free of impurities and generally are not cleaned. A sample process flow diagram for a physical coal cleaning plant is presented in Figure 2-1.

In the initial preparation phase of coal cleaning, the raw coal is unloaded, stored, conveyed, crushed, and classified by screening into coarse and fine coal fractions. The size fractions are then conveyed to their respective cleaning processes.

Fine coal processing and coarse coal processing use very similar operations and equipment to separate the contaminants. The primary differences are the severity of operating parameters. The majority of coal cleaning processes use upward currents or pulses of a fluid such as water to fluidize a bed of crushed coal and impurities. The lighter coal particles rise and are removed from the top of the bed. The heavier impurities are removed from the bottom. Coal cleaned in the wet processes then must be dried in the final preparation processes.

Final preparation processes are used to remove moisture from coal, thereby reducing freezing problems and weight and raising the heating value. The first processing step is dewatering, in which a major portion of the water is removed by the use of screens, thickeners, and cyclones. The second step is normally thermal drying, achieved by any one of three dryer types: fluidized bed, flash, and multilouvered. In the fluidized bed dryer, the coal is suspended and dried above a perforated plate by rising hot gases. In the flash dryer, coal is fed into a stream of hot gases for instantaneous drying.

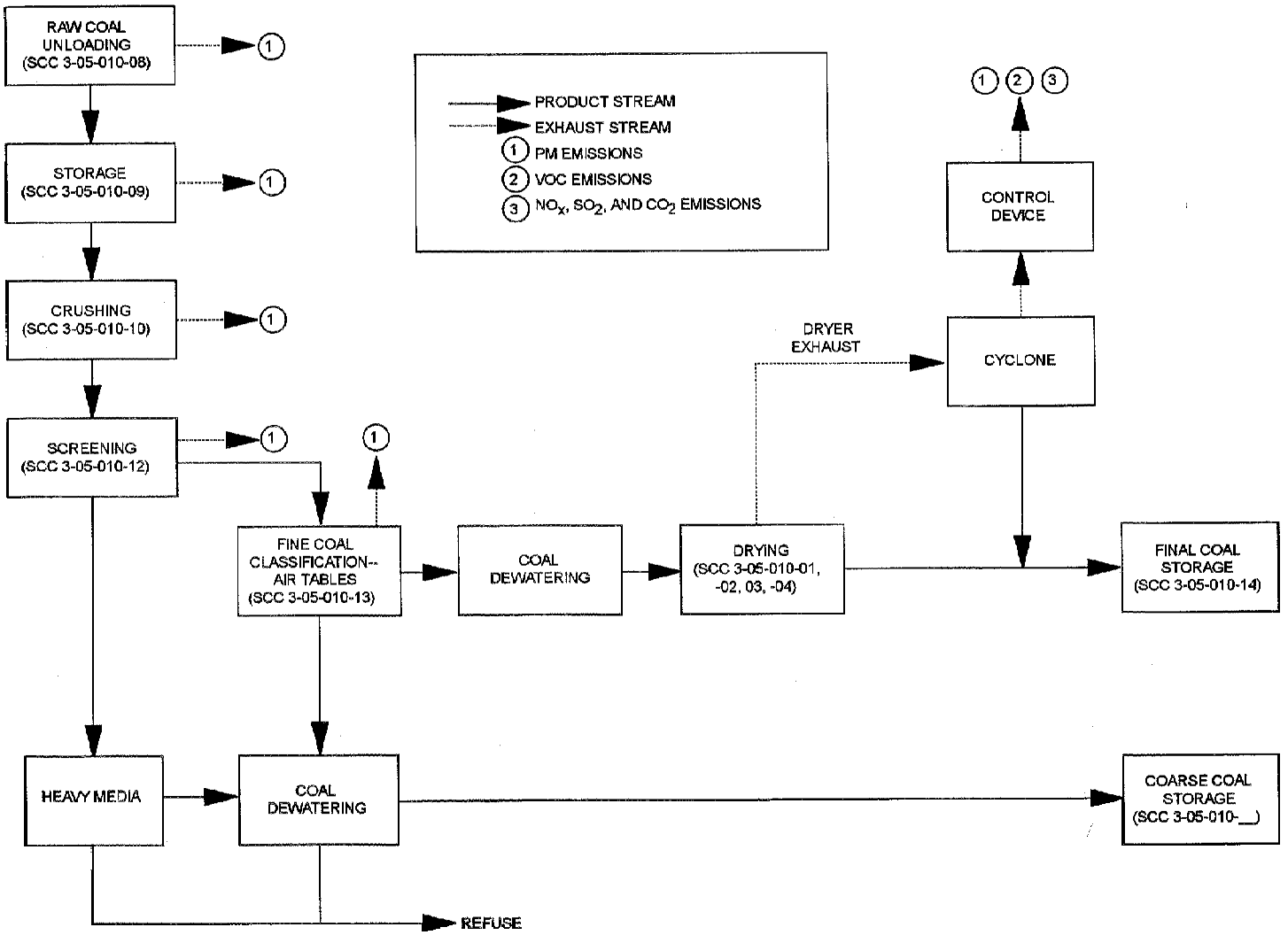

Figure 2-1. Typical coal cleaning plant process flow diagram.

The dried coal and wet gases are drawn up a drying column and into a cyclone for separation. In the multilouvered dryer, hot gases are passed through a falling curtain of coal. The coal is raised by flights of a specially designed conveyor.

2.3 EMISSIONS[1-4]

Emissions from the initial coal preparation phase of either wet or dry processes consist primarily of fugitive particulate matter (PM) as coal dust from roadways, stock piles, refuse areas, loaded railroad cars, conveyor belt pouroffs, crushers, and classifiers. The primary emission source in the fine or coarse coal processing phases is the air exhaust from the air separation processes. For the dry cleaning process, these emissions are generated when the coal is stratified by pulses of air. Potential emissions from wet cleaning processes are very low.

The major source of emissions from the final preparation phase is the thermal dryer exhaust. This emission stream contains coal particles entrained in the drying gases and volatile organic compounds (VOC) released from the coal, in addition to the standard products of coal combustion resulting from burning coal to generate the hot gases, including carbon monoxide (CO), carbon dioxide (CO_2), VOC, sulfur dioxide (SO_2), and nitrogen oxides (NO_x).

A number of inorganic hazardous air pollutants are found in trace quantities in coal, including arsenic, beryllium, cadmium, chromium, copper, mercury, manganese, nickel, lead, thorium, and uranium. Although emissions of these substances from coal cleaning have not been quantified, it is likely that many of these are emitted in trace amounts from crushing, grinding, and drying operations.

2.4 CONTROL TECHNOLOGY[1-3]

The major control technique used to reduce PM emissions from raw material storage, handling, transfer, and other initial coal preparation is wetting with water. Another technique applicable to unloading, conveying, crushing, and screening operations involves enclosing the process area and circulating air from the area through fabric filters.

Particulate matter emissions from the fine or coarse processing phases are normally controlled with cyclones followed by fabric filters. Emissions from thermal dryers in the final preparation phase generally are controlled by venturi scrubbers and mist eliminators downstream from the product recovery cyclones. The PM control efficiency of these technologies ranges from 98 to 99.9 percent. The venturi scrubbers also have a NO_x removal efficiency of 10 to 25 percent, and an SO_2 removal efficiency ranging from 70 to 80 percent for low-sulfur coals to 40 to 50 percent for high-sulfur coals.

The new source performance standards (NSPS) for coal preparation plants was promulgated in January 1976 (40 CFR 60 Subpart Y). These standards specify emission limits for particulate matter from coal cleaning thermal dryers and pneumatic cleaning equipment sources and opacity limits for fugitive emissions from coal processing and conveying equipment, coal storage systems, and coal transfer and loading systems. The standards apply to plants that process more than 180 megagrams (Mg) (200 tons) of coal per day.

REFERENCES FOR SECTION 2

1. *Background Information for Establishment of National Standards of Performance for New Sources: Coal Cleaning Industry*, Environmental Engineering, Inc., Gainesville, FL, EPA Contract No. CPA-70-142, July 1971.

2. *Air Pollutant Emissions Factors*, National Air Pollution Control Administration,Contract No. CPA-22-69-119, Resources Research Inc., Reston, VA, April 1970.

3. *Second Review of New Source Performance Standards for Coal Preparation Plants*, EPA-450/3-88-001, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1988.

4. *Estimating Air Toxic Emissions From Coal and Oil Combustion Sources*, EPA-450/2-89-001, U. S. Environmental Protection Agency, Research Triangle Park, NC, April 1989.

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 files of supporting information for the second review of the new source performance standards (NSPS) for coal preparation plants. 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 coal cleaning 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 coal cleaning industry. In addition, the National Coal 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 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. AP-42 SECTION DEVELOPMENT

4.1 INTRODUCTION

This section describes how the revised AP-42 section on coal cleaning was developed. First, descriptions of the data sets reviewed for this revision are presented, followed by a discussion of how the candidate emission factors were developed from the data. Finally, the changes to the AP-42 section on coal cleaning are summarized.

4.2 REVIEW OF SPECIFIC DATA SETS

A total of 12 emission test reports were obtained for use in developing emission factors for the revised AP-42 Section 11.10, Coal Cleaning. Three of the test reports (References 2, 3, and 7) included in this review were referenced in the previous AP-42 section. Reference 11 was not used for emission factor development because it contained incomplete test data (no volumetric flow rates were provided). The data from the test reports (References 1-10 and 12) were used to develop emission factors for filterable PM, condensible organic PM, condensible inorganic PM, CO_2, SO_2, NO_x, VOC, and trace metals. Unless noted in the following review of specific data sets, PM measurements were made using EPA Method 5 (condensible inorganic and organic PM from analysis of back half using an ether-chloroform extraction and an acetone wash of the impingers, connectors, and back half of filter holder), CO and CO_2 were measured using Orsat, and SO_2, NO_x, and VOC were measured using EPA Methods 6, 7, and 25A, respectively. The trace metal emissions were quantified using optical spectroscopy.

4.2.1 Reference 1

This test report includes measurements of filterable PM, condensible inorganic PM, condensible organic PM, and CO_2 emissions from a multilouvred dryer. Process rates were reported on the basis of feed to the dryer. The measurements were made at the outlet of a cyclone located downstream of the dryer. Cyclones are considered part of the process operations, so the emissions measured represent uncontrolled emissions. A single-run analysis of the flue gas concentrations was performed using an unnamed method, and three particle size test runs were conducted anisokinetically using a Brinks impactor. The particle size data were not used for emission factor development. The test was sponsored by EPA as part of an emission test program for developing NSPS for the coal cleaning industry.

A rating of A was assigned to the test data for filterable and condensible PM. A rating of C was assigned to the CO_2 data because the concentration was measured during only one run. The report included adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

4.2.2 Reference 2

This test report is Reference 8 in the existing AP-42 Section 8.9. It includes measurements of controlled and uncontrolled filterable PM, condensible inorganic PM, condensible organic PM, CO_2, SO_2, and NO_x emissions from a fluidized bed dryer controlled by a venturi scrubber with a pressure drop of 4.0 to 4.2 kilopascals (kPa) (16 to 17 inch water column [in. w.c.]). The test was conducted at the same plant as the Reference 6 test. Process rates were reported on the basis of feed to the

dryer. The test was sponsored by EPA as part of an emission test program for developing NSPS for the coal cleaning industry.

A rating of B was assigned to all of the test data except for the SO_2 test data, which are rated C because of inconsistency between the test runs. These data do not warrant a higher rating because only an average process rate is provided in the report. The report included adequate detail, the test methodology was sound, and the problem with the scrubber was the only problem reported during the valid test runs.

4.2.3 Reference 3

This test report is Reference 9 in the existing AP-42 Section 8.9. It includes measurements of controlled filterable PM, condensible inorganic PM, condensible organic PM, CO_2, NO_x, and VOC emissions from a fluidized bed dryer controlled by a venturi scrubber with a pressure drop of 5.2 kPa (21 in. w.c.). Carbon monoxide was not detected in the flue gas stream. The basis for the process rates is unclear in the report, but it appears that the process rates represent feed rates to the dryer. The first three runs were conducted while the plant was processing Osaka coal (a low-sulfur, medium-ash, high-volatile-steam coal), and the last two runs were conducted while the plant was processing Wentz coal (a low-sulfur, low-ash, high-volatile-metallurgical coal). The PM measurements from first test run (Osaka coal) were not valid because the sampling was not performed isokinetically. The other four test runs were considered valid and were used for emission factor development. The test was sponsored by EPA as part of an emission test program for developing NSPS for the coal cleaning industry.

A rating of B was assigned to all of the test data used for emission factor development. These data do not warrant a higher rating because only an average process rate is provided in the report. The report included adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

4.2.4 Reference 4

This test report includes measurements of controlled filterable PM, condensible inorganic PM, condensible organic PM, CO_2, SO_2, NO_x, and VOC emissions from a fluidized bed dryer controlled by a venturi scrubber with a pressure drop of 5.9 kPa (23.75 in. w.c.). Also, uncontrolled SO_2 emissions were measured at the venturi scrubber inlet. Sulfur dioxide was not detected at the venturi scrubber outlet. Process rates were reported on the basis of feed to the dryer. Three test runs were conducted but only the first two runs were representative of typical plant operations because Run 3 had to be stopped when the plant ran out of coal. In addition, experimental PM tests were conducted measuring only the amount of PM trapped in the probe and on the filter while sampling continuously at one traverse point. The results from these experimental runs varied considerably and were not used for emission factor development. The test was sponsored by EPA as part of an emission test program for developing NSPS for the coal cleaning industry.

A rating of C was assigned to the PM test data because the report noted that the high PM loadings may have been caused by water droplets that formed around the probe and nozzle and were pulled into the sampling line. A rating of B was assigned to the rest of the test data used for emission factor development. The report included adequate detail, the test methodology was sound, and no problems were reported during the valid test runs. The data were downrated from A to B because an average process rate (from Runs 2 and 3) was used to calculate the emission factors for Run 1.

4.2.5 Reference 5

This test report includes measurements of uncontrolled filterable PM and size-specific PM emissions and controlled filterable PM, condensible inorganic PM, condensible organic PM, trace metals, and CO_2 emissions from a fluidized bed dryer controlled by a venturi scrubber with a pressure drop of 8.0 kPa (32 in. w.c.). The basis for the process rates is unclear in the report, but it appears that the process rates represent feed rates to the dryer. The particle size data were collected at the inlet to the venturi scrubber using a series of two cyclones with PM cut-off points of a nominal 2.5 micrometers (µm) and 1.0 µm, respectively. Thirteen particle size test runs were conducted, but only Runs 7, 9, and 11 were considered valid. The first six test runs were conducted using an incorrect sample nozzle, and Runs 8, 10, 12, and 13 were invalid due to process slowdowns. Additional particle size analyses of the venturi scrubber water and coal samples were conducted using a Coulter Counter, which is an optical particle sizing device. These data are not presented in this report because optical particle sizing is inconsistent with the aerodynamic particle sizing that is used throughout AP-42. Trace metals were quantified from the Run 4 (outlet) PM catch using optical emission spectroscopy analysis. The results from this analysis are presented in this section but are not included in the revised AP-42 Section 8.9 because they are based on only one test run. Six PM runs were conducted at the venturi scrubber inlet, but only Runs 4, 5, and 6 were considered valid test runs. Five PM runs were conducted at the venturi scrubber outlet, but only Runs 3, 4, and 5 were considered valid. Runs 1 and 2 (inlet and outlet) were not considered valid because of process and sampling errors, and Run 3 (inlet) was voided because of incorrect placement of the sampling nozzle. The test was conducted to provide EPA with additional data to support standards development.

A rating of B was assigned to the test data for filterable PM, condensible PM, and CO_2. The report included adequate detail, the test methodology was sound, and no problems were reported during the valid test runs. The data were downrated to B because the process rate was only measured during one run, and this rate was used to calculate emission factors for all of the runs. A rating of C was assigned to the particle size data because the test method was not a standard method and the production rate used was an average rate.

4.2.6 Reference 6

This test report includes measurements of controlled filterable PM, condensible inorganic PM, and condensible organic PM emissions from a fluidized bed dryer controlled by a venturi scrubber designed for a pressure drop of 6.5 kPa (26 in. w.c.). The test was conducted at the same plant as the Reference 2 test. The test was sponsored by EPA as part of an emission test program for developing NSPS for the coal cleaning industry. Process rates were reported on the basis of feed to the dryer.

A rating of B was assigned to all of the test data used for emission factor development (Runs 6, 7, and 8). The report included adequate detail, the test methodology was sound, and no problems were reported during the valid test runs. The data were downrated to B because an average process rate was used for emission factor development. Also, the actual pressure drop of the venturi scrubber (during the test) was not specified.

4.2.7 Reference 7

This test report is Reference 7 in the existing AP-42 Section 8.9. It includes measurements of controlled and uncontrolled filterable PM, condensible inorganic PM, CO_2, and SO_2 emissions from a fluidized bed dryer controlled by a venturi scrubber with a pressure drop of 8.7 kPa (35 in. w.c.). In addition, controlled NO_x and VOC emissions were measured at the venturi scrubber outlet. Process rates were reported on the basis of feed to the dryer. Three valid test runs were conducted at both the inlet and outlet of the venturi scrubber. A single-run particle size distribution analysis was performed on the PM samples collected at the venturi scrubber inlet and outlet during Run 1. The data from this analysis were not used to develop emission factors because they came from a single test run. The test was sponsored by EPA as part of an emission test program for developing NSPS for the coal cleaning industry.

A rating of D was assigned to all of the test data used for emission factor development. The report included adequate detail and the test methodology was sound, but the results may not be representative of actual emissions due to cyclonic gas flow. This facility was tested again using straightening vanes to straighten the gas flow. Reference 10 documents the results of this test.

4.2.8 Reference 8

This test report includes measurements of controlled filterable PM and condensible inorganic PM emissions from an air table controlled by a fabric filter. Process rates were reported on the basis of feed to the air table. A single-run particle size distribution analysis was performed on the PM samples collected at the fabric filter outlet during Run 1. The data from this analysis were not used to develop emission factors because they came from a single test run. The test was sponsored by EPA as part of an emission test program for developing NSPS for the coal cleaning industry.

A rating of A was assigned to all of the test data used for emission factor development. The report included adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

4.2.9 Reference 9

This test report includes measurements of controlled filterable PM, condensible inorganic PM, and condensible organic PM emissions from an air table controlled by a fabric filter. Three test runs were conducted. Run 1 did not include condensible inorganic PM analysis. The test was sponsored by EPA as part of an emission test program for developing NSPS for the coal cleaning industry. Process rates were reported on the basis of feed to the air table.

A rating of A was assigned to the filterable PM and condensible organic PM data. A rating of B was assigned to the condensible inorganic PM data because only two valid test runs were conducted. The report included adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

4.2.10 Reference 10

This test report includes measurements of controlled filterable PM, condensible inorganic PM, and condensible organic PM emissions from a fluidized bed dryer controlled by a venturi scrubber with a pressure drop of 8.7 kPa (35 in. w.c.). The test was conducted to determine the effect that straightening vanes would have on the PM emission measurements. Process rates were reported on the basis of feed to the dryer. Runs 1, 2, 3, and 5 were conducted under cyclonic flow conditions, while Runs 6, 7, and 8 were conducted after straightening vanes were placed in the stack to eliminate the cyclonic flow. The test results showed that adding straightening vanes significantly increased the PM emission measurement. Therefore, only the data from Runs 6, 7, and 8 were used to develop emission factors. The test was conducted at the same plant as the Reference 7 test. The test was sponsored by EPA as part of an emission test program for developing NSPS for the coal cleaning industry.

A rating of A was assigned to all of the test data used for emission factor development (Runs 6, 7, and 8). The report included adequate detail, the test methodology was sound, and no problems were reported during the valid test runs.

4.2.11 Reference 12

This report documents measurements of emissions of filterable PM, SO_2, NO_x, and CO_2 from a fluidized bed coal dryer. Emissions from the dryer were exhausted through two cyclones for product recovery and controlled with a venturi scrubber and a perforated tray scrubber using a sodium hydroxide solution as the scrubber liquid. The two scrubbers are configured in series. The test was conducted in 1993 to demonstrate compliance with State regulations. Process rates were measured on the basis of feed to the dryer.

Three test runs were conducted. However, the third test run was not completed due to coal clogging and flame outs in the dryer. Emission factors were developed from the data for the first two runs for controlled emissions of filterable PM and SO_2 and uncontrolled emissions of NO_x, and CO_2; the scrubbers should have negligible effects on NO_x and CO_2 emissions. The data are assigned a rating of B. The test methods were sound, and the report documentation was adequate. However, because only two runs were completed, a higher rating is not warranted.

4.2.12 Review of XATEF and SPECIATE Data Bases

The XATEF data base identifies pollutants, including chromium, nickel, and other trace metals, but does not include emission factors for these pollutants. The sources for this information--the chromium and nickel locating and estimating documents--are secondary references. The primary reference for this information (Baig, et al., *Conventional Combustion Environmental Assessment Final Report (Draft)*, Prepared for U. S. Environmental Protection Agency, Research Triangle Park, NC, Contract No. 68-02-3138, July 1981) was not obtained.

The SPECIATE data base includes speciated VOC and PM emission factors for coal cleaning. However, because these emission factors are based on either average profiles for the mineral products industry or overall average profiles (for all industries), the emission factors have not been included in the revision to the section.

4.2.13 Review of Test Data in AP-42 Background File

(Reference numbers in this section refer to the February 1980 AP-42 Section 8.9 list of references.)

The background file contained copies of all of the references except for Reference 4. The references were reviewed, and only the data from References 7, 8, and 9 were included in the revised AP-42 section. Particulate matter emission factors from Reference 1 were excluded because they were based on an estimate that was not supported by any test data. The emission factors that were developed from References 3, 5, and 6 were also excluded from the revised section because of incomplete test data. The emission factors based on Reference 4 could not be evaluated, so they were not used in the revised section. References 7, 8, and 9 are summarized in Sections 4.2.7, 4.2.10, and 4.2.3 of this document. The emission factors developed from the data in References 7, 8, and 9 are included in the revised AP-42 section and were combined with the emission factors developed from the additional test reports that were gathered for this revision. Reference 10 is a secondary reference that summarizes test data from the early 1970's NSPS testing program for coal cleaning facilities, and it was used to supplement information from References 7, 8, and 9 as well as other NSPS tests that were used to develop emission factors.

4.3 DEVELOPMENT OF CANDIDATE EMISSION FACTORS

Uncontrolled emission factors were developed for filterable PM, condensible inorganic PM, and condensible organic PM emissions from dryers (including multilouvred and fluidized bed dryers), and size-specific PM, CO_2, SO_2, and NO_x emissions from fluidized bed dryers. Controlled emission factors were developed for filterable PM, condensible inorganic PM, condensible organic PM, trace metals, SO_2, NO_x, and VOC emissions from fluidized bed dryers controlled with venturi scrubbers. Controlled emission factors were also developed for filterable PM, total condensible PM, and condensible inorganic PM emissions from air tables controlled by fabric filters.

Most of the emission factors discussed above were developed from A- and B-rated test data but are based on data from between one and five plants. Because of the large number of domestic coal cleaning facilities (1,378), it is likely that these emission factors are not representative of the industry. Consequently, most of the emission factors presented in the revised section are assigned a D rating. The emission factor for uncontrolled SO_2 emissions from fluidized bed dryers was developed from B-, C-, and D-rated data and is consequently assigned an E rating. The emission factor for venturi scrubber-controlled SO_2 emissions from fluidized bed dryers is not rated because the factor is equal to the factor for uncontrolled SO_2 emissions; this is misleading because venturi scrubbers achieve between 0 and 95 percent control of SO_2 emissions. The size-specific PM emission factors were developed from C-rated data from Reference 5 and are therefore assigned an E rating. The emission factor for CO_2 emissions from uncontrolled multilouvered dryers was developed from a single, C-rated data point and is assigned an E rating. The emission factors for trace metals were developed from test data from a single run and therefore are not rated and are not included in the revised AP-42 section on coal cleaning.

Table 4-1 summarizes the emission data for filterable PM, condensible organic PM, condensible inorganic PM, CO_2, SO_2, NO_x, VOC, and trace metals from dryers used in the coal cleaning industry. Table 4-2 summarizes the development of emission factors for coal cleaning. Data that were combined are presented on consecutive lines, and the separate data sets are differentiated by font type (bold or regular). Data that are crossed out were not included in the average emission factors. Table 4-3 summarizes the emission factors developed from the data presented in Tables 4-1 and 4-2. Table 4-4 presents the emission data for size-specific PM, and Table 4-5 shows size-specific PM emission factors that are based on the data in Table 4-4 and the uncontrolled filterable PM emission factor from References 2 and 5.

4.4 SUMMARY OF CHANGES TO AP-42 SECTION

4.4.1 Section Narrative

Minor revisions were made to the section narrative. The revisions included identifying additional pollutants that are emitted by coal cleaning processes and adding information on Federal regulations on air emissions from coal preparation plants. In addition, the process flow diagram was revised, and SCC's were added to the diagram.

4.4.2 Emission Factors

Several changes were made to the emission factors presented in the previous AP-42 section. Table 4-5 summarizes these changes. For uncontrolled multilouvered dryers, emission factors were added for uncontrolled emissions of condensible inorganic PM, condensible organic PM, and CO_2. In addition, the revised emission factor for filterable PM (3.7 lb/ton) is significantly smaller than the corresponding factor in the previous section (25 lb/ton). Factors for cyclone- and scrubber-controlled filterable PM emissions from multilouvered dryers were deleted from the section because the factors were based on secondary data that could not be documented.

For uncontrolled fluidized bed dryers, new factors were developed for filterable PM-2.5, filterable PM-1.0, condensible inorganic PM, condensible organic PM, and CO_2. The revised factor for filterable PM from uncontrolled fluidized bed dryers (26 lb/ton) is slightly higher than the previous factor (20 lb/ton), and the revised factor for SO_2 from uncontrolled fluidized bed dryers (1.4 lb/ton) is significantly higher than the previous factor (0.43 lb/ton). For venturi scrubber-controlled fluidized bed dryers, new factors were added for condensible inorganic and inorganic PM emissions; the factor for SO_2 emissions from venturi scrubber-controlled fluidized bed dryers was deleted from the previous AP-42 section. Factors also were added for emissions of filterable PM, SO_2, NO_x, and CO_2 from fluidized bed dryers controlled with a combination of venturi scrubber and tray scrubber.

The previous AP-42 section presented factors for emissions of filterable PM from uncontrolled, cyclone-controlled, and scrubber-controlled flash dryers. These factors were deleted due to a lack of data of acceptable quality to substantiate the factors; no new data on emissions from flash dryers were identified.

Finally, new factors were added for emissions of filterable, condensible inorganic, and condensible organic PM from air tables; the previous AP-42 section did not include factors for air tables.

TABLE 4-1. SUMMARY OF TEST DATA FOR COAL CLEANING DRYERS[a]

Type of control	Type of dryer	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)	Average emission factor, kg/Mg (lb/ton)	Ref. No.
None	Multilouvered	Filterable PM	3	A	1.8-1.9 (3.6-3.8)	1.9 (3.7)	1
None	Multilouvered	Condensible inorganic PM	3	A	0.018-0.038 (0.036-0.077)	0.029 (0.057)	1
None	Multilouvered	Condensible organic PM	3	A	0.0070-0.010 (0.014-0.020)	0.0088 (0.018)	1
None	Multilouvered	CO_2	3	C	79-80 (160-160)	79 (160)	1
None	Fluidized bed	Filterable PM	3	B	10-23 (20-46)	16 (32)	2
None	Fluidized bed	Condensible inorganic PM	3	B	0.0083-0.034 (0.017-0.067)	0.017 (0.034)	2
None	Fluidized bed	Condensible organic PM	3	B	0.00079-0.0088 (0.0016-0.018)	0.0037 (0.0075)	2
None	Fluidized bed	CO_2	3	B	12-13 (23-26)	12 (24)	2
None	Fluidized bed	SO_2	3	C	0.032-5.4 (0.065-11)	2.0 (4.0)	2
None	Fluidized bed	NO_x	3	B	0.088-0.12 (0.18-0.23)	0.099 (0.20)	2
Venturi scrubber	Fluidized bed	Filterable PM	3	B	0.021-0.025 (0.041-0.051)	0.022 (0.045)	2
Venturi scrubber	Fluidized bed	Condensible inorganic PM	3	B	0.0039-0.0053 (0.0078-0.011)	0.0048 (0.010)	2
Venturi scrubber	Fluidized bed	Condensible organic PM	3	B	0-0.00079 (0-0.0016)	0.00053 (0.0011)	2
Venturi scrubber	Fluidized bed	CO_2	3	B	1.3-12 (2.6-24)	7.4 (15)	2
Venturi scrubber	Fluidized bed	SO_2	3	C	0.0014-5.6 (0.0028-11)	2.0 (4.0)	2
Venturi scrubber	Fluidized bed	NO_x	3	B	0.066-0.083 (0.13-0.17)	0.074 (0.15)	2
Venturi scrubber	Fluidized bed	Filterable PM	4	B	0.082-0.12 (0.16-0.24)	0.095 (0.19)	3
Venturi scrubber	Fluidized bed	Condensible inorganic PM	4	B	0.020-0.032 (0.039-0.064)	0.026 (0.052)	3
Venturi scrubber	Fluidized bed	Condensible organic PM	4	B	0.0038-0.0044 (0.0076-0.0088)	0.0041 (0.0082)	3
Venturi scrubber	Fluidized bed	CO_2	5	B	4.4-9.3 (8.7-19)	6.4 (13)	3
Venturi scrubber	Fluidized bed	NO_x	5	B	0.086-0.14 (0.17-0.29)	0.12 (0.24)	3
Venturi scrubber	Fluidized bed	TOC as methane	5	B	0.015-0.18 (0.031-0.36)	0.068 (0.14)	3
Venturi scrubber	Fluidized bed	Filterable PM	2	C	0.48-0.49 (0.96-0.97)	0.48 (0.97)	4

TABLE 4-1. (continued)

Type of control	Type of dryer	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)	Average emission factor, kg/Mg (lb/ton)	Ref. No.
Venturi scrubber	Fluidized bed	Condensible inorganic PM	2	C	0.013-0.030 (0.026-0.060)	0.021 (0.043)	4
Venturi scrubber	Fluidized bed	Condensible organic PM	2	C	0-0.00043 (0-0.00087)	0.00022 (0.00043)	4
Venturi scrubber	Fluidized bed	CO_2	2	B	18-31 (36-63)	25 (50)	4
Venturi scrubber	Fluidized bed	SO_2	2	B	Not detected	Not detected	4
Venturi scrubber	Fluidized bed	NO_x	2	B	0.10 (0.20-0.21)	0.10 (0.21)	4
Venturi scrubber	Fluidized bed	TOC as methane	2	B	0.024-0.033 (0.047-0.065)	0.028 (0.056)	4
None	Fluidized bed	SO_2	2	B	0.0062-0.0074 (0.012-0.015)	0.0068 (0.014)	4
None	Fluidized bed	Filterable PM	3	B	8.5-11 (17-21)	9.5 (19)	5
Venturi scrubber	Fluidized bed	Filterable PM	3	B	0.12-0.19 (0.25-0.38)	0.14 (0.29)	5
Venturi scrubber	Fluidized bed	Condensible inorganic PM	3	B	0.040-0.051 (0.081-0.10)	0.045 (0.089)	5
Venturi scrubber	Fluidized bed	Condensible organic PM	3	B	0.0016-0.0059 (0.0032-0.012)	0.0035 (0.0069)	5
Venturi scrubber	Fluidized bed	CO_2	3	B	21-27 (41-53)	24 (47)	5
Venturi scrubber	Fluidized bed	Filterable PM	3	B	0.026-0.035 (0.052-0.069)	0.032 (0.063)	6
Venturi scrubber	Fluidized bed	Condensible inorganic PM	3	B	0.0011-0.0028 (0.0022-0.0056)	0.0017 (0.0034)	6
Venturi scrubber	Fluidized bed	Condensible organic PM	3	B	0.00027-0.0022 (0.00054-0.0044)	0.0011 (0.0022)	6
None	Fluidized bed	Filterable PM	3	D	1.5-4.8 (3.0-9.5)	3.3 (6.6)	7
None	Fluidized bed	Condensible inorganic PM	3	D	0.015-0.031 (0.030-0.061)	0.020 (0.040)	7
None	Fluidized bed	CO_2	3	D	18-29 (36-57)	24 (48)	7
None	Fluidized bed	SO_2	3	D	0.09-0.12 (0.18-0.23)	0.10 (0.20)	7
Venturi scrubber	Fluidized bed	Filterable PM	3	D	0.024-0.050 (0.048-0.099)	0.036 (0.071)	7
Venturi scrubber	Fluidized bed	Condensible inorganic PM	3	D	0.008-0.015 (0.016-0.029)	0.011 (0.022)	7
Venturi scrubber	Fluidized bed	CO_2	3	D	19-27 (37-53)	23 (46)	7
Venturi scrubber	Fluidized bed	SO_2	3	D	0.0065-0.06 (0.013-0.12)	0.028 (0.056)	7

TABLE 4-1. (continued)

Type of control	Type of dryer	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)	Average emission factor, kg/Mg (lb/ton)	Ref. No.
Venturi scrubber	Fluidized bed	NO_x	3	D	0.10-0.12 (0.20-0.24)	0.11 (0.22)	7
Venturi scrubber	Fluidized bed	TOC as methane	3	D	0.033-0.11 (0.065-0.22)	0.060 (0.12)	7
Fabric filter	Air table	Filterable PM	2	A	0.012-0.023 (0.023-0.045)	0.017 (0.034)	8
Fabric filter	Air table	Condensible inorganic PM	2	A	0.007-0.017 (0.014-0.033)	0.012 (0.024)	8
Fabric filter	Air table	Filterable PM	3	A	0.0049-0.032 (0.0097-0.064)	0.015 (0.030)	9
Fabric filter	Air table	Condensible inorganic PM	2	B	0.012-0.029 (0.024-0.057)	0.020 (0.041)	9
Fabric filter	Air table	Condensible organic PM	3	A	0-0.0032 (0-0.0063)	0.0013 (0.0026)	9
Venturi scrubber	Fluidized bed	Filterable PM	3	A	0.064-0.082 (0.13-0.16)	0.076 (0.15)	10
Venturi scrubber	Fluidized bed	Condensible inorganic PM	3	A	0.0097-0.014 (0.019-0.028)	0.012 (0.024)	10
Venturi scrubber	Fluidized bed	Condensible organic PM	3	A	0.00034-0.0025 (0.00067-0.0049)	0.0012 (0.0024)	10
Venturi scrubber[b]	Fluidized bed	Filterable PM	2	B	0.0068-0.018 (0.014-0.036)	0.012 (0.025)	12
Venturi scrubber[b]	Fluidized bed	SO_2	2	B	0.035-0.038 (0.070-0.075)	0.036 (0.072)	12
Venturi scrubber[b]	Fluidized bed	NO_x	2	B	0.015-0.016 (0.031-0.032)	0.016 (0.031)	12
Venturi scrubber[b]	Fluidized bed	CO_2	2	B	5.0-15 (10-30)	10 (20)	12
Venturi scrubber	Fluidized bed	Beryllium	1	NR	2.0×10^{-6} (4.0×10^{-6})	2.0×10^{-6} (4.0×10^{-6})	5
Venturi scrubber	Fluidized bed	Cadmium	1	NR	Not detected	Not detected	5
Venturi scrubber	Fluidized bed	Arsenic	1	NR	Not detected	Not detected	5
Venturi scrubber	Fluidized bed	Vanadium	1	NR	3.0×10^{-5} (6.0×10^{-5})	3.0×10^{-5} (6.0×10^{-5})	5
Venturi scrubber	Fluidized bed	Manganese	1	NR	5.5×10^{-5} (1.1×10^{-4})	5.5×10^{-5} (1.1×10^{-4})	5
Venturi scrubber	Fluidized bed	Nickel	1	NR	7.5×10^{-5} (1.5×10^{-4})	7.5×10^{-5} (1.5×10^{-4})	5
Venturi scrubber	Fluidized bed	Antimony	1	NR	Not detected	Not detected	5
Venturi scrubber	Fluidized bed	Chromium	1	NR	9.5×10^{-5} (1.9×10^{-4})	9.5×10^{-5} (1.9×10^{-4})	5
Venturi scrubber	Fluidized bed	Zinc	1	NR	7.0×10^{-4} (1.4×10^{-3})	7.0×10^{-4} (1.4×10^{-3})	5

TABLE 4-1. (continued)

Type of control	Type of dryer	Pollutant	No. of test runs	Data rating	Emission factor range, kg/Mg (lb/ton)	Average emission factor, kg/Mg (lb/ton)	Ref. No.
Venturi scrubber	Fluidized bed	Copper	1	NR	4.6×10^{-4} (9.2×10^{-4})	4.6×10^{-4} (9.2×10^{-4})	5
Venturi scrubber	Fluidized bed	Lead	1	NR	8.0×10^{-5} (1.6×10^{-4})	8.0×10^{-5} (1.6×10^{-4})	5
Venturi scrubber	Fluidized bed	Boron	1	NR	1.7×10^{-4} (3.4×10^{-4})	1.7×10^{-4} (3.4×10^{-4})	5
Venturi scrubber	Fluidized bed	Lithium	1	NR	Not detected	Not detected	5
Venturi scrubber	Fluidized bed	Silver	1	NR	4.3×10^{-5} (8.6×10^{-5})	4.3×10^{-5} (8.6×10^{-5})	5
Venturi scrubber	Fluidized bed	Tin	1	NR	4.7×10^{-4} (9.3×10^{-4})	4.7×10^{-4} (9.3×10^{-4})	5
Venturi scrubber	Fluidized bed	Iron	1	NR	2.3×10^{-3} (4.6×10^{-3})	2.3×10^{-3} (4.6×10^{-3})	5
Venturi scrubber	Fluidized bed	Strontium	1	NR	4.6×10^{-5} (9.1×10^{-5})	4.6×10^{-5} (9.1×10^{-5})	5
Venturi scrubber	Fluidized bed	Sodium	1	NR	1.7×10^{-3} (3.4×10^{-3})	1.7×10^{-3} (3.4×10^{-3})	5
Venturi scrubber	Fluidized bed	Potassium	1	NR	2.0×10^{-3} (4.0×10^{-3})	2.0×10^{-3} (4.0×10^{-3})	5
Venturi scrubber	Fluidized bed	Calcium	1	NR	7.5×10^{-4} (1.5×10^{-3})	7.5×10^{-4} (1.5×10^{-3})	5
Venturi scrubber	Fluidized bed	Silicon	1	NR	3.3×10^{-3} (6.6×10^{-3})	3.3×10^{-3} (6.6×10^{-3})	5
Venturi scrubber	Fluidized bed	Magnesium	1	NR	5.0×10^{-4} (1.0×10^{-3})	5.0×10^{-4} (1.0×10^{-3})	5
Venturi scrubber	Fluidized bed	Barium	1	NR	9.5×10^{-5} (1.9×10^{-4})	9.5×10^{-5} (1.9×10^{-4})	5

[a]Emission factors based on coal feed rate unless otherwide noted.
[b]Emissions controlled with venturi scrubber and tray scrubber using NaOH solution as the scrubbing liquid.

TABLE 4-2. EMISSION FACTOR DEVELOPMENT FOR COAL CLEANING DRYERS[a]

Type of control	Type of dryer	Pollutant	No. of test runs	Data rating	Emission factor, kg/Mg (lb/ton)	Candidate emission factor, kg/Mg (lb/ton)	Ref. No.
Fabric filter	**Air table**	**Condensible inorganic PM**	**2**	**A**	**0.012 (0.024)**	**0.016 (0.033)**	**8**
Fabric filter	**Air table**	**Condensible inorganic PM**	**2**	**B**	**0.020 (0.041)**		**9**
Fabric filter	Air table	Condensible organic PM	3	A	0.0013 (0.0026)	0.0013 (0.0026)	9
Fabric filter	**Air table**	**Filterable PM**	**3**	**A**	**0.015 (0.030)**	**0.016 (0.032)**	**9**
Fabric filter	**Air table**	**Filterable PM**	**2**	**A**	**0.017 (0.034)**		**8**
None[b]	Fluidized bed	CO_2	5	B	6.4 (13)	15 (30)	3
None[b]	Fluidized bed	CO_2	6	B	9.7 (19)		2
None[b]	Fluidized bed	CO_2	2	B	10 (20)		12
~~None[b]~~	~~Fluidized bed~~	~~CO_2~~	~~3~~	~~D~~	~~23 (46)~~		~~7~~
None[b]	Fluidized bed	CO_2	3	B	24 (47)		5
~~None~~	~~Fluidized bed~~	~~CO_2~~	~~3~~	~~D~~	~~24 (48)~~		~~7~~
None[b]	Fluidized bed	CO_2	2	B	25 (50)		4
None	**Fluidized bed**	**Condensible inorganic PM**	**3**	**B**	**0.017 (0.034)**	**0.017 (0.034)**	**2**
~~**None**~~	~~**Fluidized bed**~~	~~**Condensible inorganic PM**~~	~~**3**~~	~~**D**~~	~~**0.020 (0.040)**~~		~~**7**~~
None	Fluidized bed	Condensible organic PM	3	B	0.0037 (0.0075)	0.0037 (0.0075)	2
~~**None**~~	~~**Fluidized bed**~~	~~**Filterable PM**~~	~~**3**~~	~~**D**~~	~~**3.3 (6.6)**~~	**13 (26)**	~~**7**~~
None	**Fluidized bed**	**Filterable PM**	**3**	**B**	**9.5 (19)**		**5**
None	**Fluidized bed**	**Filterable PM**	**3**	**B**	**16 (32)**		**2**
None[b]	Fluidized bed	NO_x	2	B	0.016 (0.031)	0.081 (0.16)	12
None[b]	Fluidized bed	NO_x	6	B	0.088 (0.18)		2
None[b]	Fluidized bed	NO_x	2	B	0.10 (0.21)		4
~~None[b]~~	~~Fluidized bed~~	~~NO_x~~	~~3~~	~~D~~	~~0.11 (0.22)~~		~~7~~
None[b]	Fluidized bed	NO_x	5	B	0.12 (0.24)		3

TABLE 4-2. (continued)

Type of control	Type of dryer	Pollutant	No. of test runs	Data rating	Emission factor, kg/Mg (lb/ton)	Candidate emission factor, kg/Mg (lb/ton)	Ref. No.
None	**Fluidized bed**	**SO_2**	**2**	**B**	**0.0068 (0.014)**	**0.70 (1.4)**	**4**
None	**Fluidized bed**	**SO_2**	**3**	**D**	**0.10 (0.20)**		**7**
None	**Fluidized bed**	**SO_2**	**3**	**C**	**2.0 (4.0)**		**2**
Venturi scrubber	Fluidized bed	Condensible inorganic PM	6	B	0.0033 (0.0067)	0.022 (0.043)	2,6
~~Venturi scrubber~~	~~Fluidized bed~~	~~Condensible inorganic PM~~	~~3~~	~~D~~	~~0.011 (0.022)~~		~~7~~
Venturi scrubber	Fluidized bed	Condensible inorganic PM	3	A	0.012 (0.024)		10
~~Venturi scrubber~~	~~Fluidized bed~~	~~Condensible inorganic PM~~	~~2~~	~~C~~	~~0.021 (0.043)~~		~~4~~
Venturi scrubber	Fluidized bed	Condensible inorganic PM	4	B	0.026 (0.052)		3
Venturi scrubber	Fluidized bed	Condensible inorganic PM	3	B	0.045 (0.089)		5
~~Venturi scrubber~~	**~~Fluidized bed~~**	**~~Condensible organic PM~~**	**~~2~~**	**~~C~~**	**~~0.00022 (0.00043)~~**	**0.0024 (0.0048)**	**4**
Venturi scrubber	**Fluidized bed**	**Condensible organic PM**	**6**	**B**	**0.00082 (0.0016)**		**2,6**
Venturi scrubber	**Fluidized bed**	**Condensible organic PM**	**3**	**A**	**0.0012 (0.0024)**		**10**
Venturi scrubber	**Fluidized bed**	**Condensible organic PM**	**3**	**B**	**0.0035 (0.0069)**		**5**
Venturi scrubber	**Fluidized bed**	**Condensible organic PM**	**4**	**B**	**0.0041 (0.0082)**		**3**
Venturi scrubber	Fluidized bed	Filterable PM	6	B	0.027 (0.054)	0.085 (0.17)	2,6
~~Venturi scrubber~~	~~Fluidized bed~~	~~Filterable PM~~	~~3~~	~~D~~	~~0.036 (0.071)~~		~~7~~
Venturi scrubber	Fluidized bed	Filterable PM	3	A	0.076 (0.15)		10
Venturi scrubber	Fluidized bed	Filterable PM	4	B	0.095 (0.19)		3
Venturi scrubber	Fluidized bed	Filterable PM	3	B	0.14 (0.29)		5
~~Venturi scrubber~~	~~Fluidized bed~~	~~Filterable PM~~	~~2~~	~~C~~	~~0.48 (0.97)~~		~~4~~
Venturi scrubber	**Fluidized bed**	**SO_2**	**2**	**B**	**Not detected**	**0.68 (1.4)**	**4**
Venturi scrubber	**Fluidized bed**	**SO_2**	**3**	**D**	**0.028 (0.056)**		**7**
Venturi scrubber	**Fluidized bed**	**SO_2**	**3**	**C**	**2.0 (4.0)**		**2**

TABLE 4-2. (continued)

Type of control	Type of dryer	Pollutant	No. of test runs	Data rating	Emission factor, kg/Mg (lb/ton)	Candidate emission factor, kg/Mg (lb/ton)	Ref. No.
Venturi scrubber	Fluidized bed	TOC as methane	2	B	0.028 (0.056)	0.049 (0.098)	4
~~Venturi scrubber~~	~~Fluidized bed~~	~~TOC as methane~~	~~3~~	~~D~~	~~0.060 (0.12)~~		~~7~~
Venturi scrubber	Fluidized bed	TOC as methane	5	B	0.068 (0.14)		3
Venturi scrubber[c]	**Fluidized bed**	**Filterable PM**	**2**	**B**	**0.012 (0.025)**	**0.012 (0.025)**	12
Venturi scrubber[c]	Fluidized bed	SO_2	2	B	0.036 (0.072)	0.036 (0.072)	12
None	**Multilouvered**	**CO_2**	**3**	**C**	**79 (160)**	**79 (160)**	**1**
None	Multilouvered	Condensible inorganic PM	3	A	0.029 (0.057)	0.029 (0.057)	1
None	**Multilouvered**	**Condensible organic PM**	**3**	**A**	**0.0088 (0.018)**	**0.0088 (0.018)**	**1**
None	Multilouvered	Filterable PM	3	A	1.9 (3.7)	1.9 (3.7)	1

[a]Emission factors based on coal feed rate unless otherwide noted. Crossed-out data were not used for emission factor development.
[b]Emissions measured at the outlet of a control device that does not effectively control the targeted pollutant.
[c]Emissions controlled with venturi scrubber and tray scrubber using NaOH solution as the scrubbing liquid.

TABLE 4-3. SUMMARY OF EMISSION FACTORS FOR COAL CLEANING[a]

Process	Type of control	Pollutant	No. of plants tested	Average emission factor, kg/Mg (lb/ton)	Emission factor rating	Ref. Nos.
Multilouvered dryer	None	Filterable PM	1	1.9 (3.7)	D	1
Multilouvered dryer	None	Cond. inorg. PM	1	0.029 (0.057)	D	1
Multilouvered dryer	None	Cond. org. PM	1	0.0088 (0.018)	D	1
Multilouvered dryer	None	CO_2	1	79 (160)	E	1
Fluidized bed dryer	None	Filterable PM	2	13 (26)	D	2,5
Fluidized bed dryer	None	Cond. inorg. PM	1	0.017 (0.034)	D	2
Fluidized bed dryer	None	Cond. org. PM	1	0.0037 (0.0075)	D	2
Fluidized bed dryer	None[b]	CO_2	5	15 (30)	D	2,3,4,5,12
Fluidized bed dryer	None	SO_2	3	0.70 (1.4)	E	2,4,7
Fluidized bed dryer	None[b]	NO_x	4	0.081 (0.16)	D	2-4,12
Fluidized bed dryer	Venturi scrubber	Filterable PM	4	0.085 (0.17)	D	2,3,5,6,10
Fluidized bed dryer	Venturi scrubber	Cond. inorg. PM	4	0.022 (0.043)	D	2,3,5,6,10
Fluidized bed dryer	Venturi scrubber	Cond. org. PM	4	0.0024 (0.0048)	D	2,3,5,6,10
Fluidized bed dryer	Venturi scrubber	SO_2	3	0.68 (1.4)	NR[c]	2,4,7
Fluidized bed dryer	Venturi scrubber	TOC as methane	2	0.049 (0.098)	D	3,4
Fluidized bed dryer	Venturi scrubber and tray scrubber[d]	Filterable PM	1	0.012 (0.025)	D	12
Fluidized bed dryer	Venturi scrubber and tray scrubber[d]	SO_2	1	0.036 (0.072)	D	12
Air table	Fabric filter	Filterable PM	2	0.016 (0.032)	D	8,9
Air table	Fabric filter	Cond. inorg. PM	2	0.016 (0.033)	D	8,9
Air table	Fabric filter	Cond. org. PM	1	0.0013 (0.0026)	D	9

[a]Emission factors based on coal feed rate unless otherwise noted.
[b]Includes emissions at the outlet of a venturi scrubber that does not control CO_2 or NO_x emissions.
[c]Emission factor is not rated beacause data are not consistent with other available SO_2 data.
[d]Tray scrubber uses NaOH solution as the scrubbing liquid.

TABLE 4-4. PARTICLE SIZE DATA FOR COAL CLEANING DRYER EMISSIONS[a]

DATA RATING: C

Particle size	Cumulative mass ≤ stated size (%)			
	Run 7	Run 9	Run 11	Average
1.0 µm	3.8	3.0	6.0	4.3
2.7 µm	13.6	11.6	17.6	14.3

[a]Reference 5. Thirteen particle size runs were conducted at the inlet to the venturi scrubber. Runs 7, 9, and 11 were the only runs with no problems reported.

TABLE 4-5. UNCONTROLLED SIZE-SPECIFIC PM EMISSION FACTORS FOR COAL CLEANING DRYERS[a]

EMISSION FACTOR RATING: E

Particle size	Average emission factor, kg/Mg (lb/ton)
1.0 µm	0.56 (1.1)
2.7 µm	1.9 (3.8)

[a]References 2 and 5. Based on an average filterable PM emission factor of 1.3 kg/Mg (26 lb/ton) of coal feed.

TABLE 4-6. SUMMARY OF CHANGES IN EMISSION FACTORS FROM PREVIOUS AP-42 SECTION

Emission source	Pollutant	Emission factor, lb/ton	
		Previous	Revised
Multilouvered dryer	Filterable PM	25	3.7
	Condens. inorg. PM	None	0.057
	Condens. org. PM	None	0.018
	CO_2	None	160
Multilouvered dryer with cyclone	Filterable PM	8	None
Multilouvered dryer with scrubber	Filterable PM	0.1	None
Fluidized bed dryer	Filterable PM	20	26
	Filterable PM 2.5	None	3.8
	Filterable PM 1.0	None	1.1
	Condens. inorg. PM	None	0.034
	Condens. org. PM	None	0.0075
	SO_2	0.43	1.4
	NO_x	0.14	0.16
	CO_2	None	30
Fluidized bed dryer with cyclone	Filterable PM	12	None
Fluidized bed dryer with venturi scrubber	Filterable PM	0.09	0.17
	Condens. inorg. PM	None	0.043
	Condens. org. PM	None	0.0048
	SO_2	0.25	None
	VOC	0.10	0.098
	NO_x	0.14	0.16
	CO_2	None	30
Fluidized bed dryer with venturi scrubber and tray scrubber	Filterable PM	None	0.025
	SO_2	None	0.072
	NO_x	None	0.16
	CO_2	None	30
Flash dryer	Filterable PM	16	None
Flash dryer with cyclone	Filterable PM	10	None
Flash dryer with scrubber	Filterable PM	0.4	None
Air tables with fabric filter	Filterable PM	None	0.032
	Condens. inorg. PM	None	0.033
	Condens. org. PM	None	0.0026

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2. *Coal Preparation Plant Emission Tests, Consolidation Coal Company, Bishop, West Virginia*, EMB Report 72-CCL-19A, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1972.

3. *Coal Preparation Plant Emission Tests, Westmoreland Coal Company, Wentz Plant*, EMB Report 72-CCL-22, U. S. Environmental Protection Agency, Research Triangle Park, NC, April 1972.

4. *Emission Test Report, U.S. Steel #50, Pineville, West Virginia*, EMB Report 73-CCL-1, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1972.

5. *Emission Test Report, Westmoreland Coal Company, Quinwood, West Virginia*, EMB Report 75-CCL-7, U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1976.

6. *Coal Preparation Plant Emission Tests: Consolidation Coal Company, Bishop, West Virginia*, EMB Report 73-CCL-19, U. S. Environmental Protection Agency, Research Triangle Park, NC, November 1972.

7. *Report by York Research Corporation on Emissions From The Island Creek Coal Company Coal Processing Plant, Vansant, Virginia*, EMB Report 72-CCL-6, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1972.

8. *Report by York Research Corporation on Emissions From The Florence Mining Company Coal Processing Plant, Seward, Pennsylvania*, EMB Report 72-CCL-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1972.

9. *Coal Preparation Plant Emission Tests: Eastern Associates Coal Company, Keystone, West Virginia*, EMB Report 72-CCL-13, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1972.

10. *Coal Preparation Plant Emission Tests: Island Creek Coal Company, Vansant, Virginia*, EMB Report 73-CCL-2, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1972.

11. *Coal Preparation Plant Emission Tests: Valley Camp Coal Company, Triadelphia, West Virginia*, EMB Report 73-CCL-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 1973.

12. *Report on Compliance Testing, Performed for Peabody Coal Company, Hawthorne Mine, Cerlisle, Indiana*, Clean Air Engineering, Palatine, IL, May 6, 1993.

5. REVISED AP-42 SECTION

The revised AP-42, Section 11.10, Coal Cleaning, is presented on the following pages as it appears in the document.