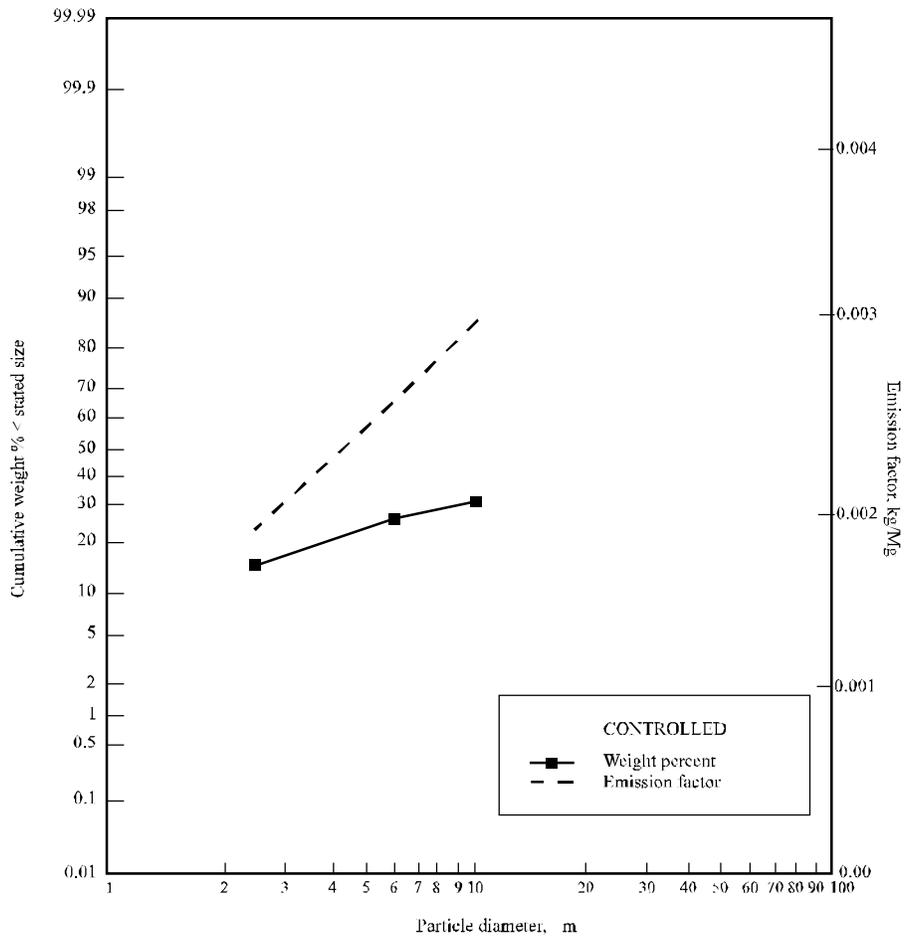


11.10 COAL CLEANING: DRY PROCESS

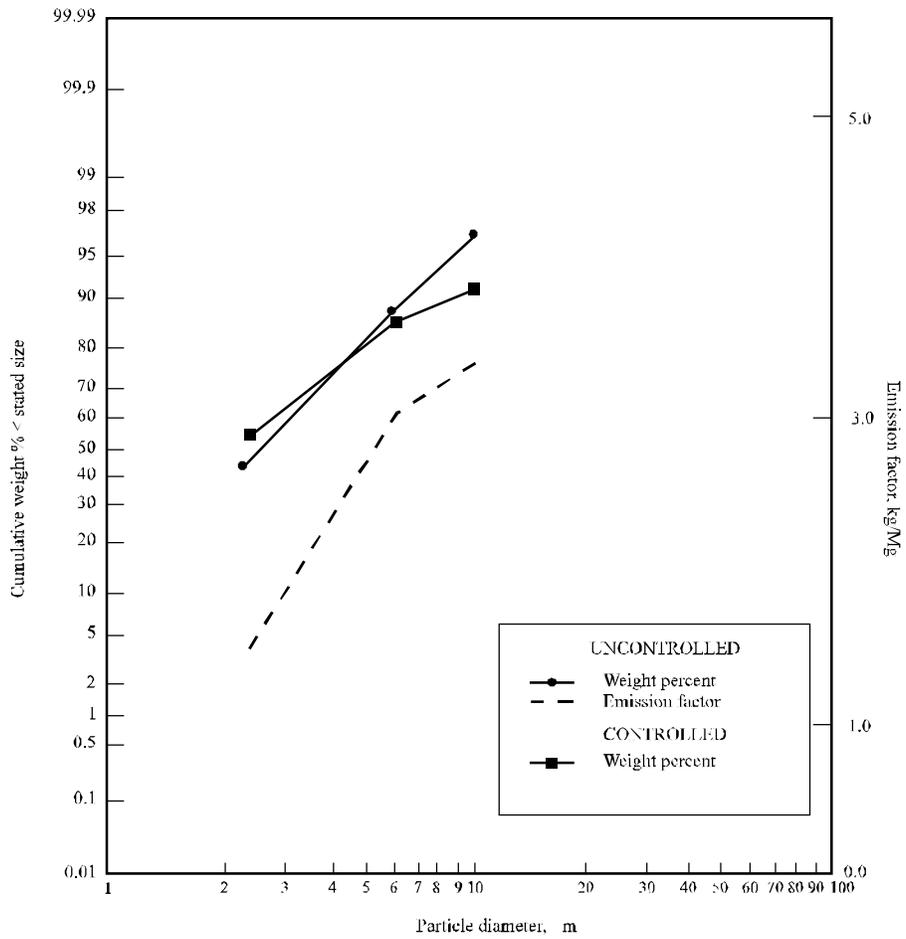
11.10 COAL CLEANING: DRY PROCESS



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	After fabric filter control	After fabric filter control
2.5	16	0.002
6.0	26	0.0025
10.0	31	0.003

11.10 COAL CLEANING: THERMAL DRYER

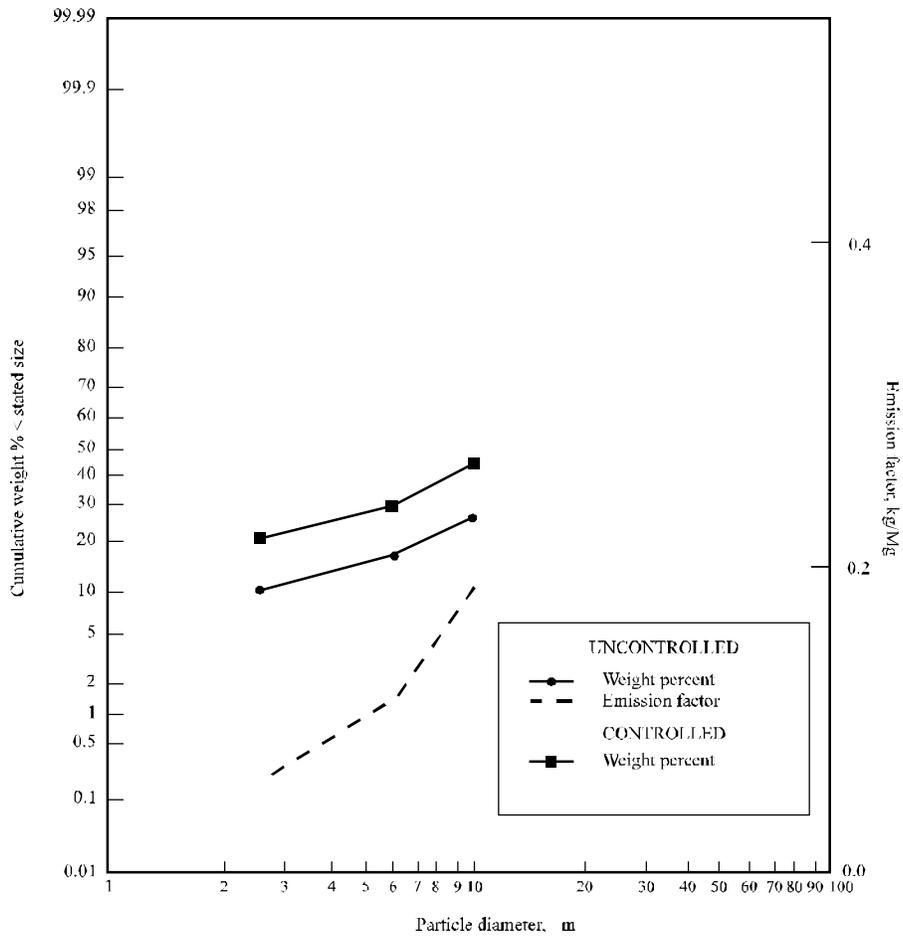
11.10 COAL CLEANING: THERMAL DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled	After wet scrubber	Uncontrolled	After wet scrubber
2.5	42	53	1.47	0.016
6.0	86	85	3.01	0.026
10.0	96	91	3.36	0.027

11.10 COAL PROCESSING: THERMAL INCINERATOR

11.10 COAL PROCESSING: THERMAL INCINERATOR



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg
	Uncontrolled	Cyclone controlled	Uncontrolled
2.5	9.6	21.3	0.07
6.0	17.5	31.8	0.12
10.0	26.5	43.7	0.19

11.10 COAL PROCESSING: THERMAL INCINERATOR

NUMBER OF TESTS: (a) 2, conducted before controls
(b) 2, conducted after multicyclone control

STATISTICS:	(a)	Aerodynamic particle diameter (μm):	2.5	6.0	10.0
		Mean (Cum. %):	9.6	17.5	26.5
		Standard deviation (Cum. %):			
		Min (Cum. %):			
		Max (Cum. %):			
	(b)	Aerodynamic particle diameter (μm):	2.5	6.0	10.0
		Mean (Cum. %):	26.4	35.8	46.6
		Standard deviation (Cum. %):			
		Min (Cum. %):			
		Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: 0.7 kg particulate/Mg coal dried, before multicyclone control. Factor from AP-42, Section 11.10.

SOURCE OPERATION: Source is a thermal incinerator controlling gaseous emissions from a rotary kiln drying coal. No additional operating data are available.

SAMPLING TECHNIQUE: Andersen Mark III Impactor

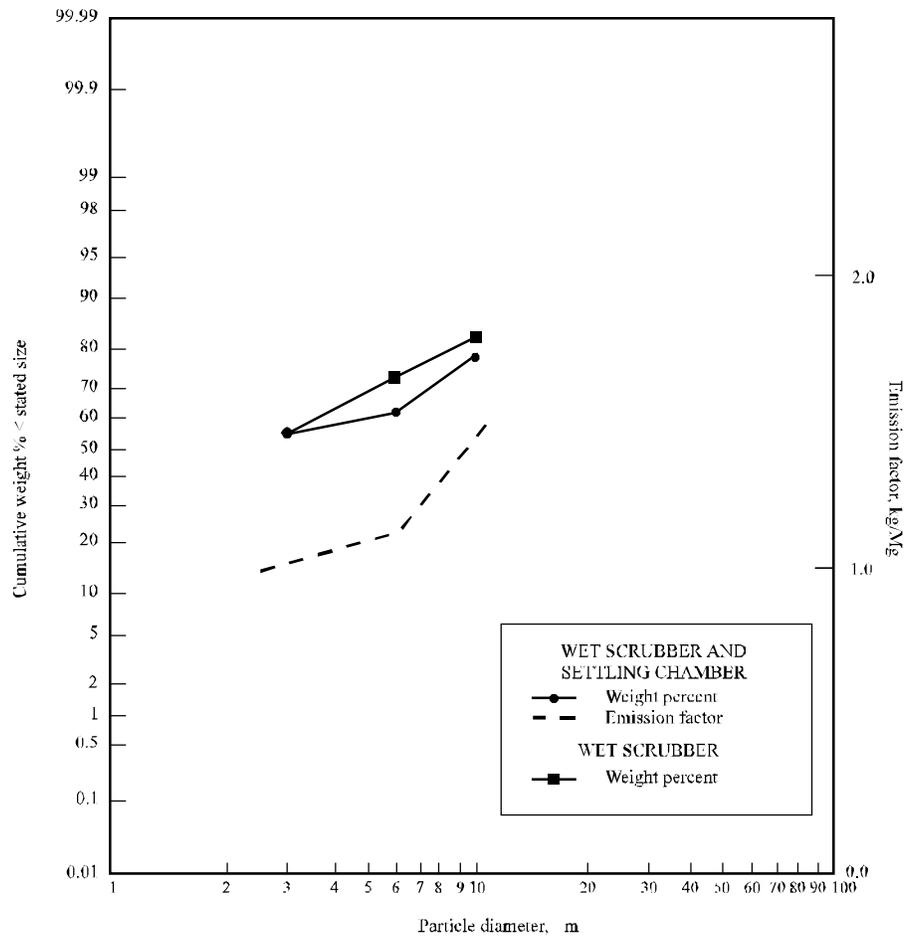
EMISSION FACTOR RATING: D

REFERENCE:

Confidential test data from a major coal processor, PEI Associates, Inc., Golden, CO, January 1985.

11.20 LIGHTWEIGHT AGGREGATE (CLAY): COAL-FIRED ROTARY KILN

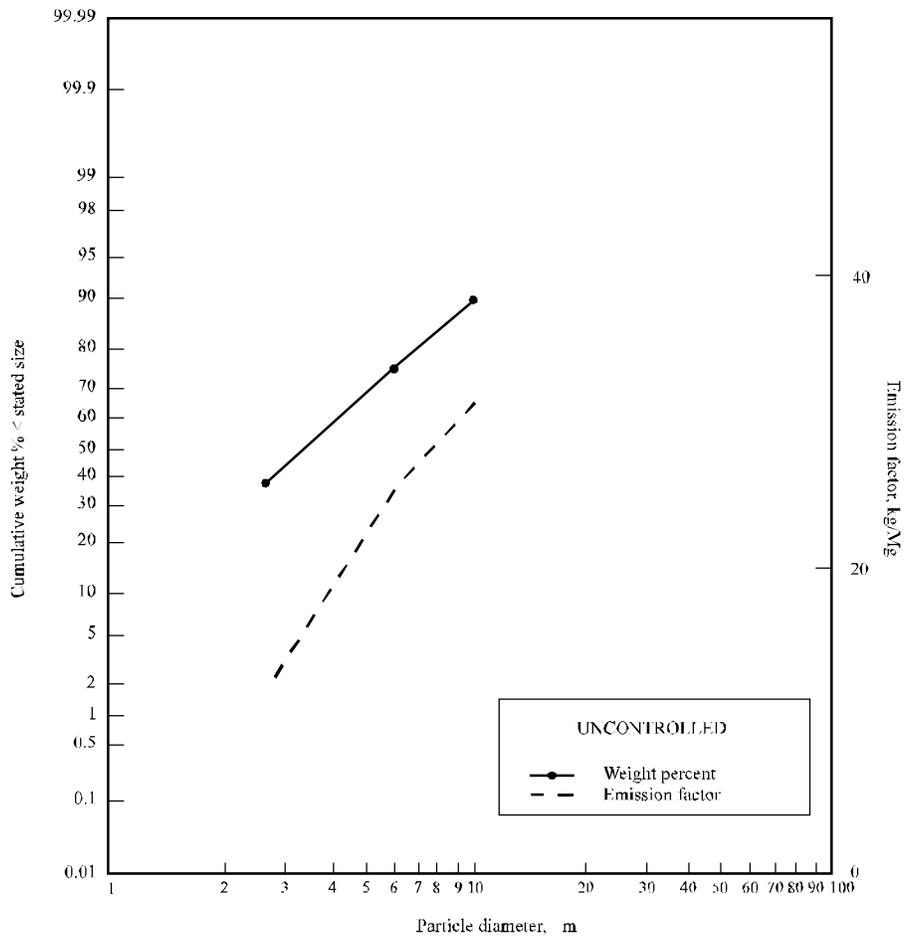
11.20 LIGHTWEIGHT AGGREGATE (CLAY): COAL-FIRED ROTARY KILN



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg
	Wet scrubber and settling chamber	Wet scrubber	Wet scrubber and settling chamber
2.5	55	55	0.97
6.0	65	75	1.15
10.0	81	84	1.43

11.20 LIGHTWEIGHT AGGREGATE (CLAY): DRYER

11.20 LIGHTWEIGHT AGGREGATE (CLAY): DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled		Uncontrolled	
2.5	37.2		13.0	
6.0	74.8		26.2	
10.0	89.5		31.3	

11.20 LIGHTWEIGHT AGGREGATE (CLAY): DRYER

NUMBER OF TESTS: 5, conducted before controls

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	37.2	74.8	89.5
Standard deviation (Cum. %):	3.4	5.6	3.6
Min (Cum. %):	32.3	68.9	85.5
Max (Cum. %):	41.0	80.8	92.7

TOTAL PARTICULATE EMISSION FACTOR: 65 kg/Mg clay feed to dryer. From AP-42, Section 11.20.

SOURCE OPERATION: No information on source operation is available

SAMPLING TECHNIQUE: Brink Impactor

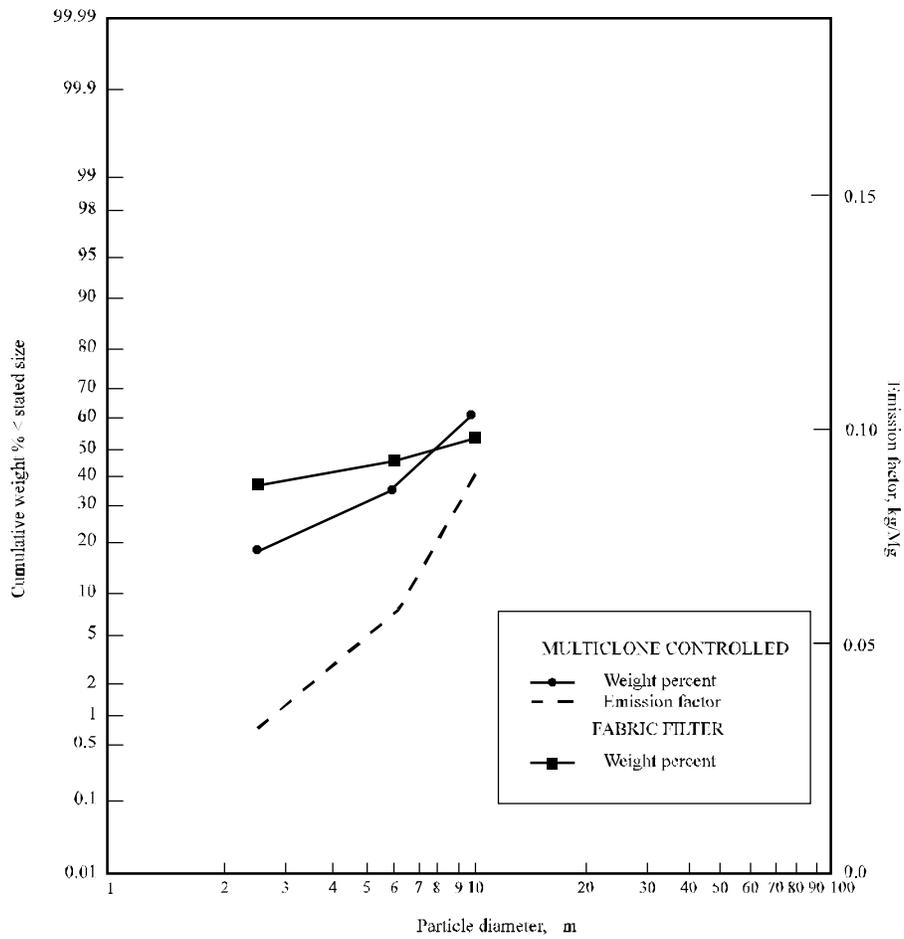
EMISSION FACTOR RATING: C

REFERENCE:

Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System, Series Report No. 88, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.

11.20 LIGHTWEIGHT AGGREGATE (CLAY): RECIPROCATING GRATE CLINKER COOLER

11.20 LIGHTWEIGHT AGGREGATE (CLAY): RECIPROCATING GRATE CLINKER COOLER



Aerodynamic particle diameter, μm	Cumulative wt. % < stated size		Emission factor, kg/Mg
	Multiclone	Fabric filter	Multiclone
2.5	19.3	39	0.03
6.0	38.1	48	0.06
10.0	56.1	54	0.09

11.20 LIGHTWEIGHT AGGREGATE (CLAY): RECIPROCATING GRATE CLINKER COOLER

NUMBER OF TESTS: (a) 12, conducted after Multicyclone control
(b) 4, conducted after Multicyclone and fabric filter control

STATISTICS: (a) Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	19.3	38.1	56.7
Standard deviation (Cum. %):	7.9	14.9	17.9
Min (Cum. %):	9.3	18.6	29.2
Max (Cum. %):	34.6	61.4	76.6
(b) Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	39	48	54
Standard deviation (Cum. %):			
Min (Cum. %):			
Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: 0.157 kg particulate/Mg clay processed, after multicyclone control. Factor calculated from data in Reference b. After fabric filter control, particulate emissions are negligible.

SOURCE OPERATION: Sources produce lightweight clay aggregate in a coal-fired rotary kiln and reciprocating grate clinker cooler.

SAMPLING TECHNIQUE: (a) Andersen Impactor
(b) Andersen Impactor

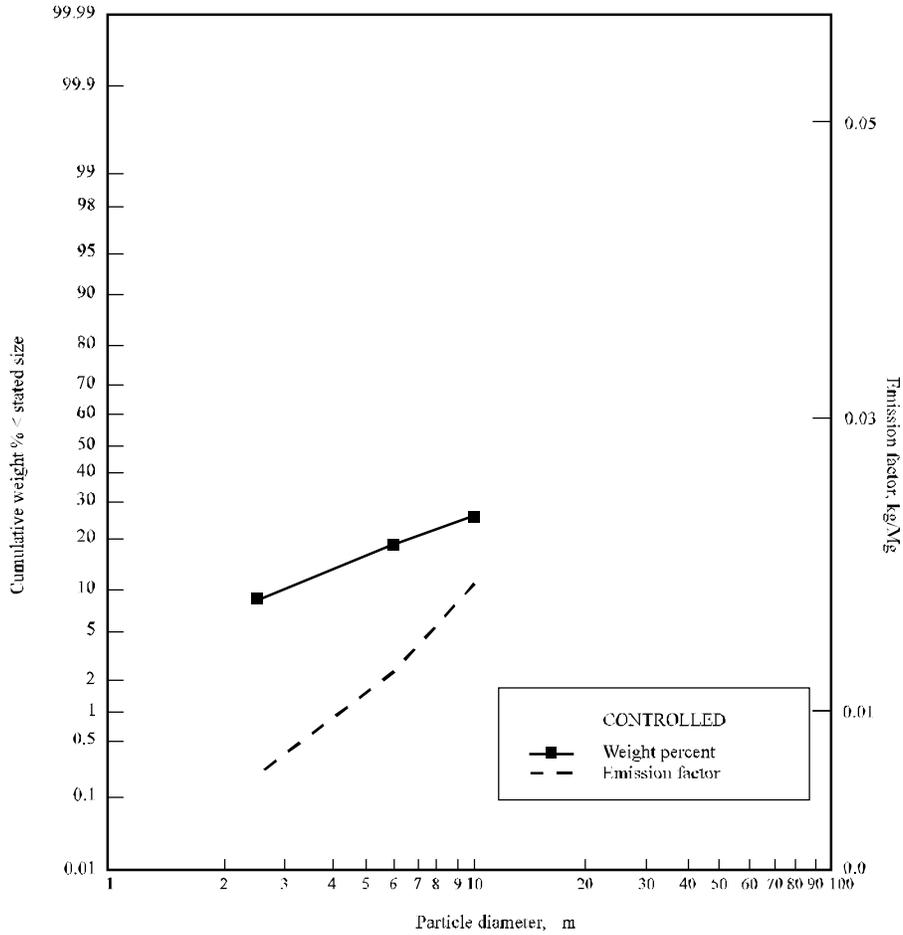
EMISSION FACTOR RATING: C

REFERENCES:

- Emission Test Report, Lightweight Aggregate Industry, Texas Industries, Inc.*, EMB-80-LWA-3, in U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1981.
- Emission Test Report, Lightweight Aggregate Industry, Arkansas Lightweight Aggregate Corporation*, EMB-80-LWA-2, U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1981.
- Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System, Series Report No. 342, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.

11.20 LIGHTWEIGHT AGGREGATE (SHALE):
 RECIPROCATING GRATE CLINKER COOLER

11.20 LIGHTWEIGHT AGGREGATE (SHALE): RECIPROCATING GRATE CLINKER COOLER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	Settling chamber control	Settling chamber control
2.5	8.2	0.007
6.0	17.6	0.014
10.0	25.6	0.020

11.20 LIGHTWEIGHT AGGREGATE (SHALE):
RECIPROCATING GRATE CLINKER COOLER

NUMBER OF TESTS: 4, conducted after settling chamber control

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	8.2	17.6	25.6
Standard deviation (Cum. %):	4.3	2.8	1.7
Min (Cum. %):	4.0	15.0	24.0
Max (Cum. %):	14.0	21.0	28.0

TOTAL PARTICULATE EMISSION FACTOR: 0.08 kg particulate/Mg of aggregate produced.
Factor calculated from data in reference.

SOURCE OPERATION: Source operates 2 kilns to produce lightweight shale aggregate, which is cooled and classified on a reciprocating grate clinker cooler. Normal production rate of the tested kiln is 23 tons/hr, about 66% of rated capacity. Kiln rotates at 2.8 rpm. Feed end temperature is 1100°F.

SAMPLING TECHNIQUE: Andersen Impactor

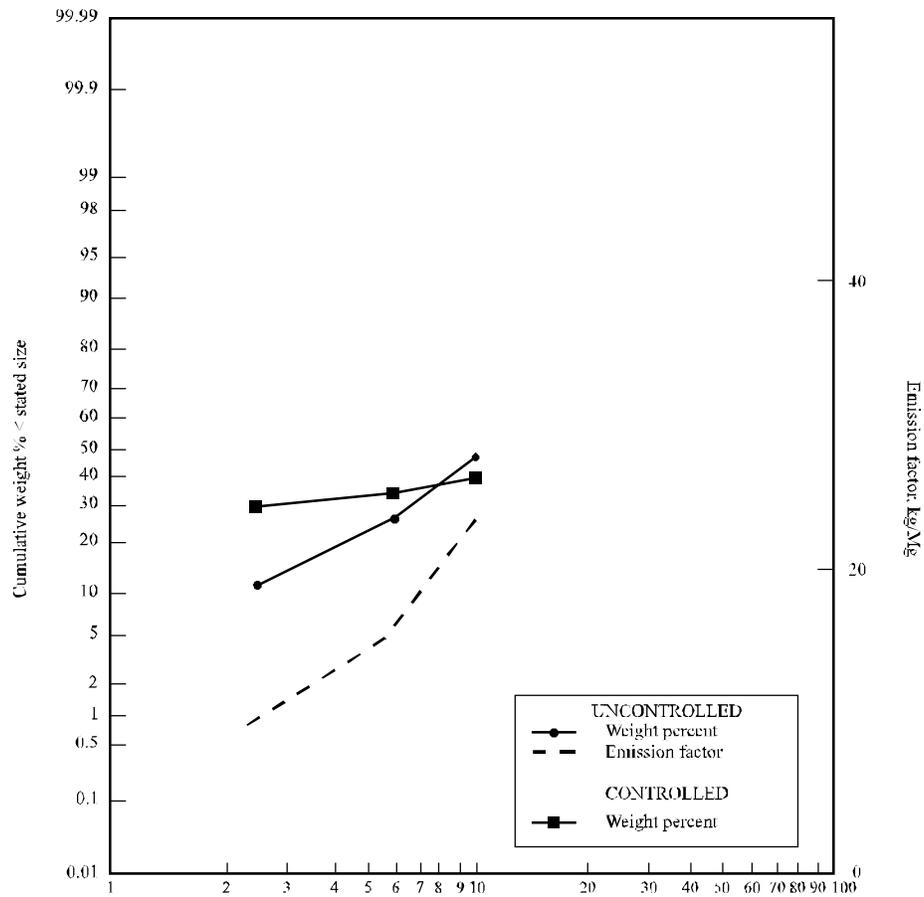
EMISSION FACTOR RATING: B

REFERENCE:

Emission Test Report, Lightweight Aggregate Industry, Vulcan Materials Company, EMB-80-LWA-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 1982.

11.20 LIGHTWEIGHT AGGREGATE (SLATE): COAL-FIRED ROTARY KILN

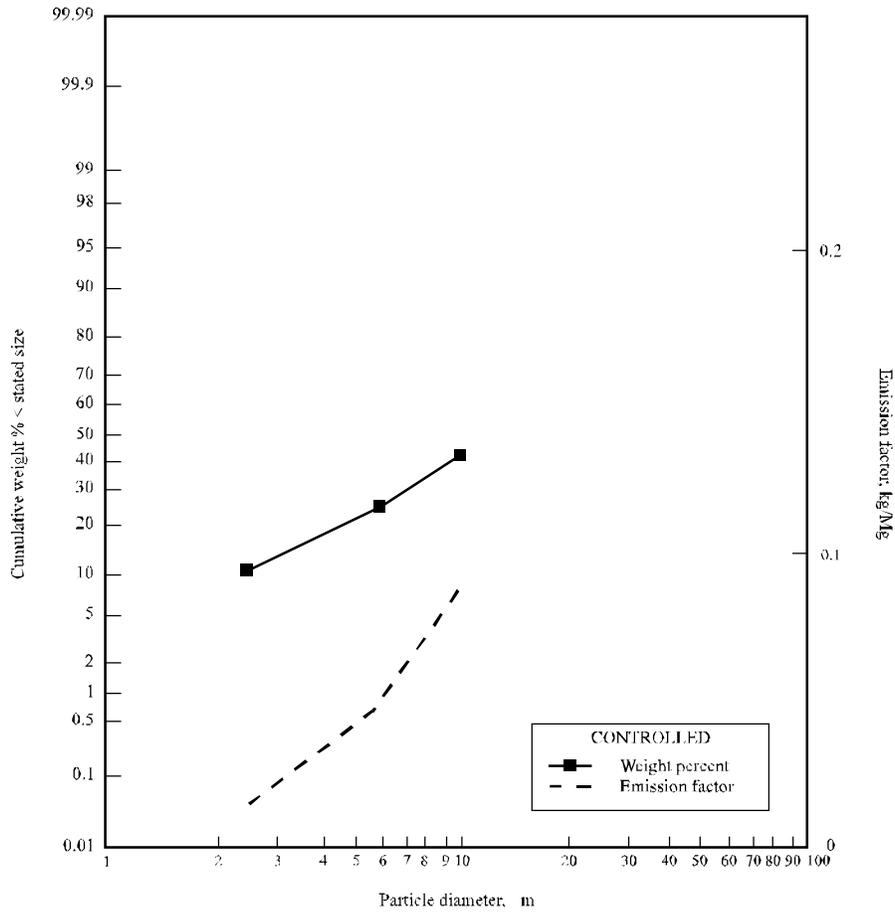
11.20 LIGHTWEIGHT AGGREGATE (SLATE): COAL-FIRED ROTARY KILN



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Without controls	After wet scrubber control	Without controls	After wet scrubber control
2.5	13	33	7.3	0.59
6.0	29	36	16.2	0.65
10.0	42	39	23.5	0.70

11.20 LIGHTWEIGHT AGGREGATE (SLATE):
 RECIPROCATING GRATE CLINKER COOLER

11.20 LIGHTWEIGHT AGGREGATE (SLATE):
 RECIPROCATING GRATE CLINKER COOLER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	After settling chamber control	After settling chamber control
2.5	9.8	0.02
6.0	23.6	0.05
10.0	41.0	0.09

11.20 LIGHTWEIGHT AGGREGATE (SLATE):
RECIPROCATING GRATE CLINKER COOLER

NUMBER OF TESTS: 5, conducted after settling chamber control

STATISTICS: Aerodynamic particle diameter (μm): 2.5 6.0 10.0

Mean (Cum. %): 9.8 23.6 41.0

Standard deviation (Cum. %):

Min (Cum. %):

Max (Cum. %):

TOTAL PARTICULATE EMISSION FACTOR: 0.22 kg particulate/Mg of raw material feed. Factor calculated from data in reference.

SOURCE OPERATION: Source produces lightweight slate aggregate in a coal-fired kiln and a reciprocating grate clinker cooler. During testing, source was operating at a feed rate of 33 tons/hr, 83% of rated capacity. Firing zone temperatures are about 2125°F, and kiln rotates at 3.25 rpm.

SAMPLING TECHNIQUE: Andersen Impactor

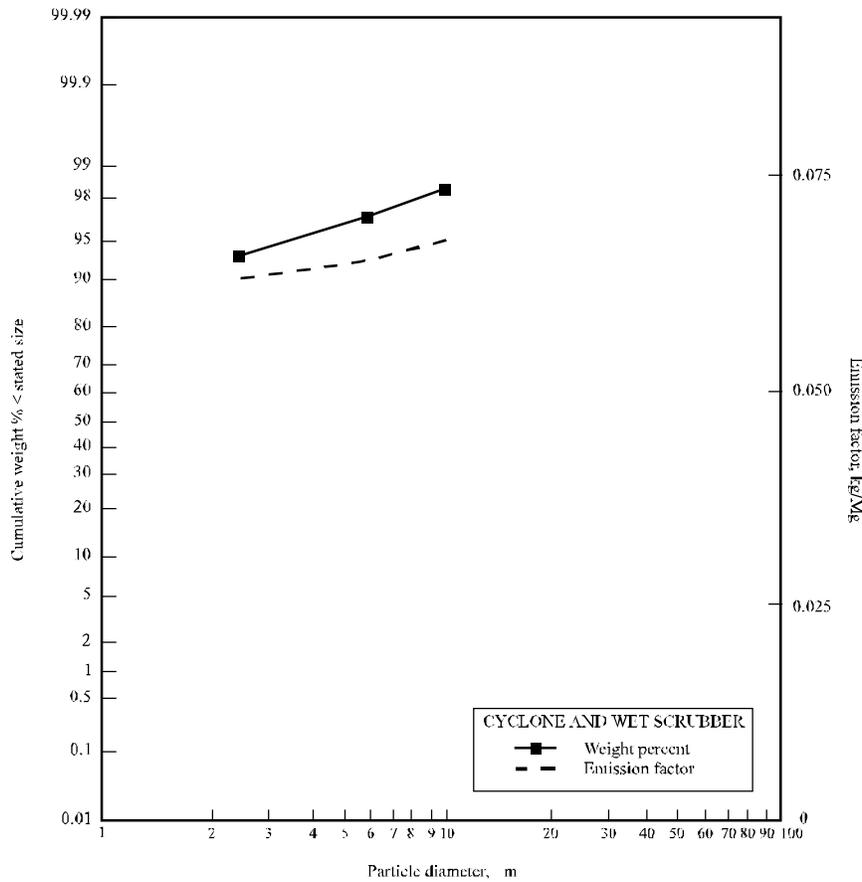
EMISSION FACTOR RATING: C

REFERENCE:

Emission Test Report, Lightweight Aggregate Industry, Galite Corporation, EMB-80-LWA-6, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1982.

11.21 PHOSPHATE ROCK PROCESSING: CALCINER

11.21 PHOSPHATE ROCK PROCESSING: CALCINER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	After cyclone ^a and wet scrubber	After cyclone ^a and wet scrubber
2.5	94.0	0.064
6.0	97.0	0.066
10.0	98.0	0.067

^a Cyclones are typically used in phosphate rock processing as product collectors. Uncontrolled emissions are emissions in the air exhausted from such cyclones.

11.21 PHOSPHATE ROCK PROCESSING: CALCINER

NUMBER OF TESTS: 6, conducted after wet scrubber control

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	94.0	97.0	98.0
Standard deviation (Cum. %):	2.5	1.6	1.5
Min (Cum. %):	89.0	95.0	96.0
Max (Cum. %):	98.0	99.2	99.7

TOTAL PARTICULATE EMISSION FACTOR: 0.0685 kg particulate/Mg of phosphate rock calcined, after collection of airborne product in a cyclone, and wet scrubber controls. Factor from reference cited below.

SOURCE OPERATION: Source is a phosphate rock calciner fired with No. 2 oil, with a rated capacity of 70 tons/hr. Feed to the calciner is beneficiated rock.

SAMPLING TECHNIQUE: Andersen Impactor.

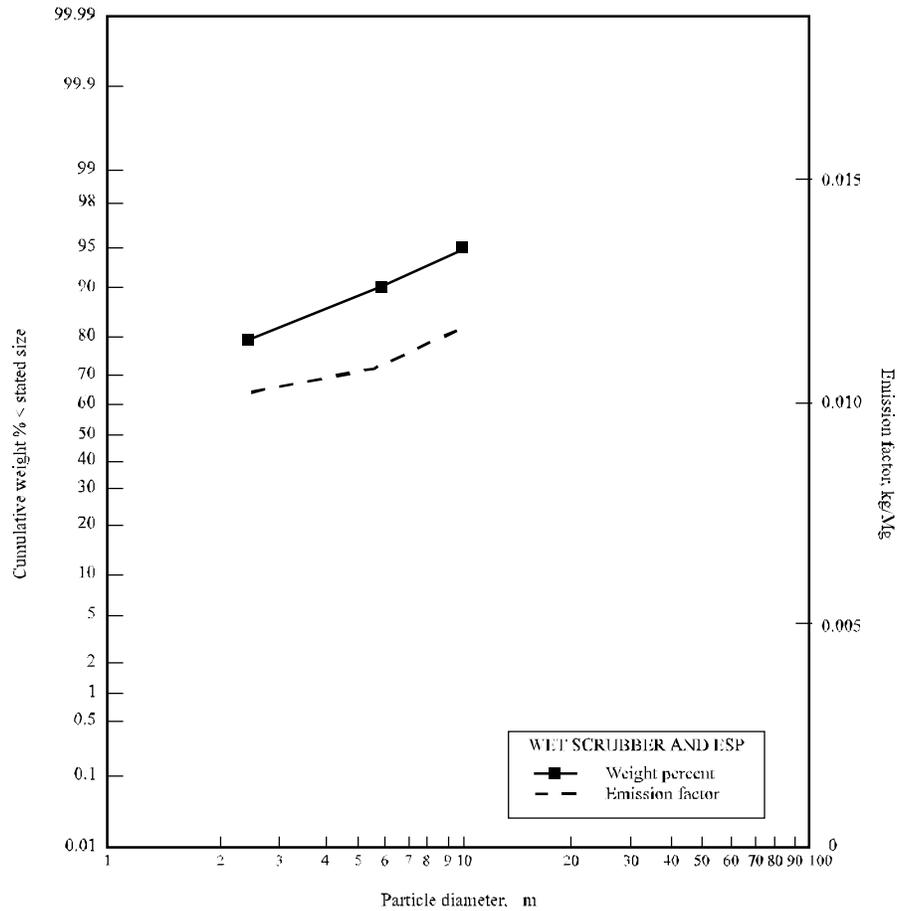
EMISSION FACTOR RATING: C

REFERENCE:

Air Pollution Emission Test, Beker Industries, Inc., Conda, ID, EMB-75-PRP-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, November 1975.

**11.21 PHOSPHATE ROCK PROCESSING:
OIL-FIRED ROTARY AND FLUIDIZED-BED TANDEM DRYERS**

11.21 PHOSPHATE ROCK PROCESSING:
OIL-FIRED ROTARY AND FLUIDIZED-BED TANDEM DRYERS



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	After wet scrubber and ESP control	After wet scrubber and ESP control
2.5	78.0	0.010
6.0	88.8	0.011
10.0	93.8	0.012

11.21 PHOSPHATE ROCK PROCESSING:
OIL-FIRED ROTARY AND FLUIDIZED-BED TANDEM DRYERS

NUMBER OF TESTS: 2, conducted after wet scrubber and electrostatic precipitator control

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	78.0	88.8	93.8
Standard deviation (Cum. %):	22.6	9.6	2.5
Min (Cum. %):	62	82	92
Max (Cum. %):	94	95	95

TOTAL PARTICULATE EMISSION FACTOR: 0.0125 kg particulate/Mg phosphate rock processed, after collection of airborne product in a cyclone and wet scrubber/ESP controls. Factor from reference cited below.

SOURCE OPERATION: Source operates a rotary and a fluidized bed dryer to dry various types of phosphate rock. Both dryers are fired with No. 5 fuel oil, and exhaust into a common duct. The rated capacity of the rotary dryer is 300 tons/hr, and that of the fluidized bed dryer is 150-200 tons/hr. During testing, source was operating at 67.7% of rated capacity.

SAMPLING TECHNIQUE: Andersen Impactor

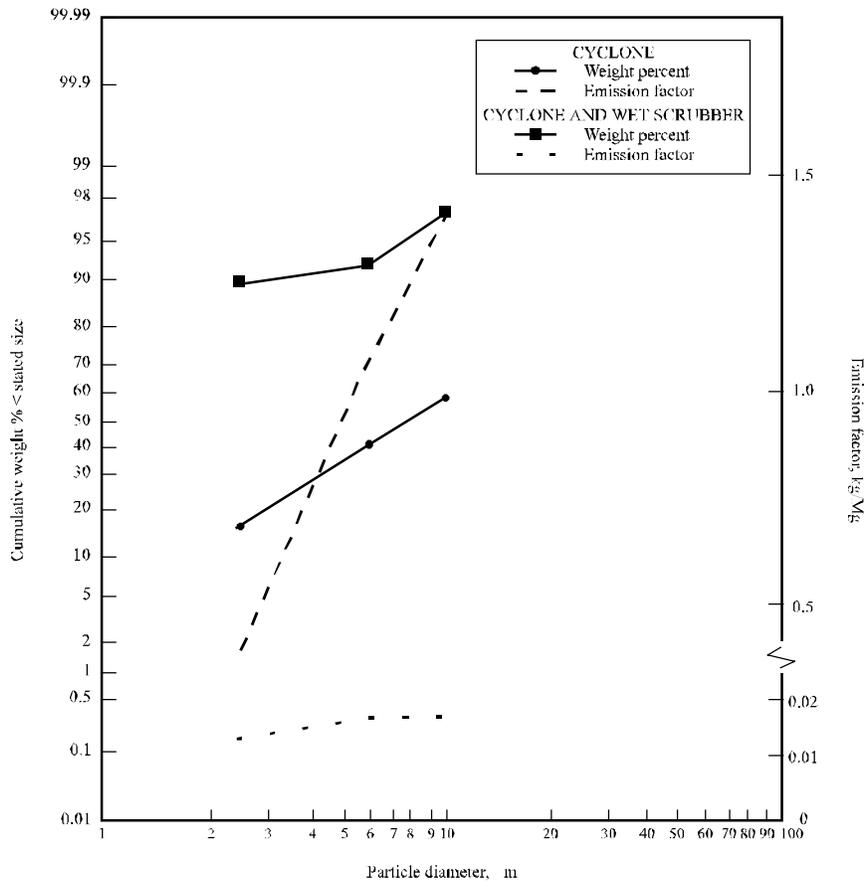
EMISSION FACTOR RATING: C

REFERENCE:

Air Pollution Emission Test, W. R. Grace Chemical Company, Bartow, FL, EMB-75-PRP-1, U. S. Environmental Protection Agency, Research Triangle Park, NC, January 1976.

11.21 PHOSPHATE ROCK PROCESSING: OIL-FIRED ROTARY DRYER

11.21 PHOSPHATE ROCK PROCESSING: OIL-FIRED ROTARY DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	After cyclone ^a	After wet scrubber	After cyclone ^a	After wet scrubber
2.5	15.7	89	0.38	0.017
6.0	41.3	92.3	1.00	0.018
10.0	58.3	96.6	1.41	0.018

^a Cyclones are typically used in phosphate rock processing as product collectors. Uncontrolled emissions are emissions in the air exhausted from such cyclones.

11.21 PHOSPHATE ROCK PROCESSING: OIL-FIRED ROTARY DRYER

NUMBER OF TESTS: (a) 3, conducted after cyclone
 (b) 2, conducted after wet scrubber control

STATISTICS:	(a)	Aerodynamic particle diameter (μm):	2.5	6.0	10.0
		Mean (Cum. %):	15.7	41.3	58.3
		Standard deviation (Cum. %):	5.5	9.6	13.9
		Min (Cum. %):	12	30	43
		Max (Cum. %):	22	48	70
	(b)	Aerodynamic particle diameter (μm):	2.5	6.0	10.0
		Mean (Cum. %):	89.0	92.3	96.6
		Standard Deviation (Cum. %):	7.1	6.0	3.7
		Min (Cum. %):	84	88	94
		Max (Cum. %):	94	96	99

Impactor cut points for the tests conducted before control are small, and many of the data points are extrapolated. These particle size distributions are related to specific equipment and source operation, and are most applicable to particulate emissions from similar sources operating similar equipment. Table 11.21-2, Section 11.21, AP-42 presents particle size distributions for generic phosphate rock dryers.

TOTAL PARTICULATE EMISSION FACTORS: After cyclone, 2.419 kg particulate/Mg rock processed. After wet scrubber control, 0.019 kg/Mg. Factors from reference cited below.

SOURCE OPERATION: Source dries phosphate rock in #6 oil-fired rotary dryer. During these tests, source operated at 69% of rated dryer capacity of 350 tons/day, and processed coarse pebble rock.

SAMPLING TECHNIQUE: (a) Brinks Cascade Impactor
 (b) Andersen Impactor

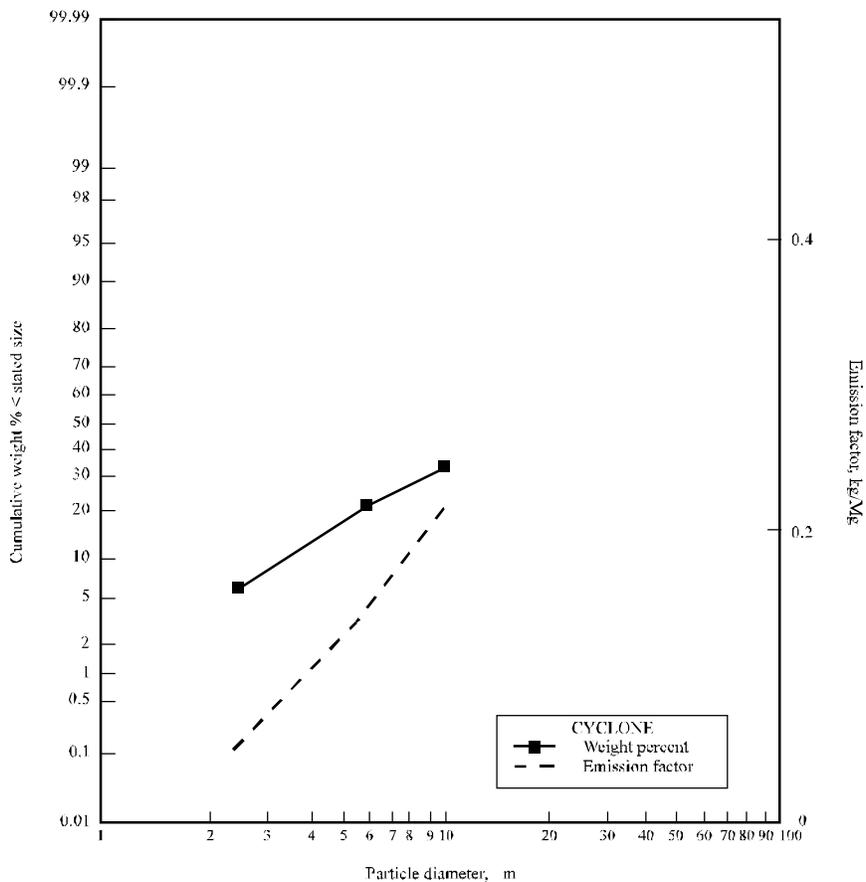
EMISSION FACTOR RATING: D

REFERENCE:

Air Pollution Emission Test, Mobil Chemical, Nichols, FL, EMB-75-PRP-3, U. S. Environmental Protection Agency, Research Triangle Park, NC, January 1976.

11.21 PHOSPHATE ROCK PROCESSING: BALL MILL

11.21 PHOSPHATE ROCK PROCESSING: BALL MILL



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	After cyclone ^a		After cyclone ^a	
2.5	6.5		0.05	
6.0	19.0		0.14	
10.0	30.8		0.22	

^a Cyclones are typically used in phosphate rock processing as product collectors. Uncontrolled emissions are emissions in the air exhausted from such cyclones.

11.21 PHOSPHATE ROCK PROCESSING: BALL MILL

NUMBER OF TESTS: 4, conducted after cyclone

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	6.5	19.0	30.8
Standard deviation (Cum. %):	3.5	0.9	2.6
Min (Cum. %):	3	18	28
Max (Cum. %):	11	20	33

Impactor cutpoints were small, and most data points were extrapolated.

TOTAL PARTICULATE EMISSION FACTOR: 0.73 kg particulate/Mg of phosphate rock milled, after collection of airborne product in cyclone. Factor from reference cited below.

SOURCE OPERATION: Source mills western phosphate rock. During testing source was operating at 101% of rated capacity, producing 80 tons/hr.

SAMPLING TECHNIQUE: Brink Impactor

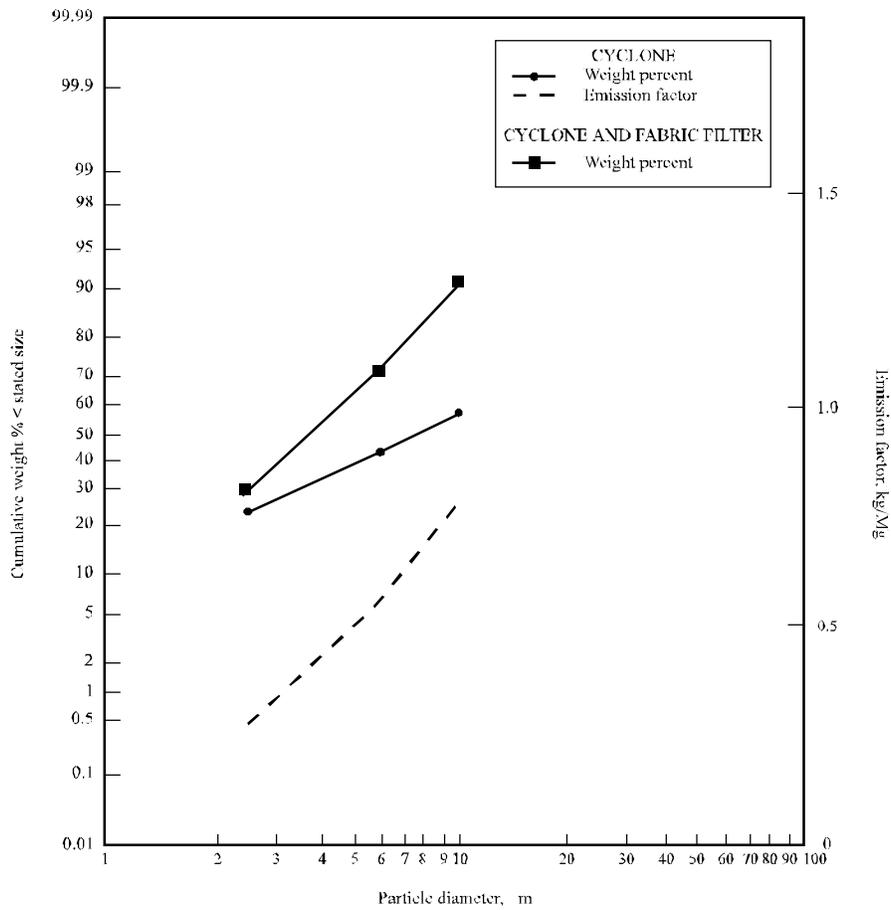
EMISSION FACTOR RATING: C

REFERENCE:

Air Pollution Emission Test, Beker Industries, Inc., Conda, ID, EMB-75-PRP-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, November 1975.

11.21 PHOSPHATE ROCK PROCESSING: ROLLER MILL AND BOWL MILL GRINDING

11.21 PHOSPHATE ROCK PROCESSING: ROLLER MILL AND BOWL MILL GRINDING



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	After cyclone ^a	After fabric filter	After cyclone ^a	After fabric filter
2.5	21	25	0.27	Negligible
6.0	45	70	0.58	Negligible
10.0	62	90	0.79	Negligible

^a Cyclones are typically used in phosphate rock processing as product collectors. Uncontrolled emissions are emissions in the air exhausted from such cyclones.

11.21 PHOSPHATE ROCK PROCESSING: ROLLER MILL AND BOWL MILL GRINDING

NUMBER OF TESTS: (a) 2, conducted after cyclone
 (b) 1, conducted after fabric filter control

STATISTICS: (a)	Aerodynamic particle diameter (μm):	2.5	6.0	10.0
	Mean (Cum. %):	21.0	45.0	62.0
	Standard deviation (Cum. %):	1.0	1.0	0
	Min (Cum. %):	20.0	44.0	62.0
	Max (Cum. %):	22.0	46.0	62.0
(b)	Aerodynamic particle diameter (μm):	2.5	6.0	10.0
	Mean (Cum. %):	25	70	90
	Standard deviation (Cum. %):			
	Min (Cum. %):			
	Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR. 0.73 kg particulate/Mg of rock processed, after collection of airborne product in a cyclone. After fabric filter control, 0.001 kg particulate/Mg rock processed. Factors calculated from data in reference cited below. See Table 11.21-3 for guidance.

SOURCE OPERATION: During testing, source was operating at 100% of design process rate. Source operates 1 roller mill with a rated capacity of 25 tons/hr of feed, and 1 bowl mill with a rated capacity of 50 tons/hr of feed. After product has been collected in cyclones, emissions from each mill are vented to a coin baghouse. Source operates 6 days/week, and processes Florida rock.

SAMPLING TECHNIQUE: (a) Brink Cascade Impactor
 (b) Andersen Impactor

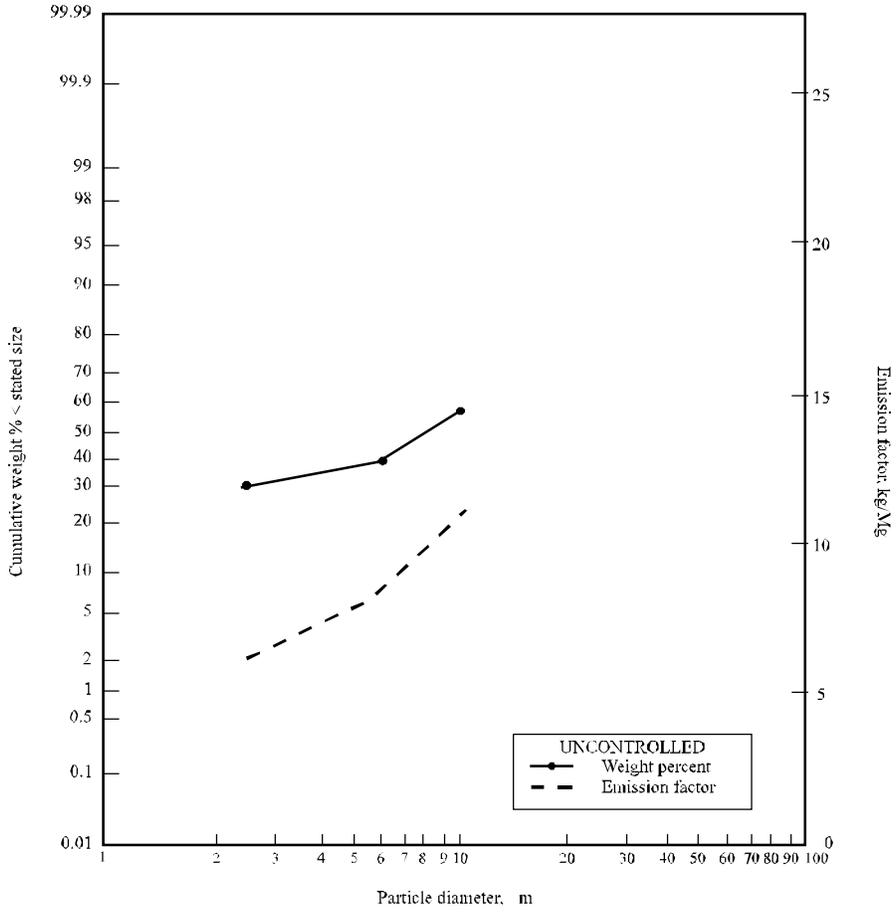
EMISSION FACTOR RATING: D

REFERENCE:

Air Pollution Emission Test, The Royster Company, Mulberry, FL, EMB-75-PRP-2, U. S. Environmental Protection Agency, Research Triangle Park, NC, January 1976.

11.26 NONMETALLIC MINERALS: TALC PEBBLE MILL

11.26 NONMETALLIC MINERALS: TALC PEBBLE MILL



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	Before controls	Before controls
2.5	30.1	5.9
6.0	42.4	8.3
10.0	56.4	11.1

11.26 NONMETALLIC MINERALS: TALC PEBBLE MILL

NUMBER OF TESTS: 2, conducted before controls

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	30.1	42.4	56.4
Standard deviation (Cum. %):	0.8	0.2	0.4
Min (Cum. %):	29.5	42.2	56.1
Max (Cum. %):	30.6	42.5	56.6

TOTAL PARTICULATE EMISSION FACTOR: 19.6 kg particulate/Mg ore processed. Calculated from data in reference.

SOURCE OPERATION: Source crushes talc ore then grinds crushed ore in a pebble mill. During testing, source operation was normal according to the operators. An addendum to the reference indicates throughput varied between 2.8 and 4.4 tons/hr during these tests.

SAMPLING TECHNIQUE: Sample was collected in an alundum thimble and analyzed with a Spectrex Prototron Particle Counter Model ILI 1000.

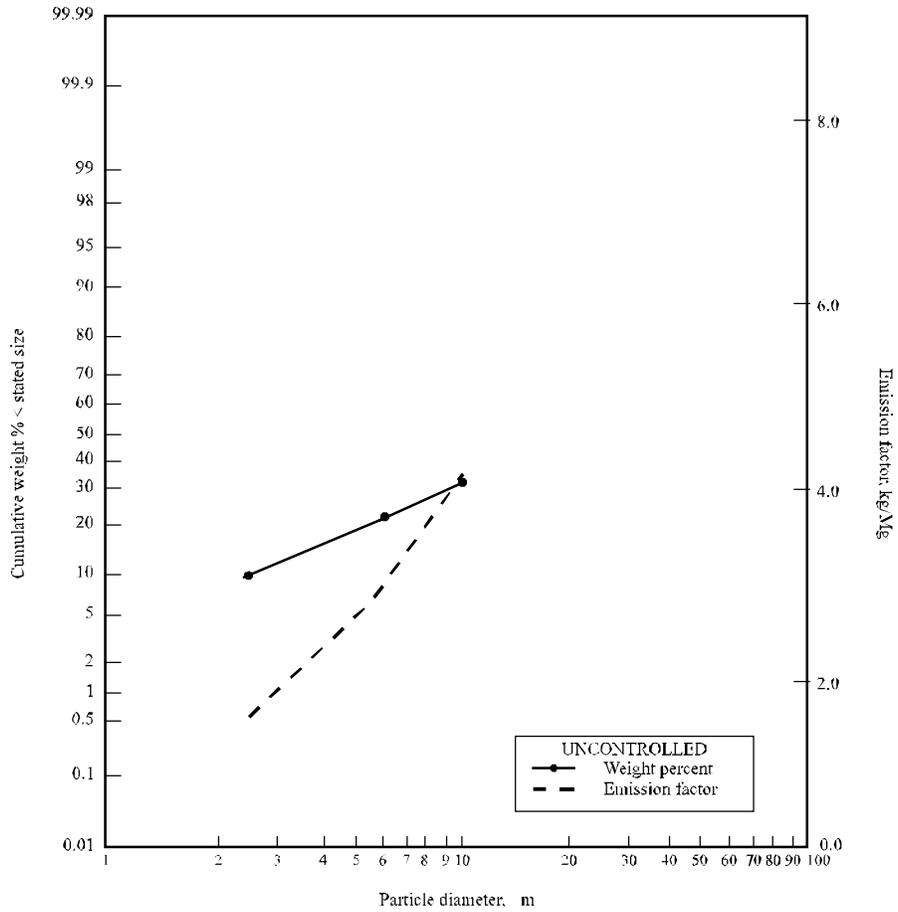
EMISSION FACTOR RATING: E

REFERENCE:

Air Pollution Emission Test, Pfizer, Inc., Victorville, CA, EMB-77-NMM-5, U. S. Environmental Protection Agency, Research Triangle Park, NC, July 1977.

11.xx NONMETALLIC MINERALS: FELDSPAR BALL MILL

11.xx NONMETALLIC MINERALS: FELDSPAR BALL MILL



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	Before controls	Before controls
2.5	11.5	1.5
6.0	22.8	2.9
10.0	32.3	4.2

11.xx NONMETALLIC MINERALS: FELDSPAR BALL MILL

NUMBER OF TESTS: 2, conducted before controls

STATISTICS: Aerodynamic particle diameter (µm):	2.5	6.0	10.0
Mean (Cum. %):	11.5	22.8	32.3
Standard deviation (Cum. %):	6.4	7.4	6.7
Min (Cum. %):	7.0	17.5	27.5
Max (Cum. %):	16.0	28.0	37.0

TOTAL PARTICULATE EMISSION FACTOR: 12.9 kg particulate/Mg feldspar produced. Calculated from data in reference and related documents.

SOURCE OPERATION: After crushing and grinding of feldspar ore, source produces feldspar powder in a ball mill.

SAMPLING TECHNIQUE: Alundum thimble followed by 12-inch section of stainless steel probe followed by 47-mm type SGA filter contained in a stainless steel Gelman filter holder. Laboratory analysis methods: microsieve and electronic particle counter.

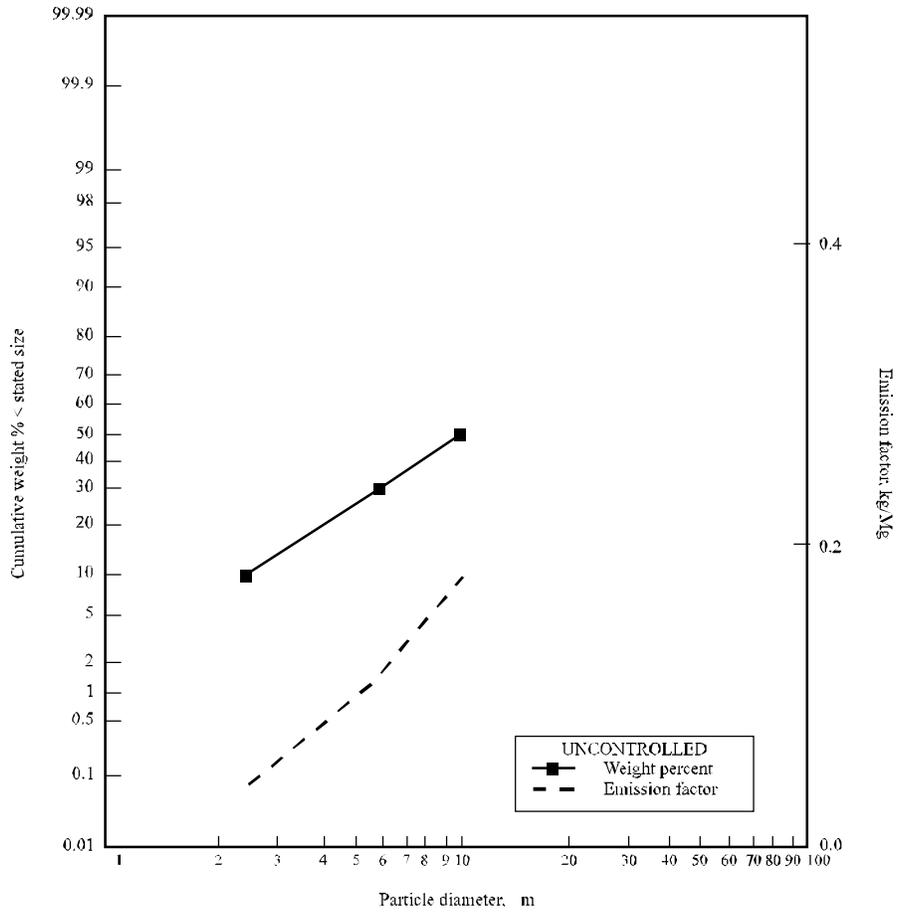
EMISSION FACTOR RATING: D

REFERENCE:

Air Pollution Emission Test, International Minerals and Chemical Company, Spruce Pine, NC, EMB-76-NMM-1, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1976.

11.xx NONMETALLIC MINERALS: FLUORSPAR ORE ROTARY DRUM DRYER

11.xx NONMETALLIC MINERALS: FLUORSPAR ORE ROTARY DRUM DRYER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	After fabric filter control	After fabric filter control
2.5	10	0.04
6.0	30	0.11
10.0	48	0.18

11.xx NONMETALLIC MINERALS: FLUORSPAR ORE ROTARY DRUM DRYER

NUMBER OF TESTS: 1, conducted after fabric filter control

STATISTICS: Aerodynamic particle diameter (μm): 2.5 6.0 10.0

Mean (Cum. %): 10 30 48

Standard deviation (Cum. %):

Min (Cum. %):

Max (Cum. %):

TOTAL PARTICULATE EMISSION FACTOR: 0.375 kg particulate/Mg ore dried, after fabric filter control. Factors from reference.

SOURCE OPERATION: Source dries fluorspar ore in a rotary drum dryer at a feed rate of 2 tons/hr.

SAMPLING TECHNIQUE: Andersen Mark III Impactor

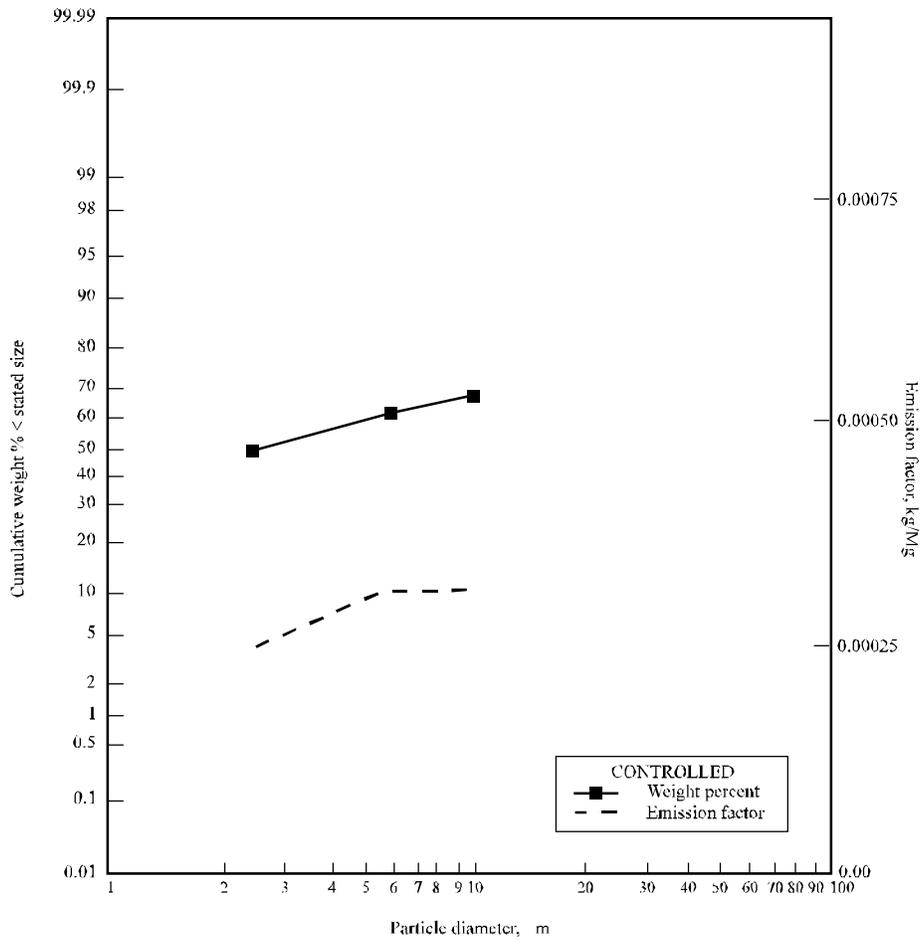
EMISSION FACTOR RATING: E

REFERENCE:

Confidential test data from a major fluorspar ore processor, PEI Associates, Inc., Golden, CO, January 1985.

12.1 PRIMARY ALUMINUM PRODUCTION: BAUXITE PROCESSING - FINE ORE STORAGE

12.1 PRIMARY ALUMINUM PRODUCTION: BAUXITE PROCESSING - FINE ORE STORAGE



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	
	Fabric filter controlled	Emission factor, kg/Mg
2.5	50.0	0.00025
6.0	62.0	0.0003
10.0	68.0	0.0003

12.1 PRIMARY ALUMINUM PRODUCTION: BAUXITE PROCESSING - FINE ORE STORAGE

NUMBER OF TESTS: 2, after fabric filter control

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	50.0	62.0	68.0
Standard deviation (Cum. %):	15.0	19.0	20.0
Min (Cum. %):	35.0	43.0	48.0
Max (Cum. %):	65.0	81.0	88.0

TOTAL PARTICULATE EMISSION FACTOR: 0.0005 kg particulate/Mg of ore filled, with fabric filter control. Factor calculated from emission and process data in reference.

SOURCE OPERATION: The facility purifies bauxite to alumina. Bauxite ore, unloaded from ships, is conveyed to storage bins from which it is fed to the alumina refining process. These tests measured the emissions from the bauxite ore storage bin filling operation (the ore drop from the conveyer into the bin), after fabric filter control. Normal bin filling rate is between 425 and 475 tons per hour.

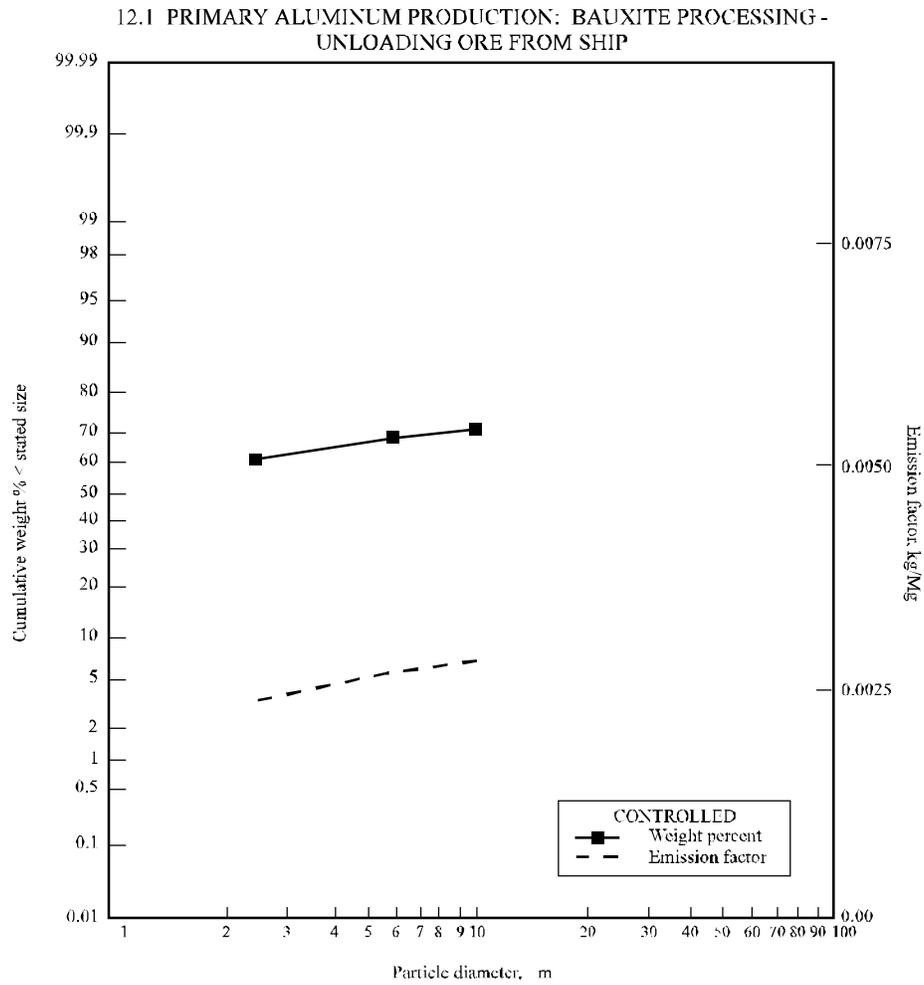
SAMPLING TECHNIQUE: Andersen Impactor

EMISSION FACTOR RATING: E

REFERENCE:

Emission Test Report, Reynolds Metals Company, Corpus Christi, TX, EMB-80-MET-9, U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1980.

12.1 PRIMARY ALUMINUM PRODUCTION: BAUXITE PROCESSING - UNLOADING ORE FROM SHIP



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor, kg/Mg
	Wet scrubber controlled	Wet scrubber controlled
2.5	60.5	0.0024
6.0	67.0	0.0027
10.0	70.0	0.0028

12.1 PRIMARY ALUMINUM PRODUCTION: BAUXITE PROCESSING -
UNLOADING ORE FROM SHIP

NUMBER OF TESTS: 1, after venturi scrubber control

STATISTICS: Aerodynamic particle diameter (μm): 2.5 6.0 10.0

Mean (Cum. %): 60.5 67.0 70.0

Standard deviation (Cum. %):

Min (Cum. %):

Max (Cum. %):

TOTAL PARTICULATE EMISSION FACTOR: 0.004 kg particulate/Mg bauxite ore unloaded after scrubber control. Factor calculated from emission and process data contained in reference.

SOURCE OPERATION: The facility purifies bauxite to alumina. Ship unloading facility normally operates at 1500-1700 tons/hr, using a self-contained extendable boom conveyor that interfaces with a dockside conveyor belt through an accordion chute. The emissions originate at the point of transfer of the bauxite ore from the ship's boom conveyer as the ore drops through the chute onto the dockside conveyer. Emissions are ducted to a dry cyclone and then to a Venturi scrubber. Design pressure drop across scrubber is 15 inches, and efficiency during test was 98.4%.

SAMPLING TECHNIQUE: Andersen Impactor

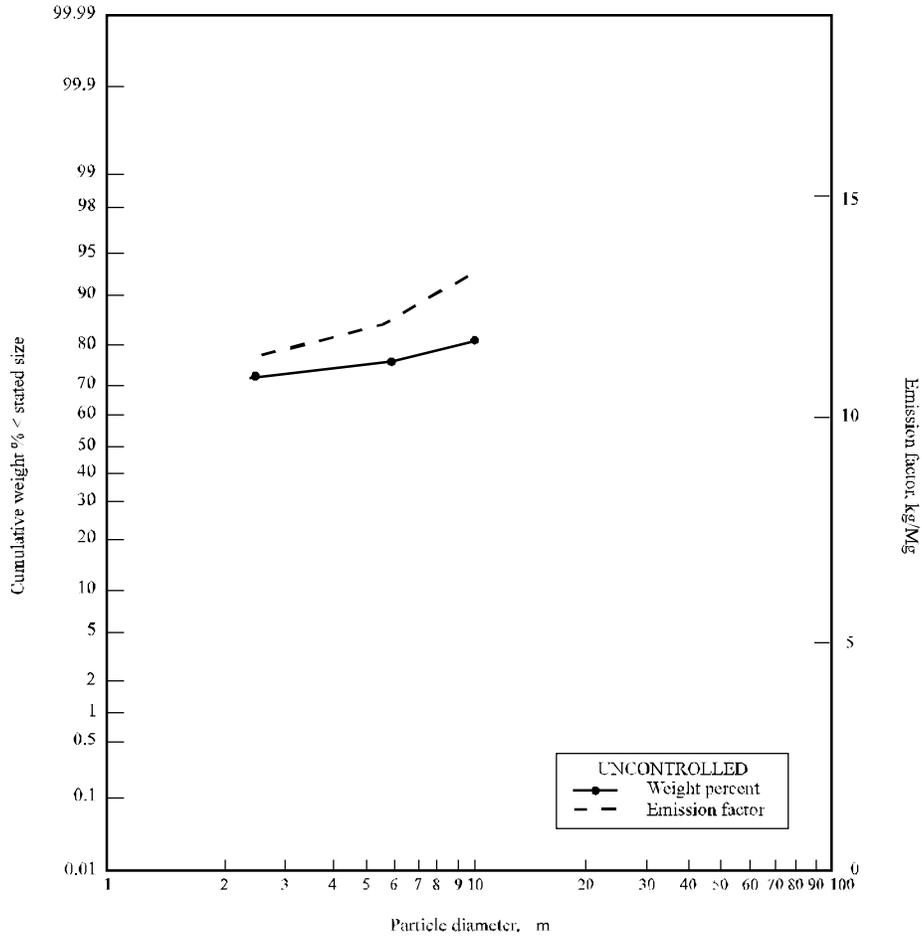
EMISSION FACTOR RATING: E

REFERENCE:

Emission Test Report, Reynolds Metals Company, Corpus Christi, TX, EMB-80-MET-9,
U. S. Environmental Protection Agency, Research Triangle Park, NC, May 1980.

12.13 STEEL FOUNDRIES: CASTINGS SHAKEOUT

12.13 STEEL FOUNDRIES: CASTINGS SHAKEOUT



Aerodynamic particle diameter, μm	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled		Uncontrolled	
2.5	72.2		11.6	
6.0	76.3		12.2	
10.0	82.0		13.1	

12.13 STEEL FOUNDRIES: CASTINGS SHAKEOUT

NUMBER OF TESTS: 2, conducted at castings shakeout exhaust hood before controls

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	72.2	76.3	82.0
Standard deviation (Cum. %):	5.4	6.9	4.3
Min (Cum. %):	66.7	69.5	77.7
Max (Cum. %):	77.6	83.1	86.3

TOTAL PARTICULATE EMISSION FACTOR: 16 kg particulate/Mg metal melted, without controls. Although no nonfurnace emission factors are available for steel foundries, emissions are presumed to be similar to those in iron foundries. Nonfurnace emission factors for iron foundries are presented in AP-42, Section 12.13.

SOURCE OPERATION: Source is a steel foundry casting steel pipe. Pipe molds are broken up at the castings shakeout operation. No additional information is available.

SAMPLING TECHNIQUE: Brink Model BMS-11 Impactor

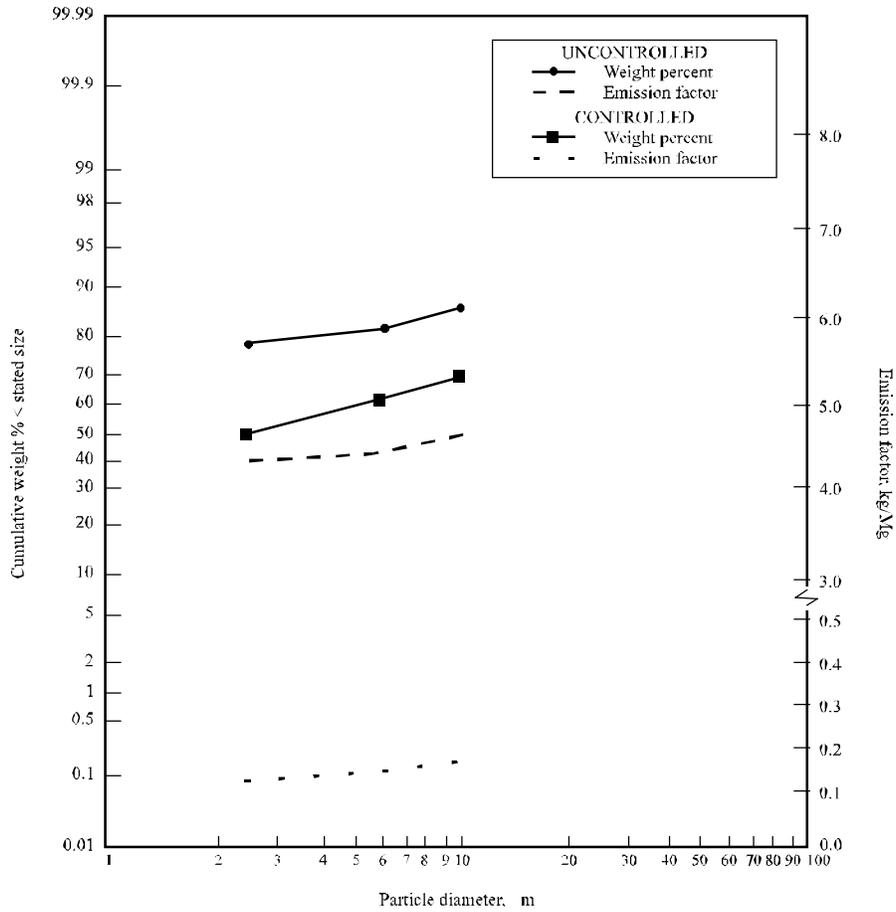
EMISSION FACTOR RATING: D

REFERENCE:

Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System, Series Report No. 117, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.

12.13 STEEL FOUNDRIES: OPEN HEARTH EXHAUST

12.13 STEEL FOUNDRIES: OPEN HEARTH EXHAUST



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled	FSP	Uncontrolled	FSP
2.5	79.6	49.3	4.4	0.14
6.0	82.8	58.6	4.5	0.16
10.0	85.4	66.8	4.7	0.18

12.13 STEEL FOUNDRIES: OPEN HEARTH EXHAUST

NUMBER OF TESTS: (a) 1, conducted before control
(b) 1, conducted after ESP control

STATISTICS: (a) Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	79.6	82.8	85.4
Standard Deviation (Cum. %):			
Min (Cum. %):			
Max (Cum. %):			

(b) Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	49.3	58.6	66.8
Standard Deviation (Cum. %):			
Min (Cum. %):			
Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: 5.5 kg particulate/Mg metal processed, before control. Emission factor from AP-42, Section 12.13. AP-42 gives an ESP control efficiency of 95 to 98.5%. At 95% efficiency, factor after ESP control is 0.275 kg particulate/Mg metal processed.

SOURCE OPERATION: Source produces steel castings by melting, alloying, and casting pig iron and steel scrap. During these tests, source was operating at 100% of rated capacity of 8260 kg metal scrap feed/hour, fuel oil-fired, and 8-hour heats.

SAMPLING TECHNIQUE: (a) Joy train with 3 cyclones
(b) SASS train with cyclones

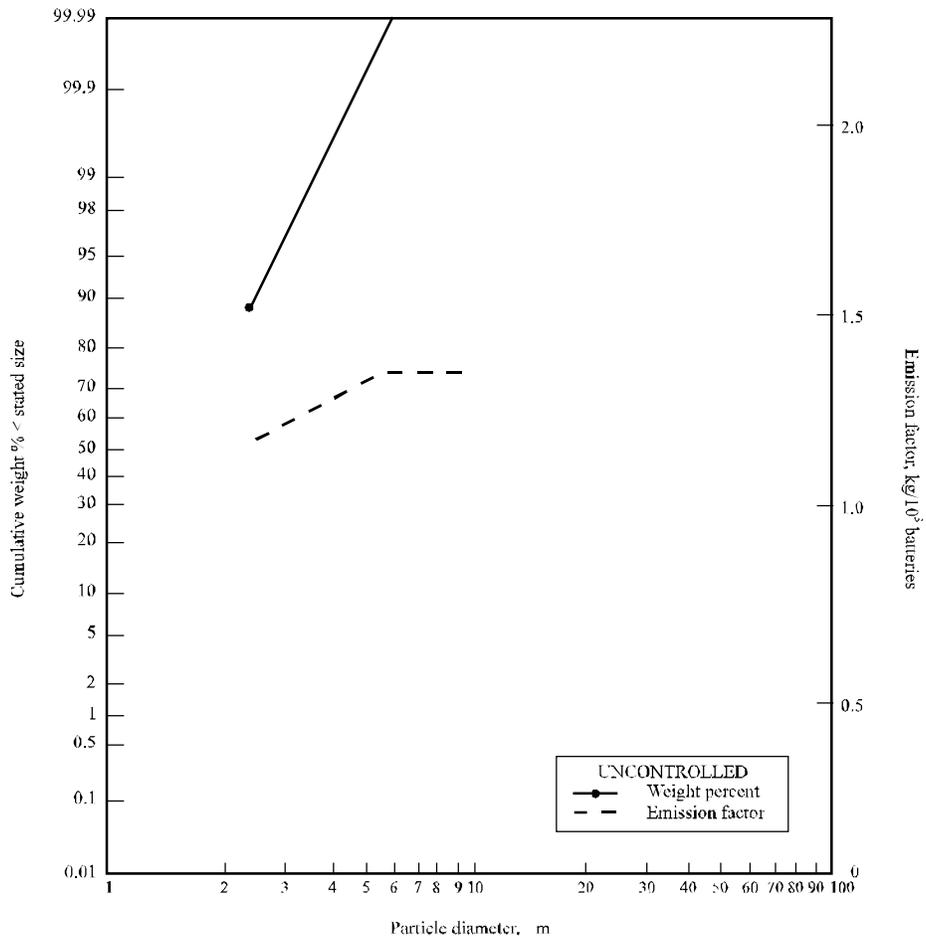
EMISSION FACTOR RATING: E

REFERENCE:

Emission test data from Environmental Assessment Data Systems, Fine Particle Emission Information System, Series Report No. 233, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1983.

12.15 STORAGE BATTERY PRODUCTION: GRID CASTING

12.15 STORAGE BATTERY PRODUCTION: GRID CASTING



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	
	Uncontrolled	
2.5	87.8	1.25
6.0	100	1.42
10.0	100	1.42

12.15 STORAGE BATTERY PRODUCTION: GRID CASTING

NUMBER OF TESTS: 3, conducted before control

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	87.8	100	100
Standard deviation (Cum. %):	10.3	—	—
Min (Cum. %):	75.4	100	100
Max (Cum. %):	100	100	100

Impactor cut points were so small that most data points had to be extrapolated.

TOTAL PARTICULATE EMISSION FACTOR: 1.42 kg particulate/ 10^3 batteries produced, without controls. Factor from AP-42, Section 12.15.

SOURCE OPERATION: During tests, plant was operated at 39% of design process rate. Six of nine of the grid casting machines were operating during the test. Typically, 26,500 to 30,000 pounds of lead per 24-hour day are charged to the grid casting operation.

SAMPLING TECHNIQUE: Brink Impactor

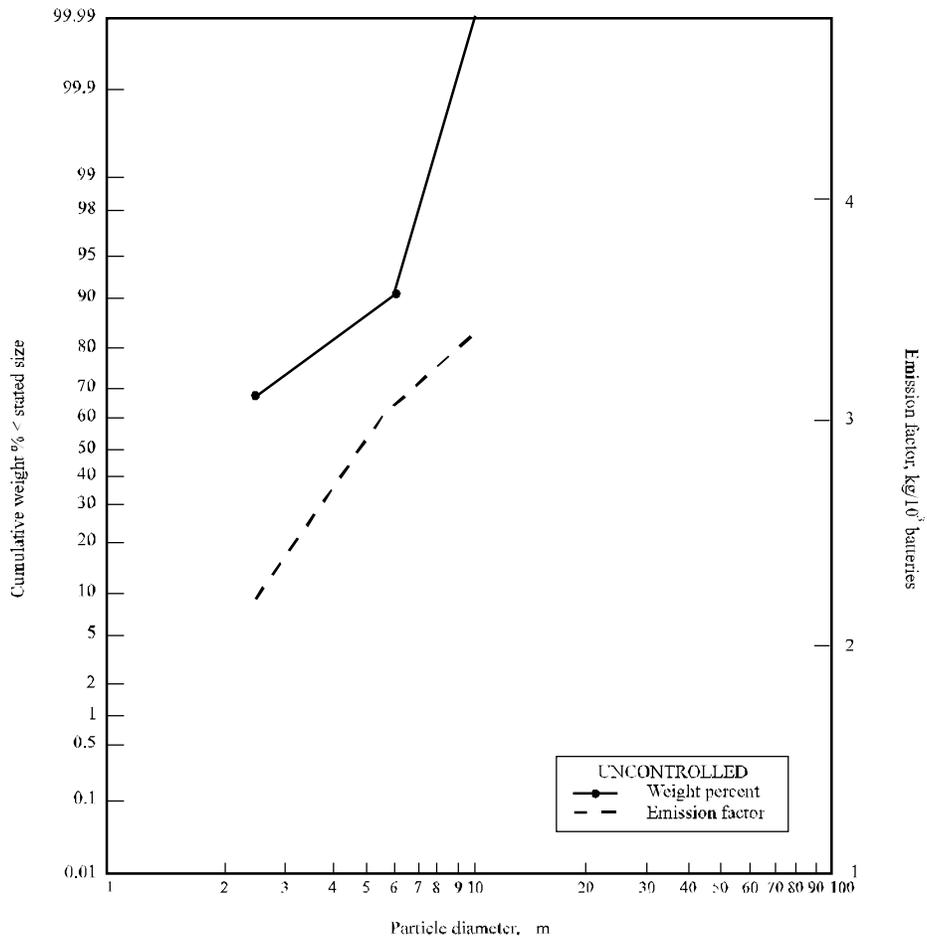
EMISSION FACTOR RATING: E

REFERENCE:

Air Pollution Emission Test, Globe Union, Inc., Canby, OR, EMB-76-BAT-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1976.

12.15 STORAGE BATTERY PRODUCTION: GRID CASTING AND PASTE MIXING

12.15 STORAGE BATTERY PRODUCTION: GRID CASTING AND PASTE MIXING



Aerodynamic particle diameter, μm	Cumulative wt. % < stated size	
	Uncontrolled	
2.5	65.1	2.20
6.0	90.4	3.05
10.0	100	3.38

12.15 STORAGE BATTERY PRODUCTION: GRID CASTING AND PASTE MIXING

NUMBER OF TESTS: 3, conducted before control

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	65.1	90.4	100
Standard deviation (Cum. %):	24.8	7.4	—
Min (Cum. %):	44.1	81.9	100
Max (Cum. %):	100	100	100

TOTAL PARTICULATE EMISSION FACTOR: 3.38 kg particulate/ 10^3 batteries, without controls. Factor is from AP-42, Section 12.15, and is the sum of the individual factors for grid casting and paste mixing.

SOURCE OPERATION: During tests, plant was operated at 39% of the design process rate. Grid casting operation consists of 4 machines. Each 2,000 lb/hr paste mixer is controlled for product recovery by a separate low-energy, impingement-type wet collector designed for an 8 - 10 inch w. g. pressure drop at 2,000 acfm.

SAMPLING TECHNIQUE: Brink Impactor

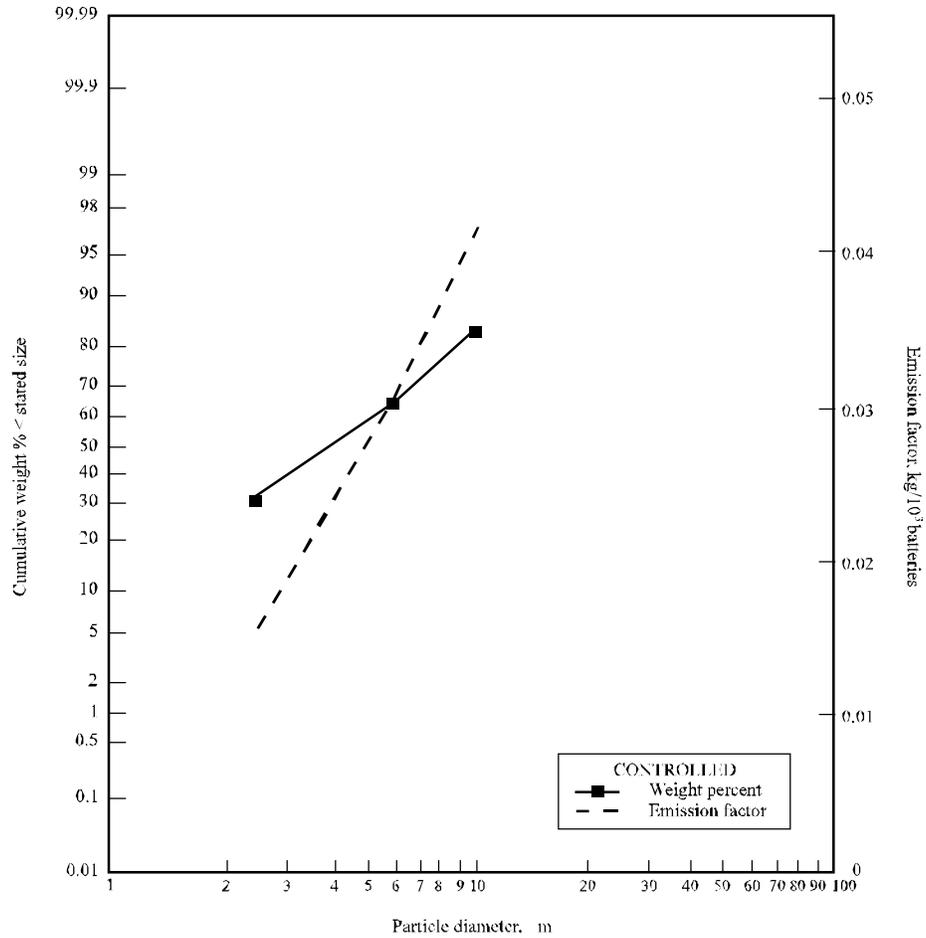
EMISSION FACTOR RATING: E

REFERENCE:

Air Pollution Emission Test, Globe Union, Inc., Canby, OR, EMB-76-BAT-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1976.

12.15 STORAGE BATTERY PRODUCTION: LEAD OXIDE MILL

12.15 STORAGE BATTERY PRODUCTION: LEAD OXIDE MILL



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor (kg/10 ³ batteries)
	After fabric filter		After fabric filter
2.5	32.8		0.016
6.0	64.7		0.032
10.0	83.8		0.042

12.15 STORAGE BATTERY PRODUCTION: LEAD OXIDE MILL

NUMBER OF TESTS: 3, conducted after fabric filter

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	32.8	64.7	83.8
Standard deviation (Cum. %):	14.1	29.8	19.5
Min (Cum. %):	17.8	38.2	61.6
Max (Cum. %):	45.9	97.0	100

TOTAL PARTICULATE EMISSION FACTOR: 0.05 kg particulate/ 10^3 batteries, after typical fabric filter control (oil-to-cloth ratio of 4:1). Emissions from a well-controlled facility (fabric filters with an average air-to-cloth ratio of 3:1) were 0.025 kg/ 10^3 batteries (Table 12.15-1 of AP-42).

SOURCE OPERATION: Plant receives metallic lead and manufactures lead oxide by the ball mill process. There are 2 lead oxide production lines, each with a typical feed rate of 15 100-pound lead pigs per hour. Product is collected with a cyclone and baghouses with 4:1 air-to-cloth ratios.

SAMPLING TECHNIQUE: Andersen Impactor

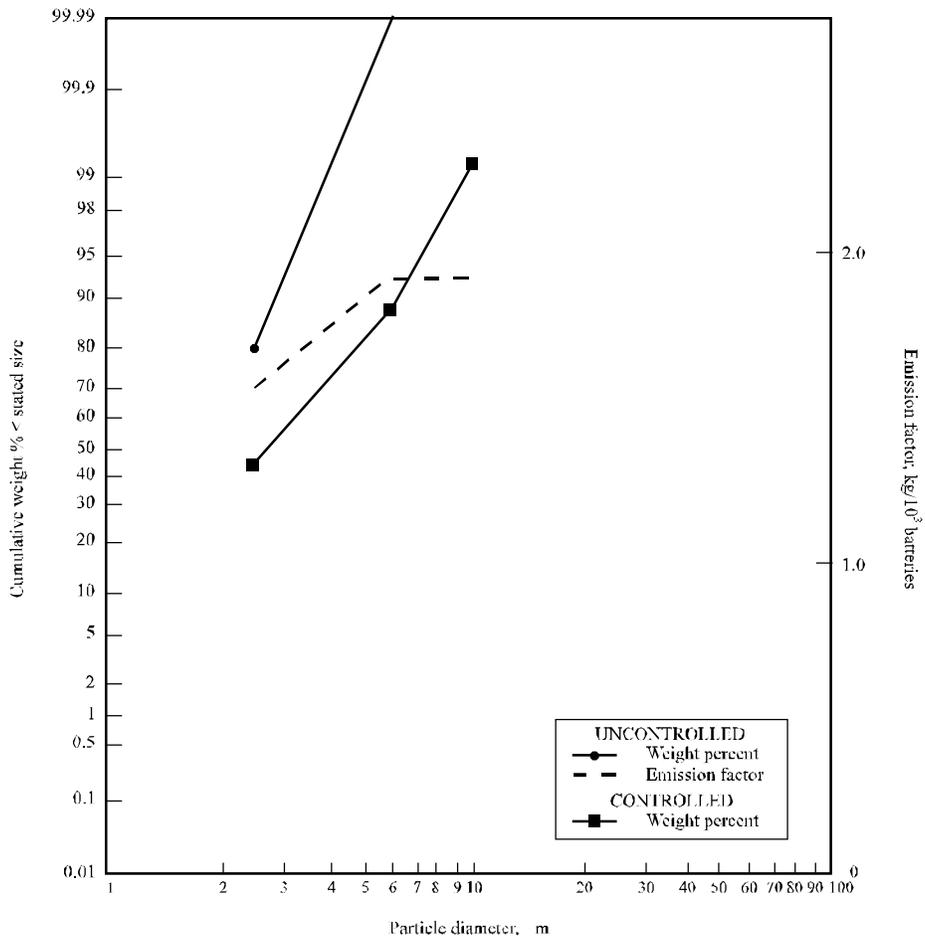
EMISSION FACTOR RATING: E

REFERENCE:

Air Pollution Emission Test, ESB Canada Limited, Mississouga, Ontario, EMB-76-BAT-3,
U. S. Environmental Protection Agency, Research Triangle Park, NC, August 1976.

12.15 STORAGE BATTERY PRODUCTION: PASTE MIXING AND LEAD OXIDE CHARGING

12.15 STORAGE BATTERY PRODUCTION: PASTE MIXING AND LEAD OXIDE CHARGING



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor (kg/10 ³ batteries)
	Uncontrolled	Fabric filter	
2.5	80	47	1.58
6.0	100	87	1.96
10.0	100	99	1.96

12.15 STORAGE BATTERY PRODUCTION: PASTE MIXING AND LEAD OXIDE CHARGING

NUMBER OF TESTS: (a) 1, conducted before control
(b) 4, conducted after fabric filter control

STATISTICS: (a) Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	80	100	100
Standard deviation (Cum. %):			
Min (Cum. %):			
Max (Cum. %):			
(b) Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	47	87	99
Standard deviation (Cum. %):	33.4	14.5	0.9
Min (Cum. %):	36	65	98
Max (Cum. %):	100	100	100

Impactor cut points were so small that many data points had to be extrapolated. Reliability of particle size distributions based on a single test is questionable.

TOTAL PARTICULATE EMISSION FACTOR: 1.96 kg. particulate/ 10^3 batteries, without controls.
Factor from AP-42, Section 12.15.

SOURCE OPERATION: During test, plant was operated at 39% of the design process rate. Plant has normal production rate of 2,400 batteries per day and maximum capacity of 4,000 batteries per day. Typical amount of lead oxide charged to the mixer is 29,850 lb/8-hour shift. Plant produces wet batteries, except formation is carried out at another plant.

SAMPLING TECHNIQUE: (a) Brink Impactor
(b) Andersen Impactor

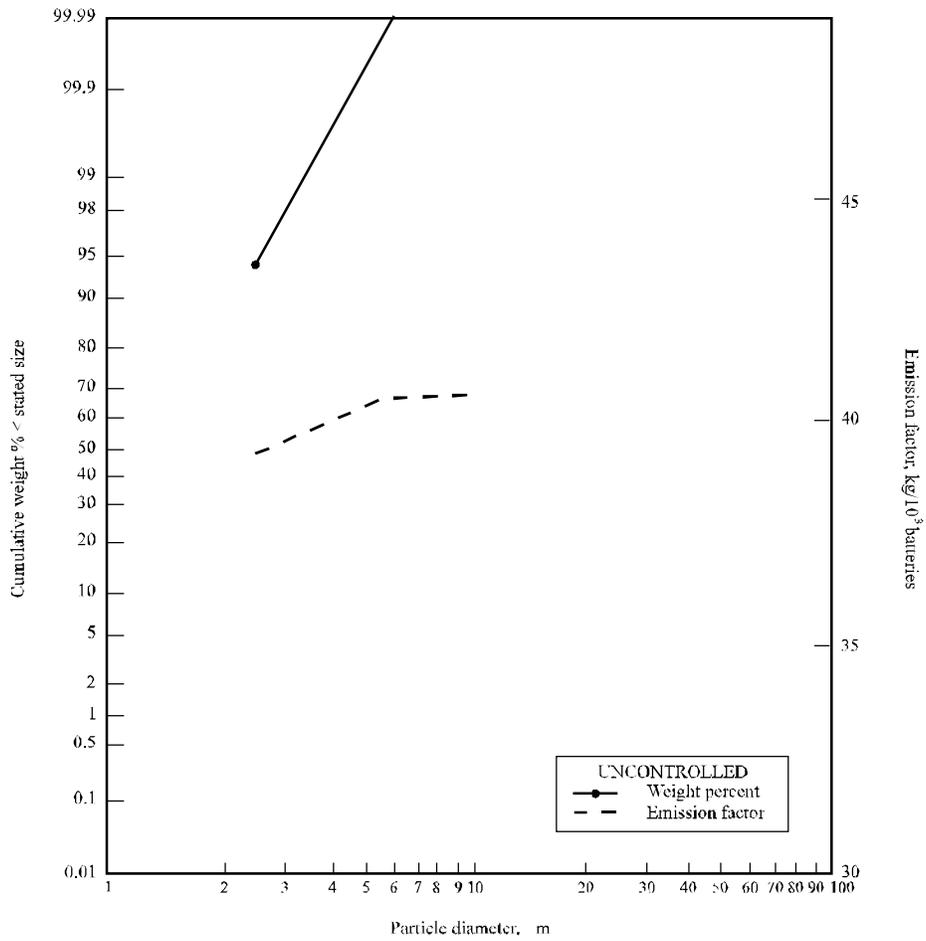
EMISSION FACTOR RATING: E

REFERENCE:

Air Pollution Emission Test, Globe Union, Inc., Canby, OR, EMB-76-BAT-4, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1976.

12.15 STORAGE BATTERY PRODUCTION: THREE-PROCESS OPERATION

12.15 STORAGE BATTERY PRODUCTION: THREE-PROCESS OPERATION



Aerodynamic particle diameter, m	Cumulative wt. % < stated size	Emission factor (kg/10 ³ batteries)
	Uncontrolled	Uncontrolled
2.5	93.4	39.3
6.0	100	42
10.0	100	42

12.15 STORAGE BATTERY PRODUCTION: THREE-PROCESS OPERATION

NUMBER OF TESTS: 3, conducted before control

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	93.4	100	100
Standard deviation (Cum. %):	6.43		
Min (Cum. %):	84.7		
Max (Cum. %):	100		

Impactor cut points were so small that data points had to be extrapolated.

TOTAL PARTICULATE EMISSION FACTOR: 42 kg particulate/ 10^3 batteries, before controls.
Factor from AP-42, Section 12.15.

SOURCE OPERATION: Plant representative stated that the plant usually operated at 35% of design capacity. Typical production rate is 3,500 batteries per day (dry and wet), but up to 4,500 batteries per day can be produced. This is equivalent to normal and maximum daily element production of 21,000 and 27,000 battery elements, respectively.

SAMPLING TECHNIQUE: Brink Impactor

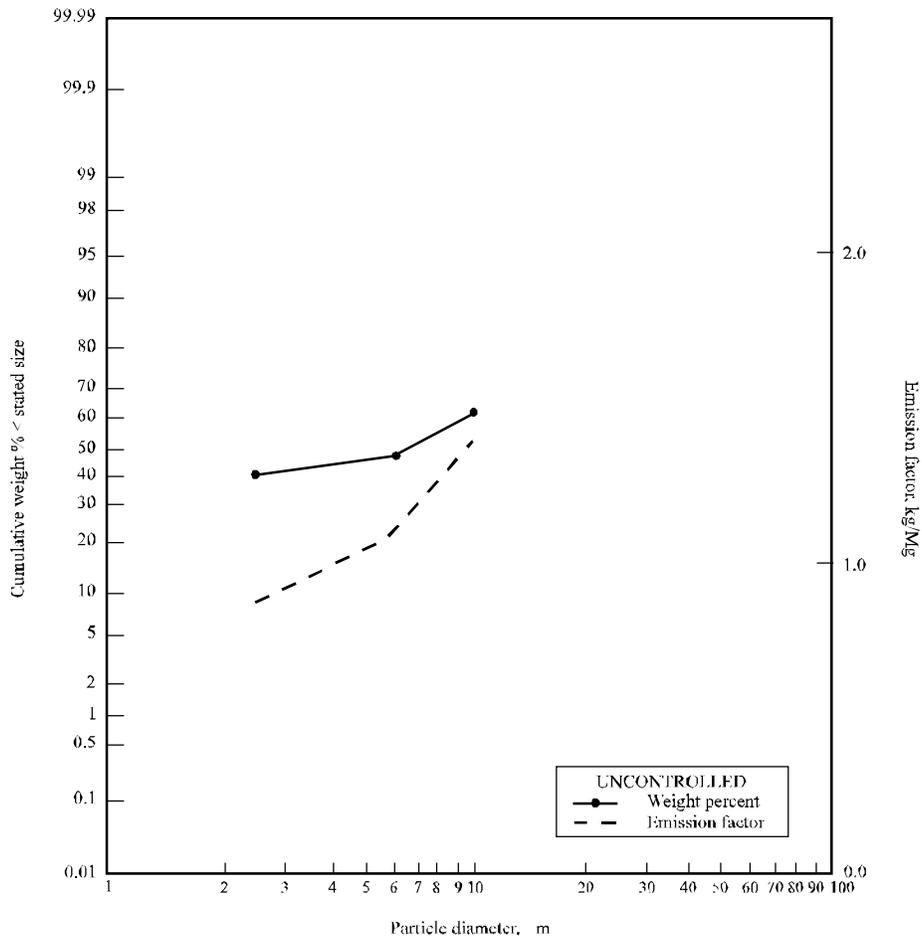
EMISSION FACTOR RATING: E

REFERENCE:

Air Pollution Emission Test, ESB Canada Limited, Mississouga, Ontario, EMB-76-BAT-3,
U. S. Environmental Protection Agency, Research Triangle Park, NC, August 1976.

12.xx BATCH TINNER

12.xx BATCH TINNER



Aerodynamic particle diameter, m	Cumulative wt. % < stated size		Emission factor, kg/Mg	
	Uncontrolled		Uncontrolled	
2.5	37.2		0.93	
6.0	45.9		1.15	
10.0	55.9		1.40	

12.xx BATCH TINNER

NUMBER OF TESTS: 2, conducted before controls

STATISTICS: Aerodynamic particle diameter (μm):	2.5	6.0	10.0
Mean (Cum. %):	37.2	45.9	55.9
Standard deviation (Cum. %):			
Min (Cum. %):			
Max (Cum. %):			

TOTAL PARTICULATE EMISSION FACTOR: 2.5 kg particulate/Mg tin consumed, without controls. Factor from AP-42, Section 12.14.

SOURCE OPERATION: Source is a batch operation applying a lead/tin coating to tubing. No further source operating information is available.

SAMPLING TECHNIQUE: Andersen Mark III Impactor

EMISSION FACTOR RATING: D

REFERENCE:

Confidential test data, PEI Associates, Inc., Golden, CO, January 1985.