



TAMPA ELECTRIC

March 10, 2004

Ms. Trina Vielhauer, Chief
Bureau of Air Regulation
Florida Department of Environmental Protection
111 South Magnolia Drive, Suite 4
Tallahassee, FL 32301

**Re: Tampa Electric Company (TEC)
Big Bend Station
Title V Permit No. 0570039-010-AV
Request for Generic Exemption
Coal or Petcoke Transloading**

Dear Ms. Vielhauer,

This purpose of this correspondence is to notify the Florida Department of Environmental Protection (Department) that Tampa Electric Company (TEC) intends to utilize the fuel yard at Big Bend Station to temporarily store coal or petcoke for another facility. TEC presently handles a variety of solid fuels at its Big Bend Station located in North Ruskin, Hillsborough County. These solid fuels include coal, coal residual, and petroleum coke (petcoke). TEC plans to receive, store, and transfer coal or petcoke to trucks for subsequent use by another facility.

TEC is submitting the request for a generic exemption to ensure that this is included in Big Bend Station's Title V Permit. TEC believes that this qualifies as a generic exemption per the Florida Administrative Code (F.A.C.) 62-210.300(3). TEC believes that this request does not need to be formally submitted until permit renewal per F.A.C. 62-210-300(3). However, in the interest of completeness and open disclosure TEC is informing the Department with this letter.

The coal or petcoke will be brought in by barge at infrequent intervals and transloaded onto existing solid fuel handling equipment. The only new additional emission points associated with the handling of coal or petcoke are: (a) the transfer of coal or petcoke from a storage pile by front-end loaders to trucks, and (b) coal or petcoke truck travel on Big Bend Station paved roads. All other coal or petcoke handling activities will utilize existing equipment; i.e., conveyor belts, storage pile stackout, dozer operations on storage piles, etc. The coal or petcoke will be treated with a chemical surfactant prior to arriving at the Big Bend Station. TEC plans to handle a maximum of 125,000 tons of coal or petcoke annually. There will be no increases in maximum hourly or annual Big Bend Station fuel yard solid fuel handling rates. TEC will continue to comply with all solid fuel yard requirements specified in its current Big Bend Station Title V operating permit.

A block diagram with the illustrated transfer points is included in Attachment D. The coal or petcoke is loaded into the hopper on the dock with the clamshell and transfers onto the D conveyor. From the D conveyor it moves through the T1 (transfer structure 1). It is then transferred through the T1 to the E conveyor. From the E conveyor it moves through the T2 (transfer structure 2). It is then transferred through the T2 to the Y conveyor. Finally, the coal or petcoke moves from the Y conveyor to the Z

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Ms. Trina Vielhauer
March 10, 2004
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conveyor. The Z conveyor stacks the coal or petcoke material in the North Yard. All transfer structures are enclosed. The hopper on the dock is enclosed on 3 sides and the top.

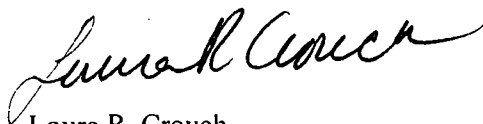
Potential PM/PM₁₀ emissions were estimated using applicable procedures from EPA's AP-42 document, *Compilation of Air Pollutant Emission Factors, Fifth Edition*. Specifically, potential PM/PM₁₀ emissions from coal or petcoke truck loading were estimated using procedures obtained from AP-42, Section 13.2.4, Aggregate Handling and Storage Piles. Potential PM/PM₁₀ emissions due to coal or petcoke truck traffic on paved plant roadways were estimated using procedures obtained from AP-42, Section 13.2.1, Paved Roads. Details of these potential PM/PM₁₀ emission rate estimates are provided in Attachment A and are based on the worst case scenario, petcoke transloading. Petcoke handling potential emission rates, using these AP-42 procedures, are estimated to total 2.89 and 0.56 tons per year for PM and PM₁₀, respectively. These estimated emission rates are well below the 5.0 tons per year threshold for fugitive emissions of particulate matter. The coal or petcoke will not emit lead or any other hazardous air pollutants. There is no unit-specific requirement for coal or petcoke handling, and the additional emissions from the activity will not cause the facility to exceed any major source thresholds, even in combination with emissions from all other insignificant emission sources. Therefore, the coal or petcoke handling activity will qualify for a generic exemption and constitute as an "insignificant activity."

A Professional Engineer certification is provided in Attachment B along with a Responsible Official certification in Attachment C.

Based on this information, TEC believes that this operation is exempt from permitting per F.A.C. 62-210.300(3) and requests written concurrence from the Department. TEC appreciates the Department's immediate consideration in this matter.

If you have any questions, please feel free to telephone Shelly Castro or me at (813) 228-4408.

Sincerely,



Laura R. Crouch
Manager - Air Programs
Environmental, Health & Safety

EHS/bmr/SSC180

Attachments

c/attach.: Mr. Jerry Kissel, FDEP SW
Mr. Scott Sheplak, FDEP
Mr. Sterlin Woodard, EPCHC
Ms. Alice Harman, EPCHC

Attachment A

**Tampa Electric Company - Big Bend Station
 Petroleum Coke Transloading PM/PM₁₀ Emission Estimates**

Emission Point Description	Emission Point ID	Potential Emission Rates			
		PM		PM ₁₀	
		(lb/hr)	(tpy)	(lb/hr)	(tpy)
Petcoke Truck Loading at Storage Pile	PET-01	0.012	0.006	0.006	0.003
Petcoke Trucks (Empty)	PET-02a	1.446	0.752	0.281	0.146
Petcoke Trucks (Full)	PET-02b	4.092	2.128	0.797	0.415
Totals		5.550	2.886	1.084	0.564

Source: ECT, 2004.

EMISSION INVENTORY WORKSHEET	PET-01
Tampa Electric Company - Big Bend Station	Petcoke Trucks

EMISSION SOURCE TYPE	
FUGITIVE PM - MATERIAL TRANSFER (DROPS)	Figure:

FACILITY AND SOURCE DESCRIPTION	
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Emission Source Description:	Fugitive PM - Transloading of Petroleum Coke
Emission Control Method(s)/ID No.(s):	Moist material, application of chemical surfactant
Emission Point ID:	PET-01

EMISSION ESTIMATION EQUATIONS	
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PM Emission (lb/hr) = $0.74 \times 0.0032 \times [(Wind\ Speed/5)^{1.2} / (Material\ Moisture\ Content/2)^{1.4}] \times Material\ Handled\ (ton/hr)$
PM Emission (ton/yr) = $0.74 \times 0.0032 \times [(Wind\ Speed/5)^{1.2} / (Material\ Moisture\ Content/2)^{1.4}] \times Material\ Handled\ (ton/yr) \times (1\ ton/2,000\ lb)$
Source: Section 13.2.4, AP-42, January 1995.

INPUT DATA AND EMISSIONS CALCULATIONS								
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Mean Wind Speed:		8.6 mph		Material Moisture Content:		7.0 weight %		
Material Transfer Point	Source ID	Material Transfer Rates		Uncontrolled Emission Factor (lb PM/ton)	Control Efficiency (%)	Controlled Emission Factor (lb PM/ton)	Potential PM Emission Rates	
		(ton/hr)	(ton/yr)				(lb/hr)	(ton/yr)
Front-End Loader Reclaim from Petcoke Storage	PET-1	144.2	150,000	0.000830	90.0	0.000083	0.0120	0.0062
Pile to Petcoke Trucks								
Totals							0.0120	0.0062

SOURCES OF INPUT DATA	
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Parameter	Data Source
Mean Wind Speed, mph	Climate of the States (Tampa, FL), Third Edition, 1985.
Material Moisture Content	TEC, 2004.
Material Transfer Point Identification	TEC, 2004.
Material Transfer Rates	TEC, 2004.
Control Efficiency	Table 3.2.17-2, Workbook on Estimation and Dispersion Modeling for Fugitive Particulate Sources, UARG, September 1981.

NOTES AND OBSERVATIONS	
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1. Material transfer rates based on 8 hrs/dy, 5 dys/wk, and 26 wks/yr operation.

DATA CONTROL			
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Data Collected by:	L. Crouch	Date:	2/04
Evaluated by:	T. Davis	Date:	2/04
Data Entered by:	T. Davis	Date:	2/04

EMISSION INVENTORY WORKSHEET							PET-01	
Tampa Electric Company - Big Bend Station							Petcoke Trucks	
EMISSION SOURCE TYPE								
FUGITIVE PM ₁₀ - MATERIAL TRANSFER (DROPS)							Figure:	
FACILITY AND SOURCE DESCRIPTION								
Emission Source Description:			Fugitive PM ₁₀ - Transloading of Petroleum Coke					
Emission Control Method(s)/ID No.(s):			Moist material, application of chemical surfactant					
Emission Point ID:			PET-01					
EMISSION ESTIMATION EQUATIONS								
PM ₁₀ Emission (lb/hr) = 0.35 x 0.0032 x [(Wind Speed/5) ^{1.3} / (Material Moisture Content/2) ^{1.4}] x Material Handled (ton/hr)								
PM ₁₀ Emission (ton/yr) = 0.35 x 0.0032 x [(Wind Speed/5) ^{1.3} / (Material Moisture Content/2) ^{1.4}] x Material Handled (ton/yr) x (1 ton/2,000 lb)								
Source: Section 13.2.4, AP-42, January 1995.								
INPUT DATA AND EMISSIONS CALCULATIONS								
Mean Wind Speed: 8.6 mph			Material Moisture Content: 7.0 weight %					
Material Transfer Point	Source ID	Material Transfer Rates		Uncontrolled Emission Factor (lb PM/ton)	Control Efficiency (%)	Controlled Emission Factor (lb PM/ton)	Potential PM ₁₀ Emission Rates	
		(ton/hr)	(ton/yr)				(lb/hr)	(ton/yr)
Front-End Loader Reclaim from Petcoke Storage	PET-1	144.2	150,000	0.000392	90.0	0.000039	0.0057	0.0029
Pile to PetcokeTrucks								
Totals							0.0057	0.0029
SOURCES OF INPUT DATA								
Parameter	Data Source							
Mean Wind Speed, mph	Climate of the States (Tampa, FL), Third Edition, 1985.							
Material Moisture Content	TEC, 2004.							
Material Transfer Point Identification	TEC, 2004.							
Material Transfer Rates	TEC, 2004.							
Control Efficiency	Table 3.2.17-2, Workbook on Estimation and Dispersion Modeling for Fugitive Particulate Sources, UARG, September 1981.							
NOTES AND OBSERVATIONS								
1. Material transfer rates based on 8 hrs/dy, 5 dys/wk, and 26 wks/yr operation.								
DATA CONTROL								
Data Collected by:	L. Crouch					Date:	2/04	
Evaluated by:	T. Davis					Date:	2/04	
Data Entered by:	T. Davis					Date:	2/04	

EMISSION INVENTORY WORKSHEET

PET-02

Tampa Electric Company - Big Bend Station

Petcoke Trucks

EMISSION SOURCE TYPE

FUGITIVE PM - TRUCK TRAFFIC ON PAVED ROADS

FACILITY AND SOURCE DESCRIPTION

Emission Source Description: Fugitive PM - Transloading of Petroleum Coke; Truck Traffic on Paved Roads

Emission Control Method(s)/ID No.(s): Watering, As Necessary

Emission Point ID: PET-02

EMISSION ESTIMATION EQUATIONS

PM Emission (lb/hr) = $((0.082 \times ((\text{Silt Loading Factor}/2)^{0.65}) \times ((\text{Truck Weight}/3)^{1.5}) - 0.00047) \times (1 - (\text{"Wet" Days}/1,460)) \times \text{Vehicle Miles Traveled (VMT)}/\text{hr}$

PM Emission (ton/yr) = $((0.082 \times ((\text{Silt Loading Factor}/2)^{0.65}) \times ((\text{Truck Weight}/3)^{1.5}) - 0.00047) \times (1 - (\text{"Wet" Days}/1,460)) \times \text{Vehicle Miles Traveled (VMT)}/\text{yr} \times (1 \text{ ton}/2,000 \text{ lb})$

Source: Section 13.2.1, AP-42, November 2003.

INPUT DATA AND EMISSIONS CALCULATIONS

Controlled Silt Loading Factor: 0.97 g/m² Mean Annual Number of "Wet" Days: 100

Operating Hours: 8 hr/dy 5 dy/wk 26 wk/yr

Petcoke Received by Truck: 150,000 ton/yr Truck Travel Distance (one way): 1,600 ft

Hourly Truck Count: 11 trucks/hr Annual Truck Count: 11,538 trucks/yr

Truck Traffic Type	Source ID	Vehicle Miles Traveled		Vehicle Weight (ton)	Control Efficiency (%)	Potential PM Emission Rates	
		(VMT/hr)	(VMT/yr)			(lb/hr)	(ton/yr)
Petcoke Trucks (Empty)	PET-02a	3.362	3,497	13.0	90.0	1.446	0.752
Petcoke Trucks (Full)	PET-02b	3.362	3,497	26.0	90.0	4.092	2.128
					Totals	5.54	2.880

SOURCES OF INPUT DATA

Parameter	Data Source
Controlled Silt Loading Factor	Based on factor for iron and steel production and overall 90% control efficiency, ECT, 2004.
Mean Annual Number of "Wet" Days	Figure 13.2.1-2, Section 13.2.1, AP-42, November 2003.
Vehicle Miles Traveled, VMT	TEC, 2004.
Truck Weights, ton	TEC, 2004.
Control Efficiency	Estimated, ECT 2004.

NOTES AND OBSERVATIONS

DATA CONTROL

Data Collected by:	L. Crouch	Date:	2/04
Evaluated by:	T. Davis	Date:	2/04
Data Entered by:	T. Davis	Date:	2/04

EMISSION INVENTORY WORKSHEET

PET-02

Tampa Electric Company - Big Bend Station

Petcoke Trucks

EMISSION SOURCE TYPE

FUGITIVE PM₁₀ - TRUCK TRAFFIC ON PAVED ROADS

FACILITY AND SOURCE DESCRIPTION

Emission Source Description: Fugitive PM₁₀ - Transloading of Petroleum Coke; Truck Traffic on Paved Roads

Emission Control Method(s)/ID No.(s): Watering, As Necessary

Emission Point ID: PET-02

EMISSION ESTIMATION EQUATIONS

PM₁₀ Emission (lb/hr) = ((0.016 x [(Silt Loading Factor/2)^{0.65}] x [(Truck Weight/3)^{1.50}] - 0.00047) x (1 - ("Wet" Days/1,460)) x Vehicle Miles Traveled (VMT)/hr

PM₁₀ Emission (ton/yr) = ((0.016 x [(Silt Loading Factor/2)^{0.65}] x [(Truck Weight/3)^{1.50}] - 0.00047) x (1 - ("Wet" Days/1,460)) x Vehicle Miles Traveled (VMT)/yr x (1 ton/2,000 lb)

Source: Section 13.2.1, AP-42, November 2003.

INPUT DATA AND EMISSIONS CALCULATIONS

Controlled Silt Loading Factor: 0.97 g/m² Mean Annual Number of "Wet" Days: 100

Operating Hours: 8 hr/dy 5 dy/wk 26 wk/yr

Petcoke Received by Truck: 150,000 ton/yr Truck Travel Distance (one way): 1,600 ft

Hourly Truck Count: 11 trucks/hr Annual Truck Count: 11,538 trucks/yr

Truck Traffic Type	Source ID	Vehicle Miles Traveled		Vehicle Weight (ton)	Control Efficiency (%)	Potential PM ₁₀ Emission Rates	
		(VMT/hr)	(VMT/yr)			(lb/hr)	(ton/yr)
Petcoke Trucks (Empty)	PET-02a	3,362	3,497	13.0	90.0	0.281	0.146
Petcoke Trucks (Full)	PET-02b	3,362	3,497	26.0	90.0	0.797	0.415
					Totals	1.08	0.561

SOURCES OF INPUT DATA

Parameter	Data Source
Controlled Silt Loading Factor	Based on factor for iron and steel production and overall 90% control efficiency, ECT, 2004.
Mean Annual Number of "Wet" Days	Figure 13.2.1-2, Section 13.2.1, AP-42, November 2003.
Vehicle Miles Traveled, VMT	TEC, 2004.
Truck Weights, ton	TEC, 2004.
Control Efficiency	Estimated, ECT 2004.

NOTES AND OBSERVATIONS

DATA CONTROL

Data Collected by:	L. Crouch	Date:	2/04
Evaluated by:	T. Davis	Date:	2/04
Data Entered by:	T. Davis	Date:	2/04

Attachment B

ATTACHMENT B

**TAMPA ELECTRIC COMPANY
BIG BEND STATION
TRANSLOADING OF PETROLEUM COKE**

Professional Engineer Certification

Professional Engineer Statement:

I, the undersigned, hereby certify, except as particularly noted herein, that:*

(1) To the best of my knowledge, the information presented in the request by Tampa Electric Company (TEC) for the transloading of petroleum coke at its Big Bend Station are true, accurate, and complete based on my review of material provided by TEC engineering and environmental staff; and

(2) To the best of my knowledge, any emission estimates reported or relied on in this submittal are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of air pollutants not regulated for an emissions unit, based solely upon the materials, information and calculations provided with this certification.

Thomas W. Davis

Signature

3/4/04

Date

(seal)

* Certification is applicable to the Tampa Electric Company (TEC) request for the transloading of petroleum coke at its Big Bend Station.

**Thomas W. Davis, P.E.
Registration No. 36777**

Attachment C

Responsible Official Certification

I have reviewed the Petcoke Transloading information in this document, and hereby certify that this document is authentic and accurate to the best of my knowledge.

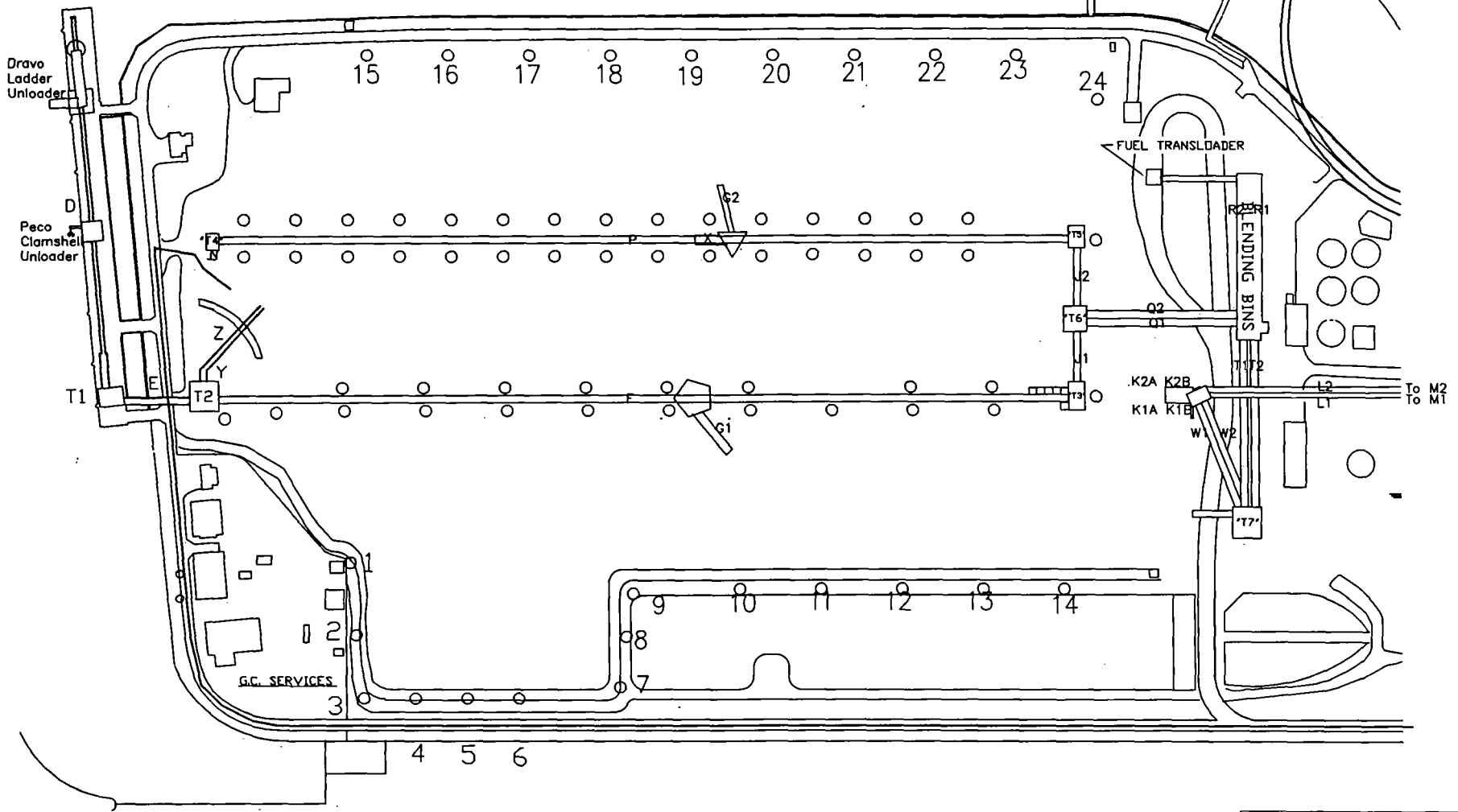
Karen A. Sheffield
Signature

3/8/04
Date

Karen A. Sheffield
Name

General Manager, Big Bend Station
Title

Attachment D



FILE	DESCRIPTION	DESIGN	DWG	DATE
TAMPA ELECTRIC - BIRNEY SUPPLY - GENERATOR SUBSTATION				
Coalfield General Arrangement 2004 Current Yard				
FILE NAME:	Current Yard	DWG NO.		REV. NO.
SCALE:				



13.2.4 Aggregate Handling And Storage Piles

13.2.4.1 General

Inherent in operations that use minerals in aggregate form is the maintenance of outdoor storage piles. Storage piles are usually left uncovered, partially because of the need for frequent material transfer into or out of storage.

Dust emissions occur at several points in the storage cycle, such as material loading onto the pile, disturbances by strong wind currents, and loadout from the pile. The movement of trucks and loading equipment in the storage pile area is also a substantial source of dust.

13.2.4.2 Emissions And Correction Parameters

The quantity of dust emissions from aggregate storage operations varies with the volume of aggregate passing through the storage cycle. Emissions also depend on 3 parameters of the condition of a particular storage pile: age of the pile, moisture content, and proportion of aggregate fines.

When freshly processed aggregate is loaded onto a storage pile, the potential for dust emissions is at a maximum. Fines are easily disaggregated and released to the atmosphere upon exposure to air currents, either from aggregate transfer itself or from high winds. As the aggregate pile weathers, however, potential for dust emissions is greatly reduced. Moisture causes aggregation and cementation of fines to the surfaces of larger particles. Any significant rainfall soaks the interior of the pile, and then the drying process is very slow.

Silt (particles equal to or less than 75 micrometers [μm] in diameter) content is determined by measuring the portion of dry aggregate material that passes through a 200-mesh screen, using ASTM-C-136 method.¹ Table 13.2.4-1 summarizes measured silt and moisture values for industrial aggregate materials.

13.2.4.3 Predictive Emission Factor Equations

Total dust emissions from aggregate storage piles result from several distinct source activities within the storage cycle:

1. Loading of aggregate onto storage piles (batch or continuous drop operations).
2. Equipment traffic in storage area.
3. Wind erosion of pile surfaces and ground areas around piles.
4. Loadout of aggregate for shipment or for return to the process stream (batch or continuous drop operations).

Either adding aggregate material to a storage pile or removing it usually involves dropping the material onto a receiving surface. Truck dumping on the pile or loading out from the pile to a truck with a front-end loader are examples of batch drop operations. Adding material to the pile by a conveyor stacker is an example of a continuous drop operation.

Table 13.2.4-1. TYPICAL SILT AND MOISTURE CONTENTS OF MATERIALS AT VARIOUS INDUSTRIES^a

Industry	No. Of Facilities	Material	Silt Content (%)			Moisture Content (%)		
			No. Of Samples	Range	Mean	No. Of Samples	Range	Mean
Iron and steel production	9	Pellet ore	13	1.3 - 13	4.3	11	0.64 - 4.0	2.2
		Lump ore	9	2.8 - 19	9.5	6	1.6 - 8.0	5.4
		Coal	12	2.0 - 7.7	4.6	11	2.8 - 11	4.8
		Slag	3	3.0 - 7.3	5.3	3	0.25 - 2.0	0.92
		Flue dust	3	2.7 - 23	13	1	—	7
		Coke breeze	2	4.4 - 5.4	4.9	2	6.4 - 9.2	7.8
		Blended ore	1	—	15	1	—	6.6
		Sinter	1	—	0.7	0	—	—
		Limestone	3	0.4 - 2.3	1.0	2	ND	0.2
Stone quarrying and processing	2	Crushed limestone	2	1.3 - 1.9	1.6	2	0.3 - 1.1	0.7
		Various limestone products	8	0.8 - 14	3.9	8	0.46 - 5.0	2.1
Taconite mining and processing	1	Pellets	9	2.2 - 5.4	3.4	7	0.05 - 2.0	0.9
		Tailings	2	ND	11	1	—	0.4
Western surface coal mining	4	Coal	15	3.4 - 16	6.2	7	2.8 - 20	6.9
		Overburden	15	3.8 - 15	7.5	0	—	—
		Exposed ground	3	5.1 - 21	15	3	0.8 - 6.4	3.4
Coal-fired power plant	1	Coal (as received)	60	0.6 - 4.8	2.2	59	2.7 - 7.4	4.5
Municipal solid waste landfills	4	Sand	1	—	2.6	1	—	7.4
		Slag	2	3.0 - 4.7	3.8	2	2.3 - 4.9	3.6
		Cover	5	5.0 - 16	9.0	5	8.9 - 16	12
		Clay/dirt mix	1	—	9.2	1	—	14
		Clay	2	4.5 - 7.4	6.0	2	8.9 - 11	10
		Fly ash	4	78 - 81	80	4	26 - 29	27
		Misc. fill materials	1	—	12	1	—	11

^a References 1-10. ND = no data.

The quantity of particulate emissions generated by either type of drop operation, per kilogram (kg) (ton) of material transferred, may be estimated, with a rating of A, using the following empirical expression:¹¹

$$E = k(0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (kg/megagram [Mg])} \quad (1)$$

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (pound [lb]/ton)}$$

where:

E = emission factor

k = particle size multiplier (dimensionless)

U = mean wind speed, meters per second (m/s) (miles per hour [mph])

M = material moisture content (%)

The particle size multiplier in the equation, k, varies with aerodynamic particle size range, as follows:

Aerodynamic Particle Size Multiplier (k) For Equation 1				
< 30 μm	< 15 μm	< 10 μm	< 5 μm	< 2.5 μm
0.74	0.48	0.35	0.20	0.11

The equation retains the assigned quality rating if applied within the ranges of source conditions that were tested in developing the equation, as follows. Note that silt content is included, even though silt content does not appear as a correction parameter in the equation. While it is reasonable to expect that silt content and emission factors are interrelated, no significant correlation between the 2 was found during the derivation of the equation, probably because most tests with high silt contents were conducted under lower winds, and vice versa. It is recommended that estimates from the equation be reduced 1 quality rating level if the silt content used in a particular application falls outside the range given:

Ranges Of Source Conditions For Equation 1			
Silt Content (%)	Moisture Content (%)	Wind Speed	
		m/s	mph
0.44 - 19	0.25 - 4.8	0.6 - 6.7	1.3 - 15

To retain the quality rating of the equation when it is applied to a specific facility, reliable correction parameters must be determined for specific sources of interest. The field and laboratory procedures for aggregate sampling are given in Reference 3. In the event that site-specific values for correction parameters cannot be obtained, the appropriate mean from Table 13.2.4-1 may be used, but the quality rating of the equation is reduced by 1 letter.

For emissions from equipment traffic (trucks, front-end loaders, dozers, etc.) traveling between or on piles, it is recommended that the equations for vehicle traffic on unpaved surfaces be used (see Section 13.2.2). For vehicle travel between storage piles, the silt value(s) for the areas among the piles (which may differ from the silt values for the stored materials) should be used.

Worst-case emissions from storage pile areas occur under dry, windy conditions. Worst-case emissions from materials-handling operations may be calculated by substituting into the equation appropriate values for aggregate material moisture content and for anticipated wind speeds during the worst case averaging period, usually 24 hours. The treatment of dry conditions for Section 13.2.2, vehicle traffic, "Unpaved Roads", follows the methodology described in that section centering on parameter p. A separate set of nonclimatic correction parameters and source extent values corresponding to higher than normal storage pile activity also may be justified for the worst-case averaging period.

13.2.4.4 Controls¹²⁻¹³

Watering and the use of chemical wetting agents are the principal means for control of aggregate storage pile emissions. Enclosure or covering of inactive piles to reduce wind erosion can also reduce emissions. Watering is useful mainly to reduce emissions from vehicle traffic in the storage pile area. Watering of the storage piles themselves typically has only a very temporary slight effect on total emissions. A much more effective technique is to apply chemical agents (such as surfactants) that permit more extensive wetting. Continuous chemical treating of material loaded onto piles, coupled with watering or treatment of roadways, can reduce total particulate emissions from aggregate storage operations by up to 90 percent.¹²

References For Section 13.2.4

1. C. Cowherd, Jr., *et al.*, *Development Of Emission Factors For Fugitive Dust Sources*, EPA-450/3-74-037, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.
2. R. Bohn, *et al.*, *Fugitive Emissions From Integrated Iron And Steel Plants*, EPA-600/2-78-050, U. S. Environmental Protection Agency, Cincinnati, OH, March 1978.
3. C. Cowherd, Jr., *et al.*, *Iron And Steel Plant Open Dust Source Fugitive Emission Evaluation*, EPA-600/2-79-103, U. S. Environmental Protection Agency, Cincinnati, OH, May 1979.
4. *Evaluation Of Open Dust Sources In The Vicinity Of Buffalo, New York*, EPA Contract No. 68-02-2545, Midwest Research Institute, Kansas City, MO, March 1979.
5. C. Cowherd, Jr., and T. Cuscino, Jr., *Fugitive Emissions Evaluation*, MRI-4343-L, Midwest Research Institute, Kansas City, MO, February 1977.
6. T. Cuscino, Jr., *et al.*, *Taconite Mining Fugitive Emissions Study*, Minnesota Pollution Control Agency, Roseville, MN, June 1979.

7. *Improved Emission Factors For Fugitive Dust From Western Surface Coal Mining Sources*, 2 Volumes, EPA Contract No. 68-03-2924, PEDCo Environmental, Kansas City, MO, and Midwest Research Institute, Kansas City, MO, July 1981.
8. *Determination Of Fugitive Coal Dust Emissions From Rotary Railcar Dumping*, TRC, Hartford, CT, May 1984.
9. *PM-10 Emission Inventory Of Landfills In the Lake Calumet Area*, EPA Contract No. 68-02-3891, Midwest Research Institute, Kansas City, MO, September 1987.
10. *Chicago Area Particulate Matter Emission Inventory — Sampling And Analysis*, EPA Contract No. 68-02-4395, Midwest Research Institute, Kansas City, MO, May 1988.
11. *Update Of Fugitive Dust Emission Factors In AP-42 Section 11.2*, EPA Contract No. 68-02-3891, Midwest Research Institute, Kansas City, MO, July 1987.
12. G. A. Jutze, et al., *Investigation Of Fugitive Dust Sources Emissions And Control*, EPA-450/3-74-036a, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.
13. C. Cowherd, Jr., et al., *Control Of Open Fugitive Dust Sources*, EPA-450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

13.2.4 Aggregate Handling And Storage Piles

13.2.4.1 General

Inherent in operations that use minerals in aggregate form is the maintenance of outdoor storage piles. Storage piles are usually left uncovered, partially because of the need for frequent material transfer into or out of storage.

Dust emissions occur at several points in the storage cycle, such as material loading onto the pile, disturbances by strong wind currents, and loadout from the pile. The movement of trucks and loading equipment in the storage pile area is also a substantial source of dust.

13.2.4.2 Emissions And Correction Parameters

The quantity of dust emissions from aggregate storage operations varies with the volume of aggregate passing through the storage cycle. Emissions also depend on 3 parameters of the condition of a particular storage pile: age of the pile, moisture content, and proportion of aggregate fines.

When freshly processed aggregate is loaded onto a storage pile, the potential for dust emissions is at a maximum. Fines are easily disaggregated and released to the atmosphere upon exposure to air currents, either from aggregate transfer itself or from high winds. As the aggregate pile weathers, however, potential for dust emissions is greatly reduced. Moisture causes aggregation and cementation of fines to the surfaces of larger particles. Any significant rainfall soaks the interior of the pile, and then the drying process is very slow.

Silt (particles equal to or less than 75 micrometers [μm] in diameter) content is determined by measuring the portion of dry aggregate material that passes through a 200-mesh screen, using ASTM-C-136 method.¹ Table 13.2.4-1 summarizes measured silt and moisture values for industrial aggregate materials.

13.2.4.3 Predictive Emission Factor Equations

Total dust emissions from aggregate storage piles result from several distinct source activities within the storage cycle:

1. Loading of aggregate onto storage piles (batch or continuous drop operations).
2. Equipment traffic in storage area.
3. Wind erosion of pile surfaces and ground areas around piles.
4. Loadout of aggregate for shipment or for return to the process stream (batch or continuous drop operations).

Either adding aggregate material to a storage pile or removing it usually involves dropping the material onto a receiving surface. Truck dumping on the pile or loading out from the pile to a truck with a front-end loader are examples of batch drop operations. Adding material to the pile by a conveyor stacker is an example of a continuous drop operation.

Table 13.2.4-1. TYPICAL SILT AND MOISTURE CONTENTS OF MATERIALS AT VARIOUS INDUSTRIES^a

Industry	No. Of Facilities	Material	Silt Content (%)			Moisture Content (%)		
			No. Of Samples	Range	Mean	No. Of Samples	Range	Mean
Iron and steel production	9	Pellet ore	13	1.3 - 13	4.3	11	0.64 - 4.0	2.2
		Lump ore	9	2.8 - 19	9.5	6	1.6 - 8.0	5.4
		Coal	12	2.0 - 7.7	4.6	11	2.8 - 11	4.8
		Slag	3	3.0 - 7.3	5.3	3	0.25 - 2.0	0.92
		Flue dust	3	2.7 - 23	13	1	—	7
		Coke breeze	2	4.4 - 5.4	4.9	2	6.4 - 9.2	7.8
		Blended ore	1	—	15	1	—	6.6
		Sinter	1	—	0.7	0	—	—
		Limestone	3	0.4 - 2.3	1.0	2	ND	0.2
Stone quarrying and processing	2	Crushed limestone	2	1.3 - 1.9	1.6	2	0.3 - 1.1	0.7
		Various limestone products	8	0.8 - 14	3.9	8	0.46 - 5.0	2.1
Taconite mining and processing	1	Pellets	9	2.2 - 5.4	3.4	7	0.05 - 2.0	0.9
		Tailings	2	ND	11	1	—	0.4
Western surface coal mining	4	Coal	15	3.4 - 16	6.2	7	2.8 - 20	6.9
		Overburden	15	3.8 - 15	7.5	0	—	—
		Exposed ground	3	5.1 - 21	15	3	0.8 - 6.4	3.4
Coal-fired power plant	1	Coal (as received)	60	0.6 - 4.8	2.2	59	2.7 - 7.4	4.5
Municipal solid waste landfills	4	Sand	1	—	2.6	1	—	7.4
		Slag	2	3.0 - 4.7	3.8	2	2.3 - 4.9	3.6
		Cover	5	5.0 - 16	9.0	5	8.9 - 16	12
		Clay/dirt mix	1	—	9.2	1	—	14
		Clay	2	4.5 - 7.4	6.0	2	8.9 - 11	10
		Fly ash	4	78 - 81	80	4	26 - 29	27
		Misc. fill materials	1	—	12	1	—	11

^a References 1-10. ND = no data.

The quantity of particulate emissions generated by either type of drop operation, per kilogram (kg) (ton) of material transferred, may be estimated, with a rating of A, using the following empirical expression:¹¹

$$E = k(0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (kg/megagram [Mg])} \tag{1}$$

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (pound [lb]/ton)}$$

where:

- E = emission factor
- k = particle size multiplier (dimensionless)
- U = mean wind speed, meters per second (m/s) (miles per hour [mph])
- M = material moisture content (%)

The particle size multiplier in the equation, k, varies with aerodynamic particle size range, as follows:

Aerodynamic Particle Size Multiplier (k) For Equation 1				
< 30 μm	< 15 μm	< 10 μm	< 5 μm	< 2.5 μm
0.74	0.48	0.35	0.20	0.11

The equation retains the assigned quality rating if applied within the ranges of source conditions that were tested in developing the equation, as follows. Note that silt content is included, even though silt content does not appear as a correction parameter in the equation. While it is reasonable to expect that silt content and emission factors are interrelated, no significant correlation between the 2 was found during the derivation of the equation, probably because most tests with high silt contents were conducted under lower winds, and vice versa. It is recommended that estimates from the equation be reduced 1 quality rating level if the silt content used in a particular application falls outside the range given:

Ranges Of Source Conditions For Equation 1			
Silt Content (%)	Moisture Content (%)	Wind Speed	
		m/s	mph
0.44 - 19	0.25 - 4.8	0.6 - 6.7	1.3 - 15

To retain the quality rating of the equation when it is applied to a specific facility, reliable correction parameters must be determined for specific sources of interest. The field and laboratory procedures for aggregate sampling are given in Reference 3. In the event that site-specific values for correction parameters cannot be obtained, the appropriate mean from Table 13.2.4-1 may be used, but the quality rating of the equation is reduced by 1 letter.

For emissions from equipment traffic (trucks, front-end loaders, dozers, etc.) traveling between or on piles, it is recommended that the equations for vehicle traffic on unpaved surfaces be used (see Section 13.2.2). For vehicle travel between storage piles, the silt value(s) for the areas among the piles (which may differ from the silt values for the stored materials) should be used.

Worst-case emissions from storage pile areas occur under dry, windy conditions. Worst-case emissions from materials-handling operations may be calculated by substituting into the equation appropriate values for aggregate material moisture content and for anticipated wind speeds during the worst case averaging period, usually 24 hours. The treatment of dry conditions for Section 13.2.2, vehicle traffic, "Unpaved Roads", follows the methodology described in that section centering on parameter p. A separate set of nonclimatic correction parameters and source extent values corresponding to higher than normal storage pile activity also may be justified for the worst-case averaging period.

13.2.4.4 Controls¹²⁻¹³

Watering and the use of chemical wetting agents are the principal means for control of aggregate storage pile emissions. Enclosure or covering of inactive piles to reduce wind erosion can also reduce emissions. Watering is useful mainly to reduce emissions from vehicle traffic in the storage pile area. Watering of the storage piles themselves typically has only a very temporary slight effect on total emissions. A much more effective technique is to apply chemical agents (such as surfactants) that permit more extensive wetting. Continuous chemical treating of material loaded onto piles, coupled with watering or treatment of roadways, can reduce total particulate emissions from aggregate storage operations by up to 90 percent.¹²

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13.2.1 Paved Roads

13.2.1.1 General

Particulate emissions occur whenever vehicles travel over a paved surface such as a road or parking lot. Particulate emissions from paved roads are due to direct emissions from vehicles in the form of exhaust, brake wear and tire wear emissions and resuspension of loose material on the road surface. In general terms, resuspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface (i.e., the surface loading). In turn, that surface loading is continuously replenished by other sources. At industrial sites, surface loading is replenished by spillage of material and trackout from unpaved roads and staging areas. Figure 13.2.1-1 illustrates several transfer processes occurring on public streets.

Various field studies have found that public streets and highways, as well as roadways at industrial facilities, can be major sources of the atmospheric particulate matter within an area.¹⁻⁹ Of particular interest in many parts of the United States are the increased levels of emissions from public paved roads when the equilibrium between deposition and removal processes is upset. This situation can occur for various reasons, including application of granular materials for snow and ice control, mud/dirt carryout from construction activities in the area, and deposition from wind and/or water erosion of surrounding unstabilized areas. In the absence of continuous addition of fresh material (through localized trackout or application of antiskid material), paved road surface loading should reach an equilibrium value in which the amount of material resuspended matches the amount replenished. The equilibrium surface loading value depends upon numerous factors. It is believed that the most important factors are: mean speed of vehicles traveling the road; the average daily traffic (ADT); the number of lanes and ADT per lane; the fraction of heavy vehicles (buses and trucks); and the presence/absence of curbs, storm sewers and parking lanes.¹⁰

The particulate emission factors presented in the previous version of this section of AP-42, dated October 2002, implicitly included the emissions from vehicles in the form of exhaust, brake wear, and tire wear as well as resuspended road surface material. EPA included these sources in the emission factor equation for paved roads since the field testing data used to develop the equation included both the direct emissions from vehicles and emissions from resuspension of road dust.

This version of the paved road emission factor equation only estimates particulate emissions from resuspended road surface material²⁸. The particulate emissions from vehicle exhaust, brake wear, and tire wear are now estimated separately using EPA's MOBILE6.2²⁷. This approach eliminates the possibility of double counting emissions. Double counting results when employing the previous version of the emission factor equation in this section and MOBILE6.2 to estimate particulate emissions from vehicle traffic on paved roads. It also incorporates the decrease in exhaust emissions that has occurred since the paved road emission factor equation was developed. The previous version of the paved road emission factor equation includes estimates of emissions from exhaust, brake wear, and tire wear based on emission rates for vehicles in the 1980 calendar year fleet. The amount of PM released from vehicle exhaust has decreased since 1980 due to lower new vehicle emission standards and changes in fuel characteristics.

13.2.1.2 Emissions And Correction Parameters

Dust emissions from paved roads have been found to vary with what is termed the "silt loading" present on the road surface as well as the average weight of vehicles traveling the road. The term silt loading (sL) refers to the mass of silt-size material (equal to or less than 75 micrometers [μm] in physical diameter) per unit area of the travel surface. The total road surface dust loading consists of loose material that can be collected by broom sweeping and vacuuming of the traveled portion of the paved road. The silt fraction is determined by measuring the proportion of the loose dry surface dust that passes through a 200-mesh screen, using the ASTM-C-136 method. Silt loading is the product of the silt fraction and the total loading, and is abbreviated "sL". Additional details on the sampling and analysis of such material are provided in AP-42 Appendices C.1 and C.2.

The surface sL provides a reasonable means of characterizing seasonal variability in a paved road emission inventory. In many areas of the country, road surface loadings¹¹⁻²¹ are heaviest during the late winter and early spring months when the residual loading from snow/ice controls is greatest. As noted earlier, once replenishment of fresh material is eliminated, the road surface loading can be expected to reach an equilibrium value, which is substantially lower than the late winter/early spring values.

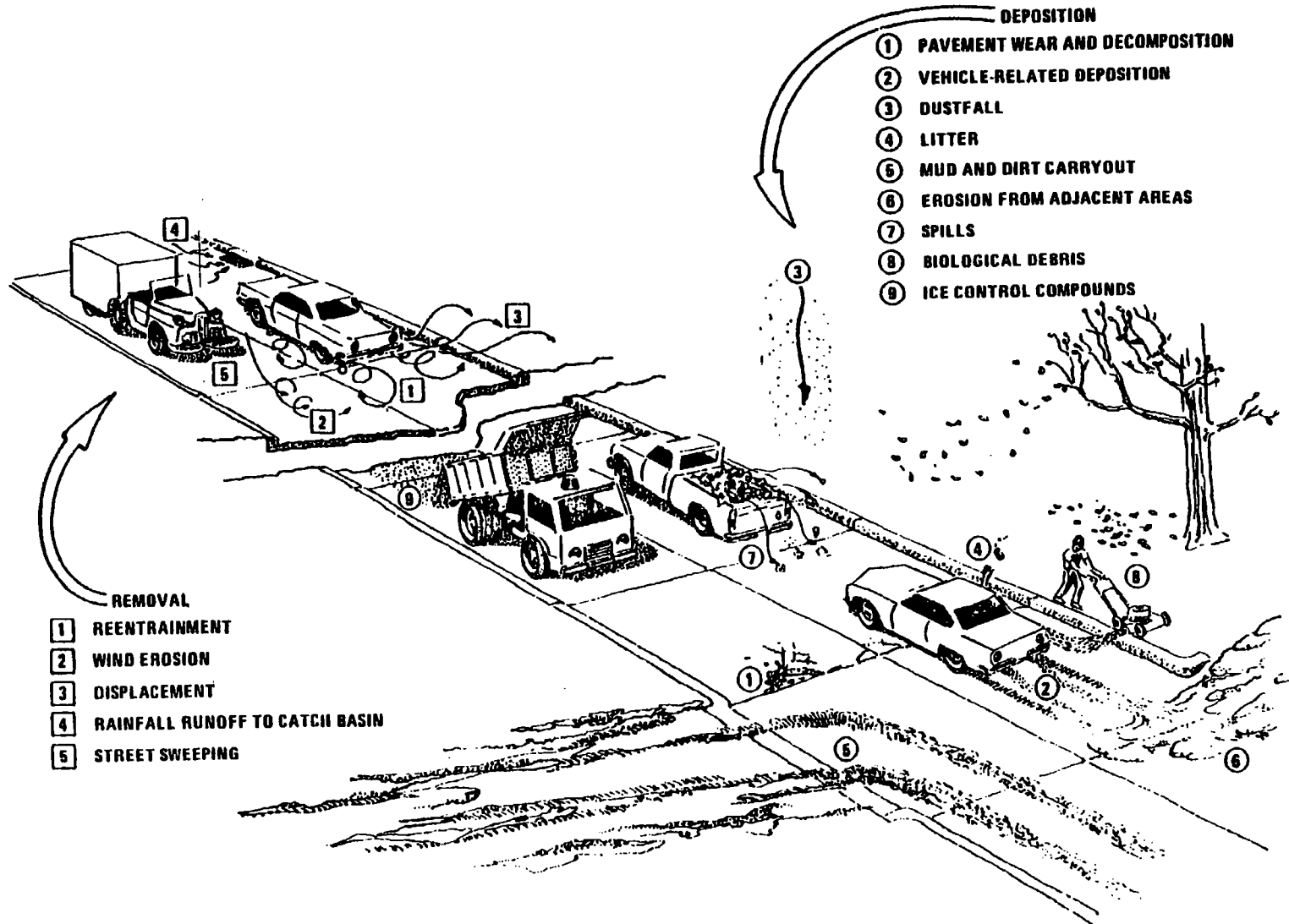


Figure 13.2.1-1. Deposition and removal processes.

13.2.1.3 Predictive Emission Factor Equations¹⁰

The quantity of particulate emissions from resuspension of loose material on the road surface due to vehicle travel on a dry paved road may be estimated using the following empirical expression:

$$E = k \left(\frac{sL}{2} \right)^{0.65} \times \left(\frac{W}{3} \right)^{1.5} - C \quad (1)$$

where: E = particulate emission factor (having units matching the units of k),
 k = particle size multiplier for particle size range and units of interest (see below),
 sL = road surface silt loading (grams per square meter) (g/m^2),
 W = average weight (tons) of the vehicles traveling the road, and
 C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

It is important to note that Equation 1 calls for the average weight of all vehicles traveling the road. For example, if 99 percent of traffic on the road are 2 ton cars/trucks while the remaining 1 percent consists of 20 ton trucks, then the mean weight "W" is 2.2 tons. More specifically, Equation 1 is *not* intended to be used to calculate a separate emission factor for each vehicle weight class. Instead, only one emission factor should be calculated to represent the "fleet" average weight of all vehicles traveling the road.

The particle size multiplier (k) above varies with aerodynamic size range as shown in Table 13.2.1-1. To determine particulate emissions for a specific particle size range, use the appropriate value of k shown in Table 13.2.1-1.

The emission factors for the exhaust, brake wear and tire wear of a 1980's vehicle fleet (C) was obtained from EPA's MOBILE6.2 model²⁸. The emission factor also varies with aerodynamic size range

Table 13.2-1.1. PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

Size range ^a	Particle Size Multiplier k^b		
	g/VKT	g/VMT	lb/VMT
PM-2.5 ^c	1.1	1.8	0.0040
PM-10	4.6	7.3	0.016
PM-15	5.5	9.0	0.020
PM-30 ^d	24	38	0.082

^a Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.

^b Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.

^c Ratio of PM-2.5 to PM-10 taken from Reference 22.

^d PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

as shown in Table 13.2.1-2.

Table 13.2.1-2. EMISSION FACTOR FOR 1980'S VEHICLE FLEET
EXHAUST, BRAKE WEAR AND TIRE WEAR

Particle Size Range ^a	C, Emission Factor for Exhaust, Brake Wear and Tire Wear ^b		
	g/VMT	g/VKT	lb/VMT
PM _{2.5}	0.1617	0.1005	0.00036
PM ₁₀	0.2119	0.1317	0.00047
PM ₁₅	0.2119	0.1317	0.00047
PM ₃₀ ^c	0.2119	0.1317	0.00047

- ^a Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.
- ^b Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT).
- ^c PM-30 is sometimes termed "suspensible particulate" (SP) and is often used as a surrogate for TSP.

Equation 1 is based on a regression analysis of numerous emission tests, including 65 tests for PM-10.¹⁰ Sources tested include public paved roads, as well as controlled and uncontrolled industrial paved roads. All sources tested were of freely flowing vehicles traveling at constant speed on relatively level roads. No tests of "stop-and-go" traffic or vehicles under load were available for inclusion in the data base. The equations retain the quality rating of A (B for PM-2.5), if applied within the range of source conditions that were tested in developing the equation as follows:

Silt loading:	0.03 - 400 g/m ² 0.04 - 570 grains/square foot (ft ²)
Mean vehicle weight:	1.8 - 38 megagrams (Mg) 2.0 - 42 tons
Mean vehicle speed:	16 - 88 kilometers per hour (kph) 10 - 55 miles per hour (mph)

Note: There may be situations where low silt loading and/or low average weight will yield calculated negative emissions from equation 1. If this occurs, the emissions calculated from equation 1 should be set to zero.

Users are cautioned that application of equation 1 outside of the range of variables and operating conditions specified above, e.g., application to roadways or road networks with speeds below 10 mph and with stop-and-go traffic, will result in emission estimates with a higher level of uncertainty. In these situations, users are encouraged to consider alternative methods that are

equally or more plausible in light of local emissions data and/or ambient concentration or compositional data.

To retain the quality rating for the emission factor equation when it is applied to a specific paved road, it is necessary that reliable correction parameter values for the specific road in question be determined. With the exception of limited access roadways, which are difficult to sample, the collection and use of site-specific silt loading (sL) data for public paved road emission inventories are strongly recommended. The field and laboratory procedures for determining surface material silt content and surface dust loading are summarized in Appendices C.1 and C.2. In the event that site-specific values cannot be obtained, an appropriate value for a paved public road may be selected from the values in Table 13.2.1-3, but the quality rating of the equation should be reduced by 2 levels. Also, recall that Equation 1 refers to emissions due to freely flowing (not stop-and-go) traffic at constant speed on level roads.

Equation 1 may be extrapolated to average uncontrolled conditions (but including natural mitigation) under the simplifying assumption that annual (or other long-term) average emissions are inversely proportional to the frequency of measurable (> 0.254 mm [0.01 inch]) precipitation by application of a precipitation correction term. The precipitation correction term can be applied on a daily or an hourly basis ²⁶.

For the daily basis, Equation 1 becomes:

$$E_{ext} = \left[k \left(\frac{sL}{2} \right)^{0.65} \left(\frac{W}{3} \right)^{1.5} - C \right] \left(1 - \frac{P}{4N} \right) \quad (2)$$

where k , sL , W , and C are as defined in Equation 1 and

- E_{ext} = annual or other long-term average emission factor in the same units as k ,
- P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
- N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

Note that the assumption leading to Equation 2 is based on analogy with the approach used to develop long-term average unpaved road emission factors in Section 13.2.2. However, Equation 2 above incorporates an additional factor of "4" in the denominator to account for the fact that paved roads dry more quickly than unpaved roads and that the precipitation may not occur over the complete 24-hour day.

For the hourly basis, equation 1 becomes:

$$E_{ext} = \left[k \left(\frac{sL}{2} \right)^{0.65} \left(\frac{W}{3} \right)^{1.5} - C \right] \left(1 - \frac{1.2P}{N} \right) \quad (3)$$

where k , sL , and W , and C are as defined in Equation 1 and

- E_{ext} = annual or other long-term average emission factor in the same units as k ,
 P = number of hours with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
 N = number of hours in the averaging period (e.g., 8760 for annual, 2124 for season 720 for monthly).

Note: In the hourly moisture correction term $(1-1.2P/N)$ for equation 3, the 1.2 multiplier is applied to account for the residual mitigative effect of moisture. For most applications, this equation will produce satisfactory results. However, if the time interval for which the equation is applied is short, e.g., for one hour or one day, the application of this multiplier makes it possible for the moisture correction term to become negative. This will result in calculated negative emissions which is not realistic. Users should expand the time interval to include sufficient "dry" hours such that negative emissions are not calculated. For the special case where this equation is used to calculate emissions on an hour by hour basis, such as would be done in some emissions modeling situations, the moisture correction term should be modified so that the moisture correction "credit" is applied to the first hours following cessation of precipitation. In this special case, it is suggested that this 20% "credit" be applied on a basis of one hour credit for each hour of precipitation up to a maximum of 12 hours.

Note that the assumption leading to Equation 3 is based on analogy with the approach used to develop long-term average unpaved road emission factors in Section 13.2.2.

Figure 13.2.1-2 presents the geographical distribution of "wet" days on an annual basis for the United States. Maps showing this information on a monthly basis are available in the *Climatic Atlas of the United States*²³. Alternative sources include other Department of Commerce publications (such as local climatological data summaries). The National Climatic Data Center (NCDC) offers several products that provide hourly precipitation data. In particular, NCDC offers *Solar and Meteorological Surface Observation Network 1961-1990* (SAMSON) CD-ROM, which contains 30 years worth of hourly meteorological data for first-order National Weather Service locations. Whatever meteorological data are used, the source of that data and the averaging period should be clearly specified.

It is emphasized that the simple assumption underlying Equations 2 and 3 has not been verified in any rigorous manner. For that reason, the quality ratings for Equations 2 and 3 should be downgraded one letter from the rating that would be applied to Equation 1.

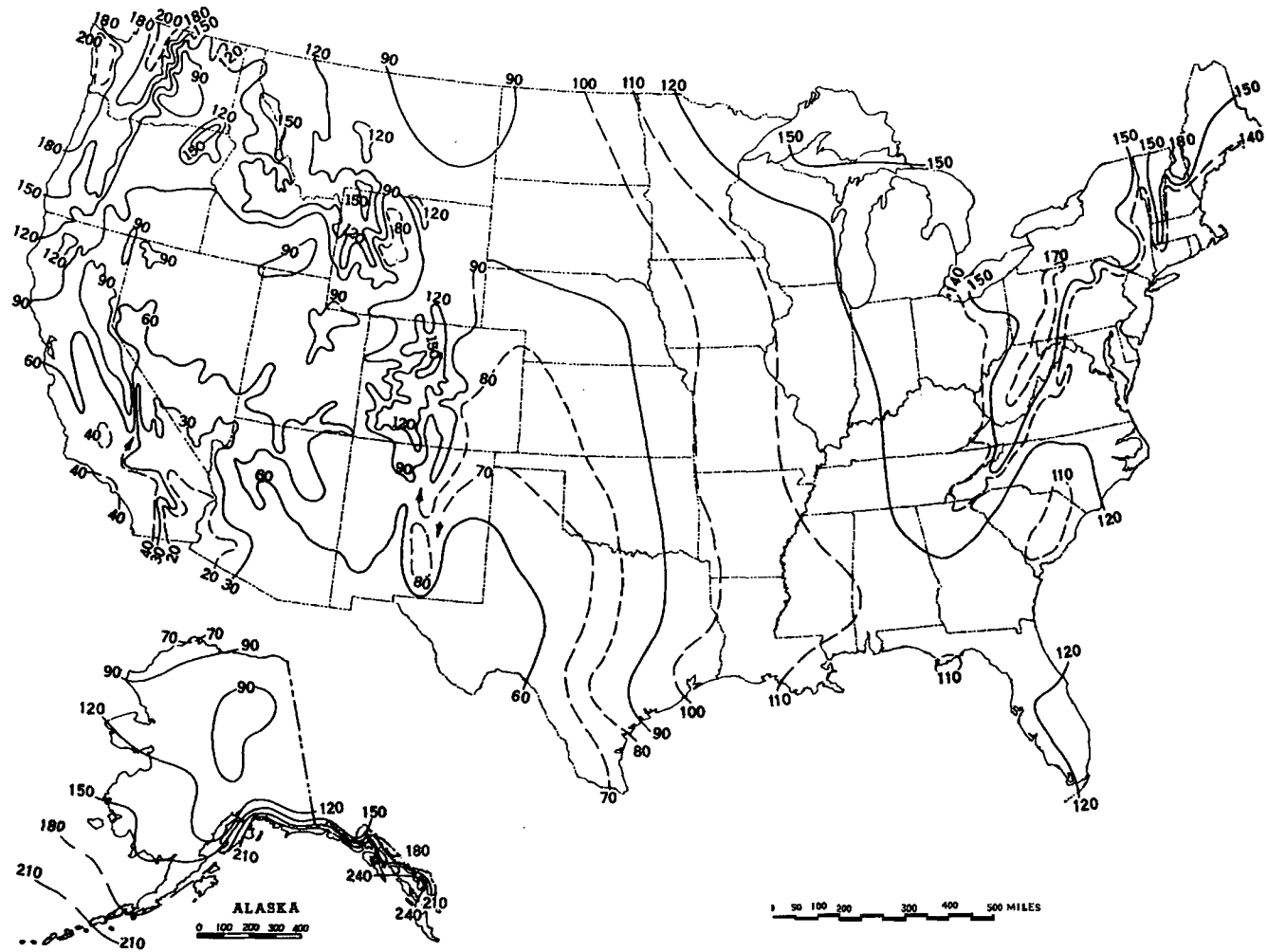


Figure 13.2.1-2. Mean number of days with 0.01 inch or more of precipitation in the United States.

Table 13.2.1-3 presents recommended default silt loadings for normal baseline conditions and for wintertime baseline conditions in areas that experience frozen precipitation with periodic application of antiskid material²⁴. The winter baseline is represented as a multiple of the non-winter baseline, depending on the ADT value for the road in question. As shown, a multiplier of 4 is applied for low volume roads (< 500 ADT) to obtain a wintertime baseline silt loading of $4 \times 0.6 = 2.4 \text{ g/m}^2$.

Table 13.2.1-3. Ubiquitous Silt Loading Default Values with Hot Spot Contributions from Anti-Skid Abrasives (g/m^2)

ADT Category	< 500	500-5,000	5,000-10,000	> 10,000
Ubiquitous Baseline g/m^2	0.6	0.2	0.06	0.03 0.015 limited access
Ubiquitous Winter Baseline Multiplier during months with frozen precipitation	X4	X3	X2	X1
Initial peak additive contribution from application of antiskid abrasive (g/m^2)	2	2	2	2
Days to return to baseline conditions (assume linear decay)	7	3	1	0.5

It is suggested that an additional (but temporary) silt loading contribution of 2 g/m^2 occurs with each application of antiskid abrasive for snow/ice control. This was determined based on a typical application rate of 500 lb per lane mile and an initial silt content of 1 % silt content. Ordinary rock salt and other chemical deicers add little to the silt loading, because most of the chemical dissolves during the snow/ice melting process.

To adjust the baseline silt loadings for mud/dirt trackout, the number of trackout points is required. It is recommended that in calculating PM-10 emissions, six additional miles of road be added for each active trackout point from an active construction site, to the paved road mileage of the specified category within the county. In calculating PM-2.5 emissions, it is recommended that three additional miles of road be added for each trackout point from an active construction site.

It is suggested the number of trackout points for activities other than road and building construction areas be related to land use. For example, in rural farming areas, each mile of paved road would have a specified number of trackout points at intersections with unpaved roads. This value could be estimated from the unpaved road density (mi/sq. mi.).

The use of a default value from Table 13.2.1-3 should be expected to yield only an order-of-magnitude estimate of the emission factor. Public paved road silt loadings are dependent

upon: traffic characteristics (speed, ADT, and fraction of heavy vehicles); road characteristics (curbs, number of lanes, parking lanes); local land use (agriculture, new residential construction) and regional/seasonal factors (snow/ice controls, wind blown dust). As a result, the collection and use of site-specific silt loading data is highly recommended. In the event that default silt loading values are used, the quality ratings for the equation should be downgraded 2 levels.

Limited access roadways pose severe logistical difficulties in terms of surface sampling, and few silt loading data are available for such roads. Nevertheless, the available data do not suggest great variation in silt loading for limited access roadways from one part of the country to another. For annual conditions, a default value of 0.015 g/m^2 is recommended for limited access roadways.^{9,22} Even fewer of the available data correspond to worst-case situations, and elevated loadings are observed to be quickly depleted because of high traffic speeds and high ADT rates. A default value of 0.2 g/m^2 is recommended for short periods of time following application of snow/ice controls to limited access roads.²²

The limited data on silt loading values for industrial roads have shown as much variability as public roads. Because of the variations of traffic conditions and the use of preventive mitigative controls, the data probably do not reflect the full extent of the potential variation in silt loading on industrial roads. However, the collection of site specific silt loading data from industrial roads is easier and safer than for public roads. Therefore, the collection and use of site-specific silt loading data is preferred and is highly recommended. In the event that site-specific values cannot be obtained, an appropriate value for an industrial road may be selected from the mean values given in Table 13.2.1-4, but the quality rating of the equation should be reduced by 2 levels.

Table 13.2.1-4 (Metric And English Units). TYPICAL SILT CONTENT AND LOADING VALUES FOR PAVED ROADS AT INDUSTRIAL FACILITIES^a

Industry	No. Of Sites	No. Of Samples	Silt Content (%)		No. Of Travel Lanes	Total Loading x 10 ⁻³			Silt Loading (g/m ²)	
			Range	Mean		Range	Mean	Units ^b	Range	Mean
Copper smelting	1	3	15.4-21.7	19.0	2	12.9-19.5 45.8-69.2	15.9 55.4	kg/km lb/mi	188-400	292
Iron and steel production	9	48	1.1-35.7	12.5	2	0.006-4.77 0.020-16.9	0.495 1.75	kg/km lb/mi	0.09-79	9.7
Asphalt batching	1	3	2.6-4.6	3.3	1	12.1-18.0 43.0-64.0	14.9 52.8	kg/km lb/mi	76-193	120
Concrete batching	1	3	5.2-6.0	5.5	2	1.4-1.8 5.0-6.4	1.7 5.9	kg/km lb/mi	11-12	12
Sand and gravel processing	1	3	6.4-7.9	7.1	1	2.8-5.5 9.9-19.4	3.8 13.3	kg/km lb/mi	53-95	70
Municipal solid waste landfill	2	7	—	—	2	—	—	—	1.1-32.0	7.4
Quarry	1	6	—	—	2	—	—	—	2.4-14	8.2

^a References 1-2,5-6,11-13. Values represent samples collected from *industrial* roads. Public road silt loading values are presented in Table-13.2.1-2. Dashes indicate information not available.

^b Multiply entries by 1000 to obtain stated units; kilograms per kilometer (kg/km) and pounds per mile (lb/mi).

13.2.1.4 Controls^{6,25}

Because of the importance of the silt loading, control techniques for paved roads attempt either to prevent material from being deposited onto the surface (preventive controls) or to remove from the travel lanes any material that has been deposited (mitigative controls). Covering of loads in trucks, and the paving of access areas to unpaved lots or construction sites, are examples of preventive measures. Examples of mitigative controls include vacuum sweeping, water flushing, and broom sweeping and flushing. Actual control efficiencies for any of these techniques can be highly variable. Locally measured silt loadings before and after the application of controls is the preferred method to evaluate controls. It is particularly important to note that street sweeping of gutters and curb areas may actually increase the silt loading on the traveled portion of the road. Redistribution of loose material onto the travel lanes will actually produce a short-term increase in the emissions.

In general, preventive controls are usually more cost effective than mitigative controls. The cost-effectiveness of mitigative controls falls off dramatically as the size of an area to be treated increases. The cost-effectiveness of mitigative measures is also unfavorable if only a short period of time is required for the road to return to equilibrium silt loading condition. That is to say, the number and length of public roads within most areas of interest preclude any widespread and routine use of mitigative controls. On the other hand, because of the more limited scope of roads at an industrial site, mitigative measures may be used quite successfully (especially in situations where truck spillage occurs). Note, however, that public agencies could make effective use of mitigative controls to remove sand/salt from roads after the winter ends.

Because available controls will affect the silt loading, controlled emission factors may be obtained by substituting controlled silt loading values into the equation. (Emission factors from controlled industrial roads were used in the development of the equation.) The collection of surface loading samples from treated, as well as baseline (untreated), roads provides a means to track effectiveness of the controls over time.

13.2.1.5 Changes since Fifth Edition

The following changes were made since the publication of the Fifth Edition of AP-42:

- 1) The particle size multiplier was reduced by approximately 55% as a result of emission testing specifically to evaluate the PM-2.5 component of the emissions.
- 2) Default silt loading values were included in Table 13.2.1-2 replacing the Tables and Figures containing silt loading statistical information.
- 3) Editorial changes within the text were made indicating the possible causes of variations in the silt loading between roads within and among different locations. The uncertainty of using the default silt loading value was discussed.

- 4) Section 13.2.1.1 was revised to clarify the role of dust loading in resuspension. Additional minor text changes were made.
- 5) Equations 2 and 3, Figure 13.2.1-2, and text were added to incorporate natural mitigation into annual or other long-term average emission factors.
- 6) The emission factor equation was adjusted to remove the component of particulate emissions from exhaust, brake wear, and tire wear. The parameter *C* in the new equation varies with aerodynamic size range of the particulate matter. Table 13.2.1-2 was added to present the new coefficients.
- 7) The default silt loading values in Table 13.2.1-3 were revised to incorporate the results from a recent analysis of silt loading data.
- 8) References were rearranged and renumbered.

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