SECTION 7.8

ROAD CONSTRUCTION DUST

(Updated August 1997)

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Construction and Demolition

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION
630-634-5400-0000 (47381) Road Construction Dust

METHODS AND SOURCES

The road construction dust source category provides estimates of the fugitive dust particulate matter due to construction activities while building roads. The emissions result from site preparation work which may include scraping, grading, loading, digging, compacting, light-duty vehicle travel, and other operations. Particulate matter emissions estimates for road building construction activities are listed in Table 1.

OVERVIEW OF ESTIMATION METHODOLOGY

Dust emissions from road construction operations are computed by using a PM_{10} emission factor developed by Midwest Research Institute during 1996.[1] The emission factor is based on observations of construction operations in California and Las Vegas. Activity data for road construction is expressed in terms of acre-months of construction. Acre-months are based on estimates of the acres disturbed for road construction. The acres disturbed are computed based on: estimates of the difference in road mileage between 1986 and 1987; estimates of road width (to compute acres disturbed); and, an assumption of 18 months as the typical project duration.

EMISSIONS ESTIMATION METHODOLOGY

Emission Factor. The emission factor used for our estimates of geologic dust emissions from road construction activities is based on work performed by Midwest Research Institute (MRI)[1] under contract to the PM_{10} Best Available Control Measure working group. For most parts of the State, the emission factor used is 0.11 tons PM_{10}/acre-month of activity (or 0.17 tons TSP/acre-month). This emission factor is based on MRI's observation of the types, quantity, and duration of operations at eight construction sites (three in Las Vegas, and five in

California). The bulk of the operations observed were site preparation related activities. The observed activity data were then combined with operation specific emission factors provided in U.S. EPA's AP-42 (5th Edition)[2] document to produce site emissions estimates. These site estimates were then combined to produce the overall average emission factor of 0.11. This emission factor is approximately 71% lower than the previous emission factor that was used from the 4th Edition of AP-42.

The construction emission factor is assumed to include the effects of routine dust suppression measures such as watering. A dust control effectiveness of 50% is assumed from these measures, which is based on the estimated control effectiveness of watering.[3] Therefore, if this emission factor is used for road construction activities where watering is not used, it should be doubled to more accurately reflect the actual emissions. The MRI document lists their average emission factor values as uncontrolled. However, our judgement is that the activities do include the effects of controls. All of the test sites were actual operations that used watering controls, even if in some cases they were not used during the actual site visits. Our belief is that the residual effects of controls are reflected in the MRI emission estimates.

The MRI report also includes an emission factor for worst-case construction emissions of 0.42 tons of PM_{10}/acre-month. This emission factor is appropriate for large scale construction operations which involve substantial earthmoving operations. The South Coast Air Quality Management District (SCAQMD) estimated that a percentage of their construction projects involve these types of operations, and applied the larger emission factor to the activities. For the remainder of the State, such detailed information is not readily available, so the average emission factor of 0.11 tons PM_{10}/acre-month was used.

This methodology directly computes PM_{10} emissions. The TSP emissions are PM_{10} x 1.56.[4]

Activity Data. For the purpose of estimating emissions, it is assumed that the fugitive dust emissions are related to the acreage affected by construction. Region-wide estimates of the acreage disturbed by roadway construction are not directly available. Therefore, the miles of road built and the acreage disturbed per mile of construction are used to estimate the overall acreage disturbed.

The miles of road built are based on the difference in the road mileage reported between 1986 and 1987. These data, from the Department of Finance[5] and Caltrans,[6] are split for each county into freeways, state highways, and city and county road, and are summarized in Table 2. The acreage of land disturbed per mile of road construction is based on the number of lanes, lane width, and shoulder width for each listed road type. The assumptions used are provided in Table 3. Because most projects will probably also disturb land outside of the immediate roadway corridor, these acreage estimates are somewhat conservative.

The final parameter needed is project duration, which is assumed to be an average 18 months.[7] Multiplying the road mileage built, the acres per mile, and the months of construction provides the acre-months of activity for road building construction. This, multiplied by the emission

factor, provides the emissions. The emissions in Table 1 are based on the 1987 activity data grown to the 1993 inventory year.

TEMPORAL ACTIVITY AND GROWTH

Temporal activity is assumed to occur five days a week between the hours of 8 a.m. and 4 p.m. The table below shows the percentage of construction activity that is estimated to occur during each month. The monthly activity increases during the spring and summer months as shown below. Some districts use a slightly different profile that has a larger peak during the summer months. Construction emissions for future years are based on construction activity projections.

CES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
47381	6.4	6.4	8.3	9.2	9.2	9.2	9.2	9.2	9.2	8.3	8.3	7.3

ASSUMPTIONS AND LIMITATIONS

1. The current methodology assumes that all construction operations in all parts of the State emit the same levels of PM_{10} on a per acre basis.

2. It is assumed that watering techniques are used statewide, reducing emissions by 50% and making it valid to apply the MRI emission factor without correction.

3. The methodology assumes that the acreage disturbed per mile for road building is similar statewide, and the overall disturbed acreage is approximately the same as the finished roadway's footprint.

4. The methodology assumes that construction dust emissions are directly proportional to the number of acres disturbed during construction.

CHANGES IN THE METHODOLOGY

The major change to the methodology is the incorporation of the MRI emission factor for construction, which reduces the PM_{10} emission estimates by over 70%.

COMMENTS AND RECOMMENDATIONS

To improve the road construction dust estimates, both the emission factor and activity data require attention. Possible improvements to the methodology that could be made are: updated estimates of the acreages disturbed by road construction projects and the duration of the projects; gathering of more detailed site data to allow use of the more site-specific emission

factors listed in the MRI document;[1] and, probably most needed, the update of activity levels to reflect conditions more recent than 1987 (even if the existing methodology is used). Unfortunately, in most cases these activity data are difficult to derive on a statewide basis.

SAMPLE CALCULATIONS

The instructions and associated table below provide an example of estimating road construction dust emissions for Santa Barbara county.

Step 1: Miles Constructed. For each road type, enter the miles of road constructed during the year. For this example, the values from Table 2 are used.

Step 2: Area per Mile. Using the data in Table 3, enter the estimated acres of land disturbed for each mile of road construction.

Step 3: Compute the Acres Disturbed. Acres disturbed is: *Miles Constructed x Area per Mile.*

Step 4: Project Duration. Enter the average project duration. The ARB default value is 18 months.

Step 5: Compute Acre-Months. Multiply the values from steps 3 and 4 together to get acre-months. *Acre-Months = Acres Disturbed x Months.*

Step 6: Emission Factor. Input the emission factor. The ARB default is 0.11 tons PM_{10}/acre-month when standard watering practices are used.

Step 7: Compute Emissions. Multiply the values from step 5 and step 6 together to get the emissions for each road type. *Acre-Months x Emission Factor = Emissions.* Then, finally, total the emissions to get the overall county-wide PM_{10} emissions.

Estimating PM_{10} Construction Dust In Santa Barbara County

		Road Type			
		Freeway	Highway	City & County	**Totals**
Step 1	Miles Constructed	1.6	14.3	25.4	**41.3**
Step 2	Area per Mile (acres)	12.1	9.2	7.8	
Step 3	Acres Disturbed	19.4	131.6	198.1	**349.0**
Step 4	Project Duration (months)	18	18	18	
Step 5	Acre-Months	348.5	2368.1	3566.2	**6282.7**
Step 6	Emission Factor (tons PM_{10}/acre-month)	0.11	0.11	0.11	
Step 7	**Emissions** (tons PM_{10}/year)	**38.3**	**260.5**	**392.3**	**691.1**

ADDITIONAL CODES

Source Category Growth and Control Codes
Various

Source Category Code Pollutant Speciation Profiles
For All: PM = 391, VOC = not applicable

Source Category Code Reactivity Factors
Not Applicable

REFERENCES

1. Muleski, Greg. Improvement of Specific Emission Factors (BACM Project No. 1), Final Report. Midwest Research Institute, March 29, 1996.

2. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, AP-42, Section 13.2.3, Fifth Edition. January 1995.

3. PEDCo Environmental Specialists. Investigation of Fugitive Dust Sources - Emissions and Control. Prepared for the Environmental Protection Agency, OAQPS. Contract No. 68-02-0044. May 1973.

4. Taback, H.J., et al, Fine Particulate Emissions from Stationary and Miscellaneous Sources in the South Coast Air Basin, Report Number KVB 5806-783, KVB. February 1979.

5. California Department of Finance, 1987 California Statistical Abstract. Financial Research Section, State of California.

6. Data received from Susan Kwong, Highway System Engineering Branch, California Department of Transportation.

7. Midwest Research Institute, Inventory of Agricultural Tilling, Unpaved Roads and Airstrips and Construction Sites. For the U.S. Environmental Protection Agency, PB 238-919, Contract 68-02-1437. November 1974.

UPDATED BY

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Table 1. 1993 Road Building PM_{10} Construction Dust.

			Road Construction	
			EIC: 630-634-5400-0000	
AB	CO	NAME	Process Rate (acre-month/yr)	PM_{10} (tons/yr)
GBV	2	ALPINE	126.2	13.9
	14	INYO	0.0	0.0
	26	MONO	0.0	0.0
LC	17	LAKE	50.3	5.5
LT	9	EL DORADO	120.8	13.3
	31	PLACER	183.3	20.2
MC	3	AMADOR	96.5	10.6
	5	CALAVERAS	79.2	8.7
	9	EL DORADO	635.3	69.9
	22	MARIPOSA	32.0	3.5
	29	NEVADA	3201.3	352.1
	31	PLACER	2953.8	324.9
	32	PLUMAS	667.7	73.4
	46	SIERRA	73.0	8.0
	55	TUOLUMNE	752.3	82.8
NC	8	DEL NORTE	840.2	92.4
	12	HUMBOLDT	543.7	59.8
	23	MENDOCINO	1963.8	216.0
	49	SONOMA	2222.5	244.5
	53	TRINITY	0.0	0.0
NCC	27	MONTEREY	1680.7	184.9
	35	SAN BENITO	647.3	71.2
	44	SANTA CRUZ	3868.2	425.5
NEP	18	LASSEN	30.3	3.3
	25	MODOC	46.3	5.1
	47	SISKIYOU	338.5	37.2
SC	19	LOS ANGELES	49.8	85.7
	30	ORANGE	41.1	70.9
	33	RIVERSIDE	13.6	23.4
	36	SAN BERNARDINO	238.2	410.4
SCC	40	SAN LUIS OBISPO	7467.3	821.4
	42	SANTA BARBARA	7180.8	789.9
	56	VENTURA	5258.2	578.4
SD	37	SAN DIEGO	47745.0	5252.0
SED	13	IMPERIAL	500.5	55.1
	15	KERN	2709.7	298.1
	19	LOS ANGELES	43.7	75.3
	33	RIVERSIDE	10.4	17.9
	36	SAN BERNARDINO	17012.3	1871.4
SF	1	ALAMEDA	1306.7	143.7
	7	CONTRA COSTA	6084.0	669.2
	21	MARIN	304.5	33.5
	28	NAPA	211.8	23.3
	38	SAN FRANCISCO	37.5	4.1
	41	SAN MATEO	3098.7	340.9
	43	SANTA CLARA	2090.3	229.9
	48	SOLANO	1082.2	119.0
	49	SONOMA	1306.8	143.8
SJV	10	FRESNO	6460.5	710.7
	15	KERN	1275.2	140.3
	16	KINGS	1558.0	171.4
	20	MADERA	0.0	0.0
	24	MERCED	1987.2	218.6
	39	SAN JOAQUIN	2753.8	302.9
	50	STANISLAUS	6652.0	731.7
	54	TULARE	2435.2	267.9
SV	4	BUTTE	1085.5	119.4
	6	COLUSA	0.0	0.0
	11	GLENN	32.5	3.6
	31	PLACER	650.2	71.5
	34	SACRAMENTO	6159.0	677.5
	45	SHASTA	1056.2	116.2
	48	SOLANO	1637.7	180.1
	51	SUTTER	366.8	40.3
	52	TEHAMA	77.7	8.5
	57	YOLO	18832.7	2071.6
	58	YUBA	211.7	23.3
		Statewide Total	178178	20239

PM Fraction: PM_{10} = TSP x 0.64 (TSP Emissions = PM_{10}/0.64)

Table 2

Miles of New Road Constructed in 1987

Air Basin	County Name	Freeway	Highway	City & County
GBV	ALPINE	0.50	0.00	0.00
	INYO	0.00	0.00	0.00
	MONO	0.00	0.00	0.00
LC	LAKE	0.20	0.00	0.00
LT	EL DORADO	0.00	0.00	0.85
	PLACER	0.00	0.21	1.23
MC	AMADOR	0.00	0.00	0.60
	CALAVERAS	0.00	0.00	0.50
	EL DORADO	0.00	0.00	3.64
	MARIPOSA	0.00	0.00	0.20
	NEVADA	3.30	0.10	13.90
	PLACER	0.00	1.54	9.18
	PLUMAS	0.00	0.00	4.20
	SIERRA	0.00	0.00	0.50
	TUOLUMNE	0.00	0.00	4.60
NC	DEL NORTE	3.40	0.00	0.00
	HUMBOLDT	0.10	0.00	3.30
	MENDOCINO	6.40	0.00	2.10
	SONOMA	0.00	0.00	15.37
	TRINITY	0.00	0.00	0.00
NCC	MONTEREY	3.40	0.90	4.60
	SAN BENITO	0.00	1.60	2.20
	SANTA CRUZ	13.40	0.00	2.40
NEP	LASSEN	0.00	0.00	0.20
	MODOC	0.00	0.00	0.30
	SISKIYOU	0.00	0.00	2.20
SC	LOS ANGELES	0.41	0.00	52.84
	ORANGE	0.20	0.00	145.40
	RIVERSIDE	2.60	0.00	34.48
	SAN BERNARDINO	0.00	0.00	6.76
SCC	SAN LUIS OBISPO	16.40	0.00	19.70
	SANTA BARBARA	1.60	14.30	25.40
	VENTURA	0.00	0.00	43.70
SD	SAN DIEGO	0.50	7.00	310.00
SED	IMPERIAL	0.00	0.10	3.10
	KERN	0.00	0.00	16.93
	LOS ANGELES	0.19	0.00	24.86
	RIVERSIDE	7.40	0.00	98.12
	SAN BERNARDINO	0.00	0.00	105.94
SF	ALAMEDA	0.00	0.20	9.80
	CONTRA COSTA	0.00	0.10	46.30
	MARIN	1.50	0.00	0.00
	NAPA	0.00	0.00	1.60
	SAN FRANCISCO	0.20	0.00	0.00
	SAN MATEO	6.00	0.00	14.70
	SANTA CLARA	0.00	0.60	15.30
	SOLANO	0.00	0.04	8.38
	SONOMA	0.00	0.00	9.83
SJV	FRESNO	2.70	0.10	36.10
	KERN	0.00	0.00	7.97
	KINGS	0.00	0.00	9.80
	MADERA	0.00	0.00	0.00
	MERCED	0.00	0.00	12.00
	SAN JOAQUIN	0.10	0.10	17.00
	STANISLAUS	0.00	0.00	40.90
	TULARE	2.70	0.00	10.20
SV	BUTTE	0.60	0.00	5.80
	COLUSA	0.00	0.00	0.00
	GLENN	0.00	0.00	0.20
	PLACER	0.00	0.55	3.29
	SACRAMENTO	0.00	0.10	39.30
	SHASTA	0.00	0.00	6.50
	SOLANO	0.00	0.06	11.11
	SUTTER	0.00	0.00	2.40
	TEHAMA	0.00	0.00	0.50
	YOLO	0.00	0.00	110.80
	YUBA	0.00	0.00	1.50
TOTAL		73.80	27.60	1380.58

Table 3

Roadway Acres per Mile of Construction Estimates

Road Type	Freeway	Highway	City & County
Number of Lanes	5	5	2
Width per Lane (feet)	12	12	12
Shoulder Width (feet)	10'x4 = 40'	20'x2 = 40'	20'x2 = 40'
Roadway Width* (feet)	100	76	64
Roadway Width* (miles)	0.019	0.014	0.012
Area per Mile** (acres)	12.1	9.2	7.8

*Roadway Width (miles) = [(Lanes x Width per Lane) + Shoulder Width] x (1 mile/5280 feet)

**Area per Mile (acres) = Length x Width
= 1 Mile x Width x 640 acres/mile^2