HANDOUT 7-3

Case Study Number 7-3 Solution

Estimating PM_{10} and $PM_{2.5}$ Emissions from Road Construction Activities

Question 1: What PM emission factors are applicable to road construction?
Answer: The PM_{10} emission factor for road construction is 0.42 tons per acre month. The $PM_{2.5}$ is assumed to be 20% of the PM_{10}. (See page 7-18 of the Student Manual)

Question 2: What is the basis of the activity data for road construction?
Answer: The number of acres disturbed is the activity data indicator for road construction. It is based on State level expenditure data for capital outlay for six road construction classifications. To obtain the activity data in terms of acres disturbed it is necessary to convert the expenditure data to mileage and then to acreage. Conversion factors are available from the NEI to convert dollars to miles and then to convert to acres disturbed per mile of road activity (See Table 7-10 in the Student Manual).

Question 3: What is the methodology for estimating PM_{10} and $PM_{2.5}$ emissions from road construction?
Answer: Equation 7-16 of the Student Manual shows the basic emission formula used for calculating PM_{10} emissions from road construction. This involves multiplying the emission factor by the activity data (converted to an acres basis) and the duration of the project. $PM_{2.5}$ emissions are assumed to be 20 percent of the PM_{10} emissions.

Adjustments for controls and rule penetration can be made by multiplying the results from Equation 7-16 by (1-(CE/100)) and (1-(RP/100)), respectively.

Finally, adjustments are applied for soil moisture content and silt content using Equation 7-13 and Equation 7-14 in the Student Manual, respectively.

Question 4: What is your estimate of the PM_{10} and $PM_{2.5}$ emissions from the road construction activities in the county within the past year without accounting for rule effectiveness, rule penetration, soil moisture, and silt content?
Answer: In solving this problem, it must be recognized that the State expenditures for capital outlay on road construction during the last 12 months are not given. However, since the total miles of road construction are given, the State expenditures are not needed. In short, the total number of miles of road construction that is given is the product of the values $ and f1 in Equation 7-16 of the Student Manual, thereby allowing this problem to be solved without knowing the State expenditures or the dollars-to-miles conversion factor.

Consequently, the answer is the product of the emission factor, the miles of road construction, the miles-to-acre conversion factor, and the duration of the road construction activity, as shown below.

PM_{10} Emissions = EF x m x f2 x d

Where: EF = emission factor (tons PM_{10}/acre month)
m = 12.3 miles
f2 = miles-to-acre conversion factor
d = duration (months)

PM_{10} Emissions = 0.42 tons/acre month x 12.3 miles x 9.8 acres/mile x 12 months = 607.5 tons

The value of f2 is obtained from Table 7-10 of the Student Manual. The value of f2 for urban collectors is 9.8. The value for the emission factor is obtained from Equation 7-16 in the Student Manual.

$PM_{2.5}$ emissions are calculated by multiplying the PM_{10} emissions by 20 percent.

$PM_{2.5}$ Emissions = 0.2 x 607.5 tons = 121.5 tons

Question 5: What is your estimate of the PM_{10} and $PM_{2.5}$ emissions from the road construction activities in the county within the past year accounting for control efficiency and rule penetration, but not accounting for soil moisture and silt content?
Answer: Adjustments for controls efficiency and rule penetration can be made by multiplying the results from Equation 7-16 by (1-(CE/100)(RP/100)) as shown below.

PM_{10} Emissions = 607.5 tons x (1-(50/100)(1-75/100)) = 379.7 tons

$PM_{2.5}$ Emissions = 379.7 tons x 0.2 = 75.9 tons

Question 6: What is your estimate of the PM_{10} and $PM_{2.5}$ emissions from the road construction activities in the county within the past year accounting for control efficiency, rule penetration, and soil moisture?
Answer: Adjustments for soil moisture content are made by applying the following formula (Equation 7-13 of the Student Manual):

Moisture Level Corrected Emissions = Base Emissions x (24/PE)

Where: PE = Precipitation Evaporation value for the county

Therefore, corrected PM_{10} emissions are equal to 379.7 tons x 24/6 = 1,518.8 tons
Corrected $PM_{2.5}$ emissions are equal to 75.9 tons x 24/6 = 303.6 tons

Question 7: What is your estimate of the PM_{10} and $PM_{2.5}$ emissions from the road construction activities in the county within the past year accounting for control efficiency, rule penetration, and silt content (but not for soil moisture)?
Answer: Emissions are adjusted for the dry silt content in the soil of the area being inventoried by using the following equation (Equation 7-14 of the Student Manual).

$$\text{Silt Content Corrected Emissions} = \text{Base Emissions} \times (s/9\%)$$

Where: s = % dry silt content in soil for area being inventoried

Therefore, corrected PM_{10} emissions are equal to 379.7 tons x 4.45 = 1,689.7 tons
Corrected $PM_{2.5}$ emissions are equal to 75.9 tons x 4.45 = 337.8 tons

Question 8: What is your estimate of the PM_{10} and $PM_{2.5}$ emissions from the road construction activities in the county within the past year accounting for control efficiency, rule penetration, soil moisture, and silt content?
Answer: Emissions are adjusted for both soil moisture content and silt content by applying the appropriate adjustments to the base emissions (already corrected for controls and rule penetration) as follows:

$$\text{Corrected Emissions} = \text{Base Emissions} \times 24/PE \times (s/9\%)$$

Therefore, corrected PM_{10} emissions are equal to 379.7 tons x 24/6 x 40/9 = 6,750 tons
Corrected $PM_{2.5}$ emissions are equal to 75.9 tons x 24/6 x 40/9 = 1,350 tons
Alternatively, $PM_{2.5}$ emissions can be calculated by applying the 20 percent value directly to the corrected PM_{10} emissions as follows: 6,750 tons of PM_{10} x 0.2 = 1,350 tons of $PM_{2.5}$.