Chapter 3: Onroad Mobile Inventory Development

LESSON GOAL

Demonstrate, through successful completion of the chapter review exercises, a general understanding of EPA's MOBILE 6 model and the National Mobile Inventory Model (NMIM). Also, the student should be able to describe the concept of vehicle miles traveled and how it is used to calculate emissions from onroad vehicles.

STUDENT OBJECTIVES

When you have mastered the material in this chapter, you should be able to:

1. Describe the inputs required to run the MOBILE 6 model.
2. Explain the purpose of the NMIM.
3. Identify sources for obtaining VMT data.
4. Explain the approach for calculating onroad vehicular emissions from VMT data.
5. Identify additional sources of information for calculating onroad emissions.

Chapter 3: Onroad Mobile Inventory Development

3.1 MOBILE 6

3.1.1 Overview

EPA's Office of Transportation and Air Quality (OTAQ) has developed MOBILE 6 to estimate emissions from mobile sources. The MOBILE 6 model includes emission factors for $PM_{2.5}$, SO_2, NH_3, PM_{10}, VOC and CO. The MOBILE6 model and the User Guide can be downloaded from www.epa.gov/otaq/m6.htm. The $PM_{2.5}$ and the PM_{10} emission factors represent primary emissions. Data on vehicle miles traveled (VMT) is matched to the corresponding MOBILE 6 emission factors to form the basis of emission calculations.

PART 5 was EPA's prior model for modeling PM emissions and the data and algorithms that were previously in PART 5, with some updates, have been integrated into the MOBILE 6 model. However, the fugitive dust emission factors that were included in PART 5 have been excluded from MOBILE 6. Consequently, the calculation of emissions from re-entrained road dust is done separately outside the model. In addition, MOBILE 6 also includes emission estimates for gaseous SO_2 as well as ammonia.

3.1.2 Modeling Inputs

In most cases MOBILE 6 uses the same type of inputs that were required for prior versions. This includes registration, distribution, ambient conditions such as temperature and humidity, speeds and speed distributions, and fuel parameters such as the Reid Vapor Pressure of gasoline and oxygenated fuel. It also includes control programs such as Stage II or Inspection and Maintenance programs, and data on VMT by vehicle type.

One additional data input required for MOBILE 6 modeling that was not required in the past is the diesel sulfur content expressed in parts per million. Also, there are additional commands needed for generating $PM_{2.5}$ inventories in MOBILE 6. These are described in the MOBILE user's guides that OTAQ has developed. One thing to note is when developing a PM inventory you cannot do a $PM_{2.5}$ and a PM_{10} inventory at the same time. As a result, it is necessary to specify just one particle size per each run.

3.2 NATIONAL MOBILE INVENTORY MODEL

The National Mobile Inventory Model (NMIM) is a tool developed by EPA's Office of Transportation and Air Quality (OTAG) to create national or sub-national emission inventories for any calendar year using county-specific input parameters. It is a consolidated emissions modeling system for EPA's MOBILE and NONROAD models. It combines a graphical user interface, MOBILE, NONROAD, and a database that contains modeling information for each county in the United States. Currently this database contains the most recent information (e.g., fuel parameters, registration data, temperatures, etc.) used by EPA to generate the default National Emission Inventory (NEI) estimates for each county.

NMIM is capable of calculating both criteria (including ammonia) and HAPs for the source categories included in the MOBILE6 and NONROAD models. The true beauty of NMIM is that it consolidates all the model inputs into a single data base such that all the estimates are based on the same input parameters in each county (e.g., fuel programs, inspection/maintenance, humidity, temperatures).

EPA used a draft version of NMIM to generate the preliminary EPA default 2002 NEI inventories for nonroad engines. For states, NMIM is an optional tool that should simplify estimating mobile source inventories by organizing and automating emission inventory development for highway vehicles and NONROAD categories. It is not a substantively different approach than directly using MOBILE6.2 and NONROAD2002.

EPA expects to complete NMIM and release it for general use in 2004 but states will not be required to use it to generate inventory estimates. This tool was developed to make creating inventories easier and does not change the answers that are obtained from running MOBILE or NONROAD individually. In the future, states may wish to tailor all or part of their own inventory generation process to the NMIM model approach to take advantage of its efficiency and transparency and to align the NEI inventory results more closely with their own inventory estimates. State and local agencies will be able to use the database to view the county-level default values and to replace them with data that better represents their geographic areas.

3.3 VMT DATA

3.3.1 Sources

State departments of transportation typically provide VMT data. In addition, metropolitan planning organizations (MPOs) track these data for certain areas. However, VMT data should be used from whatever source it is available. As a case in point, the 1999 NEI included VMT data that was provided by eight states and this data was used in conjunction with MOBILE6 emission factors. VMT data for the remaining states were obtained from the Federal Highway Administration's (FHWA) data summaries. The FHWA data contains vehicle miles traveled by roadway type,

by state, as well as VMT by roadway type for specific urban areas. The 1999 NEI relied upon a national distribution for the VMT mix by vehicle type. As a result, the same mix of vehicles was assumed for all areas unless the state provided their own data. Documentation for the 1999 NEI can be found at this web address: www.epa.gov/ttn/chief/net/1999inventory.html.

3.3.2 Approach

In the case of the NEI, the VMT data was developed for use in conjunction with MOBILE 6 by using the distributions of VMT by roadway type and vehicle type. In some cases this activity data may be available by hour of the day. Regardless of the format, these fractions can be applied directly to the total VMT, or they can be included within the MOBILE 6 input files in order to generate a weighted emission factor in MOBILE 6.

It should be noted that it is important to have speeds matched to the roadway types, either as an average speed or as speed distributions by speed ranges. This latter approach is the approach needed for link-based VMT development and some transportation demand models.

3.3.3 Level of Detail

Ideally, the level of VMT data that should be used is by county and by the various roadway types or link level if modeling at that level is planned. Using data by vehicle type is important since emission rates can vary greatly among the different vehicle types. Using vehicle type data will allow the adjustments to be made to the national defaults that are typically used. Finally, it is important to match the VMT data (daily or hourly) to the appropriate time period for modeling.

3.4 CALCULATING EMISSIONS

VMT data needs to be matched to a corresponding MOBILE 6 emission factor and mapped according to speed, roadway type, vehicle type, and time period. Emissions are calculated by multiplying the VMT data by an emissions factor as shown in the following equation.

$$\text{Emissions} = \text{VMT} * \text{EF} * \text{K}$$

where: Emissions = emissions in tons by roadway type and vehicle type
VMT = vehicle miles traveled by roadway type and vehicle type
EF = emission factor in grams/mile by roadway type and vehicle type
K = conversion factor

3.5 ADDITIONAL RESOURCES

Since this has been cursory treatment of onroad sources, Table 3-1 provides a number of online resources that should be consulted when developing an emissions inventory for onroad sources. This includes EPA's online user's guide for using MOBILE 6.1 and 6.2 as well as technical documentation describing how all the defaults were developed. There are also links to training materials that have been developed as MOBILE 6 has been updated.

Table 3-1 ONROAD SOURCES
Additional Resources

Reference	Web Site
User's Guide to MOBILE 6.1 and MOBILE 6.2: Mobile Source Emission Factor Model, EPA420-R-02-028, October 2002.	www.epa.gov/otaq/m6.htm
MOBILE 6.1 Particulate Emission Factor Model Technical Description,Draft,EPA420-R-02-012, March 2002	www.epa.gov/OMS/models/mobile6/r02012.pdf
Links to MOBILE 6 Training Materials	www.epa.gov/otaq/m6.htm#m6train
Documentation for the Onroad NEI for Base Years 1970 - 2002	ftp://ftp.epa.gov/EmisInventory/finalnei99ver3/haps/documentation /onroad/nei_onroad_jan04.pdf

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Review Exercises

1. Which of the following pollutants does **not** have an emission factor included in MOBILE 6?
   a. $PM_{2.5}$
   b. Ammonia
   c. Carbon dioxide
   d. Volatile Organic Compounds

2. Which of the following MOBILE inputs are required for MOBILE 6, but were not required for MOBILE 6.0?
   a. Reid Vapor Pressure
   b. VMT data by vehicle type
   c. Ambient humidity
   d. Sulfur content of diesel fuel

3. The National Mobile Inventory Model is a graphical interface that uses _____.
   a. MOBILE 6.2
   b. NONROAD 2002
   c. a county level database
   d. All of the above

4. The development of VMT data in the NEI for use in conjunction with MOBILE 6 is done by using the distributions of VMT by _____.
   a. vehicle type and speed ranges
   b. roadway type and vehicle type
   c. roadway type and speed ranges
   d. roadway type and link level

5. VMT data needs to be matched to a corresponding MOBILE 6 emission factor and mapped according to _____.
   a. speed
   b. roadway type
   c. vehicle type
   d. All of the above

6. Which of the following is needed to calculate emissions from onroad vehicles?
   a. VMT data
   b. Emission factor by roadway type
   c. Emission factor by vehicle type
   d. All of the above

Review Answers

1. c. Carbon dioxide

2. d. Sulfur content of diesel fuel

3. d. All of the above

4. b. roadway type and vehicle type

5. d. All of the above

6. d. All of the above

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