

Measurement and Adaptation of Vehicle Activity Variables in Mexican Sample Cities

EXECUTIVE SUMMARY

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According to the Mexican National Emissions Inventory (INEM 1999), motor vehicles are one of the main sources of air pollution due to the large amounts of nitrogen oxides (NO_x) and hydrocarbons (HC)—the main precursors to ozone formation—they release. So-called mobile sources also release significant quantities of carbon monoxide (CO) and particles under 10 microns (PM_{10}), especially vehicles using diesel fuel in the case of PM_{10} .

Motor vehicle emissions depend on a variety of parameters, ranging from the type of fuel used, the type of vehicle, the distance traveled, travel speed, vehicle maintenance and driving style, to geographical and weather factors such as altitude above sea level, topographical conditions, temperature and relative humidity, among others. However, when one wishes to estimate pollutant emissions for a given city, these variables are often unknown. This is the case with many Mexican cities, making it necessary to search for and generate basic information to calculate vehicle emissions.

In this context, and as part of the Enhancing North American Air Quality Management project, the Commission for Environmental Cooperation (CEC) endeavored to obtain information on vehicle activity in six typical cities in Mexico. In order to update the national inventory on mobile source emissions in Mexico, the information could be extrapolated to other cities of similar size (in terms of population and vehicle fleet composition), socioeconomic characteristics, and physiographical conditions, all aspects that influence the emission of air pollution by motor vehicles. The study began in 2008 at two cities: Chilpancingo (Guerrero) and Veracruz (Veracruz). In 2009, the cities of Chihuahua (Chih.), San Luis Potosí (SLP), Tepic (Nayarit), and Villahermosa (Tabasco) were studied.

The study was completed in different stages: a literature search; the design of “campaigns” to obtain field information, compilation of information on vehicle fleets and their activity, data entry, analysis and statistical treatment, and the drafting of reports. A fundamental part was the selection of appropriate

methodology to achieve the stated goals, including both the specific goals of each campaign and also the overall study objectives. The following methods and equipment were used to collect information in the field:

- a) Surveys to determine the number of kilometers traveled, by type of vehicle;
- b) AutoTap[®] equipment used on selected city roads to identify speeds on different road types;
- c) Pneumatic traffic counters to determine vehicle flows on different road types; and
- d) Video recording to determine fleet composition by vehicle type and number of trips.

The studies conducted in the six cities provided the following overall results:

- **Vehicle activity (VKT).** Surveys taken to obtain the distance traveled by different vehicle types, among other data, clearly show the differences in vehicle kilometers traveled in the different cities. This information is relevant to the air pollution calculation since it directly impacts the emissions per vehicle type and the overall emissions in the study area.
- **Driving speed.** To obtain the emission factor for the type of vehicle and pollutant, Mexico and other parts of the world now use the MOBILE6 model. However, this model requires data entry on vehicle velocities on different types of roads, as this largely determines the quantity of pollutants released. As seen in the results, driving speeds vary widely; for example, on average, vehicles travel on freeways at 48 km/h, arterial roads at 22 km/h, and local streets at 24 km/h. These speeds vary from city to city, depending on the road infrastructure, driving styles and even the topographical conditions of the area studied.
- **Traffic count.** Another basic piece of data for calculating pollutant releases is the number of vehicles driven in an area of interest, including road type, as travel speeds are influenced directly by traffic density (number of vehicles on the road) and the characteristics of the road. The results of the analysis of traffic count and vehicular flow show a significant difference in the number of vehicles driven in the six cities studied. In general, San Luis Potosí has the highest vehicle flows, with an average for the three types of roads varying between 3,500 and 4,000 vehicles per hour, while Veracruz has the lowest average traffic count: 1,000 to 1,500 vehicles per hour. The results of these two cases clearly show the difference in vehicular activity between cities with differing characteristics, highlighting the importance of conducting field studies to obtain more reliable information. Time-of-day behavior followed the same trends in all cities analyzed, i.e., peak and low-flow times are very similar in the six cities evaluated.
- **Classification of vehicle fleet.** The video recording allowed us to collect fleet information by type of vehicle. The results show that private vehicles account for 30 to 60 percent of the vehicle

fleets of the six cities studied; from 10 to 20 percent were pickups and SUVs; and a similar proportion (10 to 20 percent) were taxis, principally in the cities of Chilpancingo, Veracruz and Tepic.

In general, the results demonstrate the importance of considering specific data for each zone or area studied, in order to estimate air pollution emissions from motor vehicles, since the basic information that directly influences the emissions calculation is determined by the particular characteristics of each city or zone studied. However, based on the data from the six cities included in this study, we have specific information that may now be extrapolated to cities with similar characteristics,