Advanced Science and Technology Letters
Vol.90 (Mechanical Engineering 2015), pp.10-13
http://dx.doi.org/10.14257/astl.2015.90.03

Study On Real Driving Emission For Light-duty Vehicle

Myungdo Eom[1], Junhong Park[2], Doo-Sung Baik[3*]

[1, 2] Transportation Pollution Research Center,
National Institute of Environmental Research, Korea
[3] Mechanical Design Engineering, Daejin University, Pocheon 487-711, Korea
[*]Corresponding Author: dsbaik@daejin.ac.kr

Abstract. NOx emission from diesel vehicles in real driving condition can be significant discrepancy from the values measured with in-laboratory method. NIER developed NIER driving mode in order to evaluate emission factor for Korean domestic vehicles. The emission factor for vehicles is the function of average vehicle speed. The driving mode for each average speed reflects acceleration and driving pattern, however, it is difficult to reflect the emission factor method since in real driving on road pattern of acceleration or deceleration and driving characteristics are appeared variously even in same vehicle speeds. This research aims to investigate NOx emission of real-time driving vehicle by applying MOVES method and compared the results with current vehicle emission factor. There are large deviation depending on urban, rural and motorway. In urban, the emission factor based on average speed is computed 20~40% lower than real-time NOx emission and the amount of NOx emission in motorway and rural road is estimated 17~33% and 6~25% lower than real-time NOx respectively.

Keywords: Light-duty Vehicle, Emission, NOx

1 Introduction

The emissions from automobiles were evaluated and certified by using mainly a chassis dynamometer or an engine dynamometer in-laboratory.

According to some reports of recent research and for examples, it was confirmed that there are significant discrepancy between amounts of air–pollution materials evaluated in a laboratory and in actual driving. In particular, the amount of nitrogen oxides in diesel vehicles certified in a laboratory have been reported considerable differences compared to emission quantity emitted from actual driving conditions. Furthermore the amount of NOx emission increased up to maximum 10 times in extreme conditions of air-conditioning or sudden acceleration driving.

NIER developed NIER driving mode in order to evaluate emission factor for Korean domestic vehicles. The emission factor for vehicles is the function of average vehicle velocity. The driving mode for each average speed reflects acceleration and driving pattern, however, it is difficult to reflect the emission factor method since in real driving on road pattern of acceleration or deceleration and driving characteristics are appeared variously even in the same vehicle velocity. EPA makes an effort to

ISSN: 2287-1233 ASTL

reflect emission characteristics in various real road driving conditions by improving emission evaluating system from MOBILE to MOVES. For this, EPA provides VSP (Vehicle Specific Power) and emission rate (mg/s). By dong these, there is an effect which can provide reconsidering flexibility in modelling emission prediction for vehicles. This research aims to investigate NOx emission of real-time driving vehicle by applying Moves method and compared the results with current vehicle emission factor.

2 Experimental Approach

MOVES method is applied in order to reflect emission characteristics of actual driving for light-duty diesel vehicles. Emission rate maps are computed by MOVES OP (Operating Mode) of EPA after analyzing emission data obtained by a chassis dynamometer. OP-Mode is determined by vehicle speed and vehicle specific power (VSP). The VSP is defined by engine power per vehicle weight. Thus, vehicle power can be represented by multiplication of total tractive forces and vehicle velocity. Vehicle power is required by the consideration of aerodynamics, rolling resistance, climbing resistance and initial resistance. VSP is considered as the most important factor which can affect emission characteristics in operation variables. Vehicle velocity is classified into three sectors, for example less than 40km/h, 40~80km/h and more than 80km/h. VSP is classified into 12 sections and reconstructed according to the characteristics of each acceleration section. OP-Mode consisted of 23 sections including idle and brake conditions. The total amount of emissions is estimated by the multiplication of emission rate mapping computed from Op-Mode and activity in driving areas. In Table 1, specifications of 8 test vehicles are shown.

In order to compare and total emission computed by applying MOVES method and total emissions computed by current emission factor, average speed and amount of emission per distance (g/km) are computed. Average speeds are divided into every 10km/h and average emission and emission factor are compared in the corresponding vehicle speed section.

Table 1 Main specification of test vehicle with chassis dynamometer

Vehicle ID	Fuel	Type	Engine Volume(L)	Emission Level
VO1	Diesel	SUV	2.2	EURO-5
VO2	Diesel	SUV	2.0	EURO-5
VO3	Diesel	SUV	2.2	EURO-5
VO4	Diesel	SUV	2.0	EURO-5
VO5	Diesel	SUV	2.0	EURO-5
VO6	Diesel	SUV	2.0	EURO-5
VO7	Diesel	Sedan	1.7	EURO-5
VO8	Diesel	Sedan	1.6	EURO-5

3 Experimental Results

Emission rate maps are computed by after analyzing real-time data obtained through the various driving modes from a chassis dynamometer. Fig. 1 depicts NOx emission rates (mg/s) with respect to operation modes for 8 test vehicles, 6 SUV vehicles and 2 sedan vehicles. By applying MOVES method emissions in real-time driving are classified by vehicle average velocity and amount of average emissions per driving distance are computed. Currently applying emission factor based on vehicle speed is constant regardless road types however, the amount of emissions can be computed according to various driving characteristics even in same average vehicle speed by applying MOVES method.

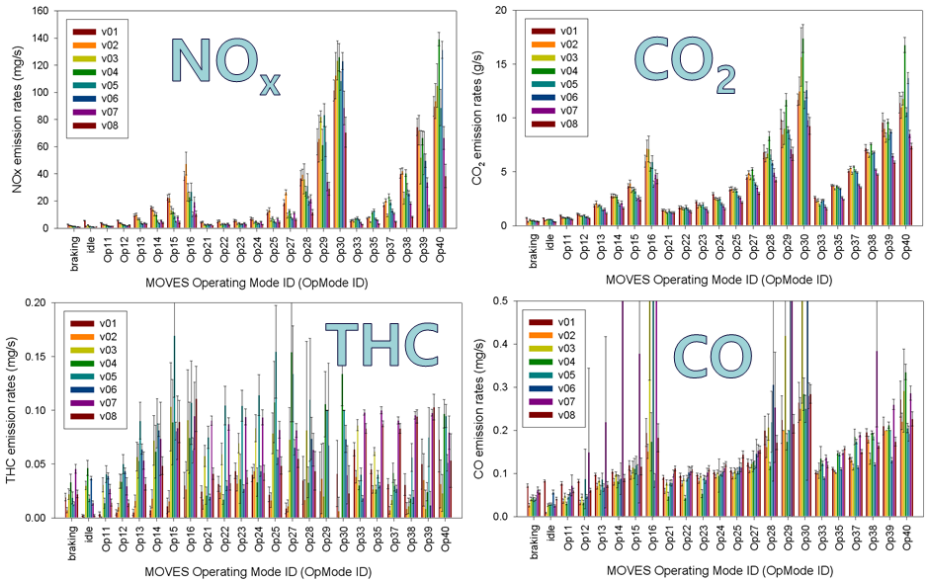

Fig. 1. Emission rate maps in OP-modes of MOVES

In Fig. 2, the amount of NOx emission in real-time average speed classified by road types for SUV and sedan vehicles are compared with NOx emission secured by applying emission factor method based on average velocity. The emission factor based on average speed is estimated 6~40% lower than real NOx emission. In urban, the emission factor based on average speed is computed 20~40% lower than real-time NOx emission and thus there are large deviation in urban area. The amount of NOx emission in motorway and rural road is estimated 17~33% and 6~25% lower than real-time NOx emission respectively.

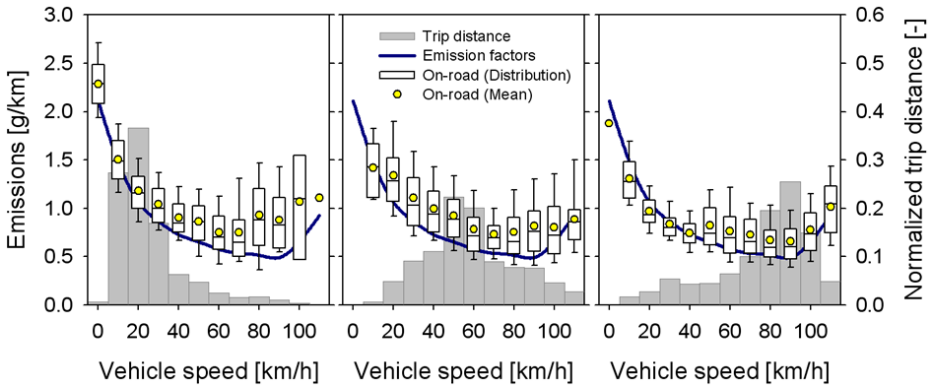

Fig. 2. Comparison of NOx emission estimated with MOVIES and Korean emission factor method

4 Summary

EPA MOVES method is applied in order to evaluate real-time NOx driving emissions, and then their amount of average NOx emissions were compared with average NOx emissions obtained from emission factor of NIER based on an average vehicle speed. In the method of current emission factors there is difficulty in reflecting various activity characteristics when it is applied to local area since current emission factor is evaluated by fixed activity based on average vehicle speed.

References

1. U.S. Environmental Protection Agency (EPA), (2011). Development of Emission Rates for Light-duty Vehicles in the Motor Vehicle Emissions Simulator (MOVES 2010), EPA-420-R-11-011.
2. Carslaw, D. C., Beevrs, J. E., Tate, J. E., Westmorel and Williams, M. L., (2011). Recent Evidence Concerning Higher NOx Emissions from Passenger Cars and Light-duty Vehicles, Atmos. Environment, 45, 39, pp. 7053-7063.
3. NIER (National Institute of Environmental Research), (2001). National inventories for air pollutants form transportation sector, Part 1: Development of laboratory driving cycles to derive average speed based emissions models for on-road vehicles, NIER.

