2B5) Speed-dependent Emission Characteristics of Air Pollutants from Gasoline Powered Passenger Cars Influencing Parameters

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1. Introduction

In Korea, the number of vehicles has been increased from about 1.1 million in 1985 to about 16.4 millions in 2007(KAMA, 2008). Air pollution from vehicles brought about by deteriorating air quality is very serious. Also around the world, road traffic is the dominant anthropogenic source of air pollution in urban area(Fenger, 1999). Since vehicle emissions are changeable according to model year, average vehicle speed, traffic conditions, annual mileage, and registration number, it is important to investigate the emission characteristics of air pollutants from vehicles.

In this study, in order to investigate the emission characteristics of air pollutants from gasoline powered passenger cars, 78 gasoline powered passenger cars, which are the most dominant vehicle type in Korea were tested to measure CO, CO_2, HC, and NOx. The emission characteristics based on average vehicle speed, mileage accumulation, and regulated model year was discussed. The correlation between CO_2 emissions and fuel consumption were investigated.

2. Experimental Method

2.1 Selection of Test Vehicles

Gasoline powered passenger cars which are the most dominant vehicle type in Korea were selected after considering vehicle registration percentage according to fuel type, vehicle type and model year. A total of 78 gasoline powered passenger cars were tested on the chassis dynamometer system ranging from small to large engine displacement.

2.2 Driving Conditions and Analysis Equipment

Vehicle speed 10 modes(4.7, 10.8, 13.4, 17.3, 24.6, 34.1, 46.4, 65.4, 79.6, 97.3km/h) and CVS-75 mode were used. The vehicle speed modes and CVS-75 mode that have been used to develop emission factors and to regulate for light-duty vehicle in Korea. The exhaust gas from vehicles was tested on the chassis dynamometer system which consists of chassis dynamometer, driver aid, constant volume sampler(CVS), dilute tunnel and exhaust gas analyzer etc. The measurement of exhaust gas was analyzed after exhaust gas from tailpipe was diluted by constant ambient air at constant volume sampler(CVS) when driving on the chassis dynamometer.

3. Results and Discussion

The results show that CO, CO_2, HC, and NOx emissions decrease with increase of vehicle speed over vehicles (model year 2000-2002.6). CO, CO_2, HC, and NOx emissions=28.471(vehicle speed)$^{-0.9077}$, R^2=0.97, 1,269.6(vehicle speed)$^{-0.4969}$, R^2=0.93, 5.478(vehicle speed)$^{-1.2133}$, R^2=0.95 and 1.844(vehicle speed)$^{-0.4123}$, R^2=0.83, respectively(see figure 1).

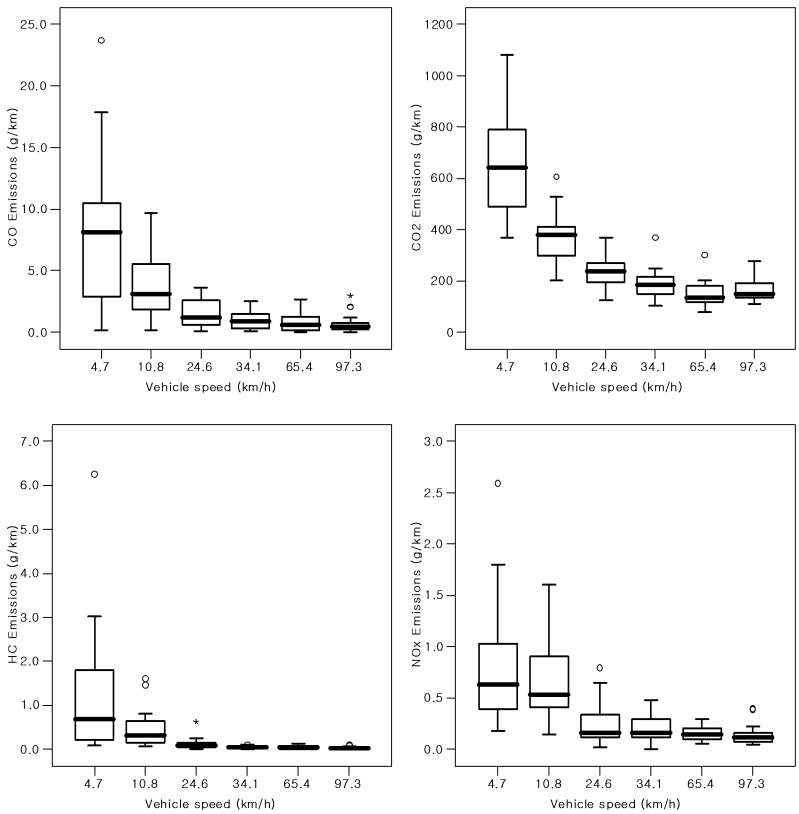

Fig. 1. CO, CO_2, HC, NOx emission characteristics by average vehicle speed(2000-2002.6 model year).

The correlation between CO, CO_2, HC, and NOx emissions and catalyst aging was examined. It found that vehicles with aged catalyst with ≥ 80,000km emit more CO, HC, and NOx emissions than those with new catalyst with < 80,000km. CO, HC, and NOx emissions from vehicles with ≥ 80,000km have 44-78%, 53-86%, and 72-81% more than those from vehicles with < 80,000km, individually. But in case of CO_2, there are almost no difference between emissions from vehicles with ≥ 80,000km and < 80,000km.

Figure 2 shows the comparison with the fuel consumption and CO_2 emissions. The figure shows linear relation between these values. CO_2 emissions are strictly related to fuel consumption. Wojciech Gis & Piotr Bielaczyc, 1999 reported R^2=0.9708 between CO_2 emissions and fuel consumption also, in this study is similar to those results. CO_2 emissions from gasoline powered passenger cars emitted by fuel combustion. For that reason, CO_2 emissions increase with increase of fuel consumption.

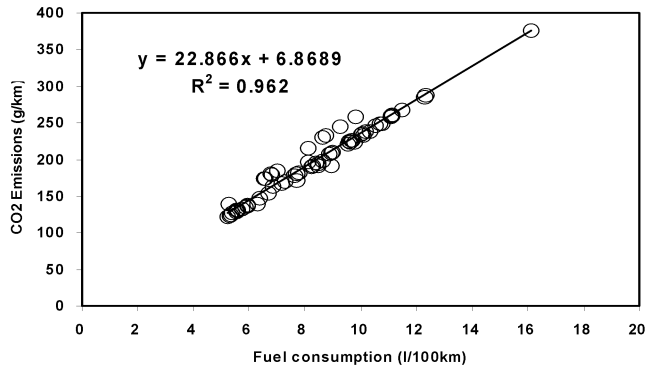

Fig. 2. Influence of the fuel consumption(FC) and CO_2 emissions for gasoline powered passenger cars.

In figure 3, CO_2 emissions are reported on the CVS-75 mode which has been used for testing new vehicles for gasoline powered passenger cars as a function of the vehicle gross vehicle weight. As expected there is a trend of increased CO_2 emissions with increasing vehicle weight(Sullivan et al., 2004). CO_2 emissions increase with increase of gross vehicle weight because the more vehicle weight is heavier, the more fuel consumption is worse.

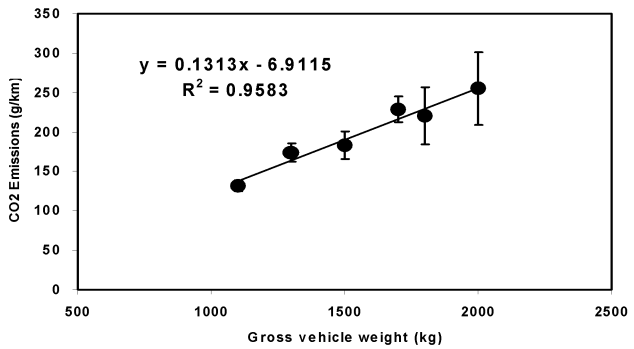

Fig. 3. CO_2 emissions according to gross vehicle weight.

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