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Development of real exhaust emission from passenger cars in Algeria by using on-board measurement

Rabah Kerbachi[a,*], Saâdane Chikhi[a,b], Ménouèr Boughedaoui[a,b]

[a]*Laboratoire des Sciences et Techniques de l'Environnement, Ecole Nationale Polytechnique, 10 Avenue Hacène Badi, El-Harrach, Algeria*
[b]*Faculté de Technologie, Université de Blida 1, Algeria*

Abstract

On-board measurements of unit emissions of CO, HC, NO_x and CO_2 were conducted on a sample of 17 private cars with different fuels, dual gasoline and LPG, single gasoline and diesel. The 298 tests have shown the effect of LPG injection technology on unit emissions and allowed to compare emissions to Artemis European model. Except for NOx, sequential multipoint injection LPG kit, without catalyst installed is the most efficient for all other pollutants. Particular test results on a subsample of LPG vehicles have shown that LPG fuel alone cannot compete with catalyzed gasoline and diesel vehicles. The advantages of LPG are quickly lost facing the high development of either gasoline or diesel engine technology and catalytic converter. LPG performance seems to be lower under real driving conditions than expected on chassis dynamometer.

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Keywords: Diesel; gasoline; LPG; on-board measurement; pollutant; unit emission; vehicle

1. Introduction

Measurements of unit emissions are typically performed on chassis dynamometer. This methodology requires a driving standardized cycle which is not representative of real traffic conditions. Researchers tend to consider emission of vehicles in real traffic as more representative for environmental studies purposes [1]. It has been noticed

* Corresponding author. Tel.: +213556273082
E-mail address: r_kerbachi@yahoo.fr

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that emissions are rather underestimated on chassis dynamometer measurements compared to on board techniques. Emissions obtained in real traffic compared to those on chassis dynamometer for almost all pollutants are higher at least 60% and 30% for diesel and gasoline vehicles respectively. NO_x emissions in real traffic are found to be 2 to 4 times higher than emissions measured on NEDC standardized European cycle [2]. Weiss [3] has shown that emissions from chassis dynamometer underestimate by 10 to 50% real CO_2 emissions to those measured with a PEMS (Portable Emission Measurement System).

However, very few on-road measurements of LPG fuelled passenger cars are performed in real driving conditions to evaluate environmental performance of LPG fuel [4]. Vehicle with LPG is found to have an abatement of 14% for CO_2 measured on a chassis dynamometer and of 71%, 89% respectively for CO and total hydrocarbons (THC) [5].

The purpose of this paper is to present the unit emissions from gasoline, Diesel and LPG fueled vehicle measured with an on-board system called mini CVS [6] in real traffic conditions on a sample of 17 vehicles. Such measurements reflect vehicles emissions considering real conditions of use in Algeria.

2. Methodology

The methodology is based upon sampling of pollutants along the route with a mini-CVS embarked on board each tested vehicle. This technique was tested and validated by INRETS (France), and used by several teams. The mini-CVS sampling system is a reduced and simplified version of the CVS system. The emitted exhaust gas passes through a conical nozzle attached to the exhaust pipe composed of 112 parallel tubes assuming to deliver equal flows. Only gases from one tube are taken to the diluted chamber with ambient air and then collected in Tedlar bags. Analysis of CO and CO_2 was performed by IR-absorption, using a COSMA-Environment SA. NOx were analyzed by chemiluminescence. THC were determined by flame ionization detection (FID).

The vehicle sample is made of 6 gasoline fueled, 4 diesel and 7 dual gasoline/LPG (table 1). The LPG vehicles are composed of 4 vehicles equipped with multi-point injection kit and 3 with sequential multipoint fuel injection. The vehicle sample is supposed to be representative of car fleet in terms of brand, engine size and age.

Table 1. Characteristics of the tested vehicle sample

Brand	Model	Fuel	Year	Engine capacity (cm^3)	Power (kW)	Catalyst	Mileage (1000 Km)
Volkswagen	Golf	Gasoline	1989	1300	40	Without	n.a
Toyota	Yaris Sedan	Gasoline	2008	1298	78	Without	110
Toyota	Yaris Sedan	Gasoline	2011	1298	78	Without	9
Chevrolet	Aveo	Gasoline - LPG	2004	1498	63	Without	179
Chevrolet	Aveo	Gasoline - LPG	2006	1498	63	Without	145
Chevrolet	Aveo	Gasoline - LPG	2007	1498	63	Without	61
Chevrolet	Aveo	Gasoline - LPG	2008	1498	85	Without	28
Chevrolet	Optra	Gasoline-LPG	2010	1598	79	Without	30
Chevrolet	Aveo	Gasoline- LPG	2010	1498	63	Without	67
Toyota	Echo	Gasoline	2004	1497	79	Without	82
Renault	Clio	Diesel	1998	1870	48	Without	405
Dacia	Logan	Gasoline	2006	1400	55	With	82
Renault	Scenic	Diesel	2002	1870	77	With	25
Toyota	Corolla	Diesel	2004	1995	85	With	177
Ford	Fiesta	Diesel	2010	1398	50	With	29
Renault	Symbol	unleaded Gasoline	2009	1390	55	With	5
Renault	Symbol	unleaded Gasoline LPG	2011	1390	55	With	10

n.a: not available

Road circuits were selected on the basis of several kinematic measurements made by using a chase vehicle within