Transportation Research Part D 44 (2016) 14–29

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

Tailpipe emission from petrol driven passenger cars ☆

Abhinav Pandey [a,1], Govind Pandey [b,2], Rajeev Kumar Mishra [c,*]

[a] Engineering Manager (Civil) – EDRC, Larsen & Toubro Construction, Delhi 110 065, India
[b] Civil Engineering Department, Madan Mohan Malaviya University of Technology, Gorakhpur 273 010, India
[c] Environmental Engineering Department, Delhi Technological University, Delhi 110 042, India

ARTICLE INFO

Article history:
Available online 27 February 2016

Keywords:
Compliance period
Inspection/maintenance programme
MUL
Tailpipe emission
Vehicle-related parameters

ABSTRACT

Realizing the dominance of petrol-driven passenger cars of MUL over the fleet of cars in India, a case study of different models of petrol-driven passenger cars of Maruti reporting at an authorized service station of M/s R.K.B.K. Automobiles, Gorakhpur was taken up and the tailpipe emissions along with individual vehicle-related parameters were monitored for idle and fast idle test conditions. The outcome of the study relating to the effect of various vehicle-related parameters on CO and HC emissions of petrol-driven passenger cars of Maruti has led to the useful inferences, which can be used not only for predicting the emission of vehicles with respect to vehicle age and mileage, but also for automobile manufacturing sector to help them produce such environmentally benign petrol-driven passenger cars having long-lasting compliance of pollution control systems with respect to vehicle age and mileage of the petrol-driven passenger cars in the country.

Introduction

Most of the Indian Cities are experiencing rapid urbanization and the majority of the country's population is expected to be living in cities within a span of next two decades. The rapid urbanization in India has also resulted in a tremendous increase the number of motor vehicles imposing a serious effect on human life and its environment in recent years – what is being referred to as Urban Air Pollution (UAP) in the context of ever-expanding urban areas.

According to Census reports, the urban population has increased from 10% in 1901 to 28% in 2001. And ever-increasing, the urban growth rate is running at 31.8% i.e., almost three times higher than rural areas in 2011 (Census, 2011). The World Health Organization (WHO) has estimated that in developing countries, increasing UAP has resulted in more than 2 million deaths per annum along with various cases of respiratory illnesses (WHO, 2005, 2014). It is reported that over 70–80% of air pollution in mega cities in developing nations is attributed to vehicular emissions caused by a large number of older vehicles coupled with poor vehicle maintenance, inadequate road infrastructure and low fuel quality (Auto Fuel Policy, 2002; Badami, 2005; Singh et al., 2007; Wang et al., 2010). Among the criteria pollutants, CO is the major pollutant coming from the transport sector, contributing 90% of total emission. Hydrocarbons are next to CO. It is indeed interesting to observe that the contribution of transport sector to the particulate pollution is as less as 3–5%, most of the SPM (Suspended Particulate Matter) are generated due to re-suspension of dust out of which PM_{10} is the most prominent air pollutant.

☆ *Capsule:* The study finds that vehicle age & mileage parameters are directly proportional to tailpipe emission from petrol driven passenger cars.

* Corresponding author. Tel.: +91 8800486298; fax: +91 11 27871023.
E-mail addresses: navabhigkp@gmail.com (A. Pandey), pandey_govind@rediffmail.com (G. Pandey), rajeevctrans@gmail.com (R.K. Mishra).
[1] Tel.: +91 11 49135310/400.
[2] Tel.: +91 511 2272272.

http://dx.doi.org/10.1016/j.trd.2016.02.002
1361-9209/

Table 1
Vehicle model and model codes.

S. No.	Vehicle code	Vehicle model	Idle RPM (Designated)	Fast idle RPM
1.	MB	M-800	710	2200–2800
2.	MRF	M-ALTO (Lx/Vx)	710	2200–2800
3.	MT	M-OMNI	710	2200–2800
4.	MH	M-ZEN (Lxi/Vxi)	810	2200–2800
5.	MRD	M-WAGON R	820	2200–2800
6.	ME	M-ESTEEM	850	2200–2800

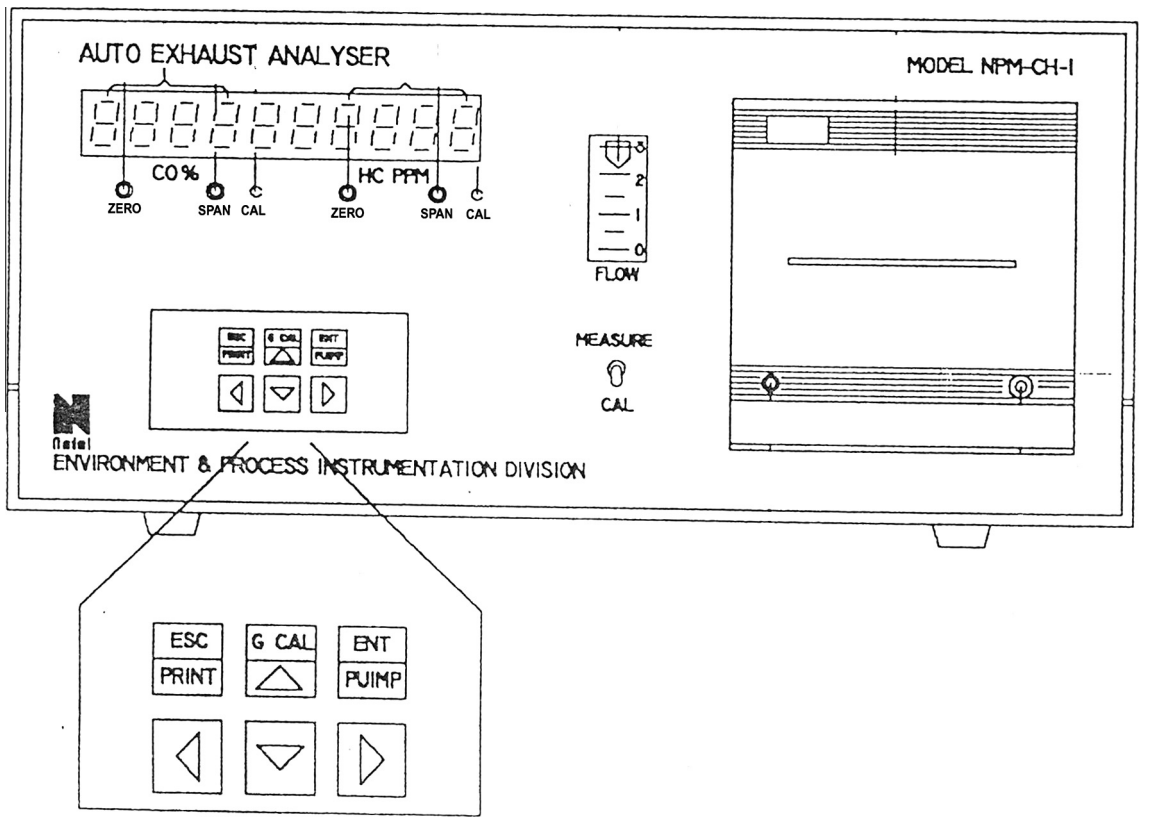

Fig. 1. Front views of the auto exhaust analyzer.

In an effort to improve air quality resulting from the transport sector, various pollution control strategies have been adopted or proposed worldwide for urban passenger transport. These measures generally include travel demand control, cleaner fuel standards, upgraded engine technology and stricter mandates on motor vehicle emissions (Bogdanovic et al., 1997). An important part of motor vehicle emission control relies on implementing a proper inspection and maintenance (I/M programme), since it is the best way to identify vehicles that need remedial maintenance or adjustment (Walsh, 1994). Engine maintenance has been shown to be the most significant parameter affecting the level of emissions (Pattas et al., 1994). In a typical I/M program, motorists are required to get their vehicles periodically inspected for exhaust emissions. A vehicle with malfunctioning emission controls or excessive exhaust pollution may or may not be repaired. In the case of repair, the vehicle should be retested to determine the post-repair emission rate. In case the vehicle is not repaired the motorist should pay an emission fee (Harrington et al., 1996, 2000). In major cities of India, there exists a mandatory system for inspection and maintenance in conformance to which every commercial vehicle has to go for a mandatory fitness test. The renewal period for fitness certification in general, is 2 years for new commercial vehicle and every 1 year for old vehicles. For private vehicles, no mandatory periodic fitness check is required in India but there exist a system of re-registration of private vehicles after 15 years of initial registration. But all in-use vehicles are required to obtain emission check certificate called Pollution Under Control (PUC). Frequency of this PUC certification varies from 2 to 4 times a year which is issued based on conformity to idle emission test for gasoline vehicles and free acceleration smoke test for diesel vehicles and is required to be carried out using authenticated Auto-exhaust gas analyzers only (CPCB, 2010).