

Accepted Manuscript

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PII: S2210-6707(17)30728-X
DOI: <https://doi.org/10.1016/j.scs.2017.09.034>
Reference: SCS 788

To appear in:

Received date: 28-6-2017
Revised date: 24-9-2017
Accepted date: 27-9-2017

Please cite this article as: Pouresmaeili, Mohammad Amin., Aghayan, Iman., & Taghizadeh, Seyed Ali., Development of a Mashhad driving cycle for passenger car to model vehicle exhaust emissions calibrated using on-board measurements. *Sustainable Cities and Society* <https://doi.org/10.1016/j.scs.2017.09.034>

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Development of a Mashhad driving cycle for passenger car to model vehicle exhaust emissions calibrated using on-board measurements

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Highlights

- A driving cycle for passenger car was developed.
- The driving cycle on arterial roads in Mashhad, Iran was compared with standard driving cycles in Europe and America.
- Exhaust emission factors were obtained with on-board measurements.
- The estimated vehicular exhaust emission factors for Mashhad were compared with those for Beijing, Pune and Mexico.

Abstract

The increase in the number of vehicles causes the air pollution in cities to be increased. Thus, evaluation of the actual level of traffic emissions has gained more interest. Driving cycle is one of the most important parameters affecting exhaust emissions. In this study, driving cycle on arterial roads in Mashhad, Iran was compared with standard driving cycles in Europe and America. After development of the driving cycle, vehicle exhaust emissions were estimated by the international vehicle emissions (IVE) model. In order to correct the emissions obtained from the model, on-board vehicle emissions were obtained. The emission factors estimated for Mashhad were compared with those reported for Beijing, Pune and Mexico. The speed-time data of vehicle was obtained in two weeks for two different routes. The driving cycle showed the average speed in Mashhad was significantly different with that in the European and American driving cycles. The results of the model showed CO in vehicle exhaust constituted the most emission of criteria pollutants. Moreover, ammonia and benzene were the main toxic gases in vehicle exhaust, respectively. By considering the vehicle exhaust emission factors, CO produced in Mashhad was 10.5, 30.69 and 25.67 % more than Pune, Mexico and Beijing, respectively.

Keywords: Arterial roads; Driving cycle; Driving patterns; Exhaust emission factors; Microtrip.

1. Introduction

According to World Health Organization (WHO) statistics, about 7 million people are dying prematurely each year due to air pollution. In general, it can be said that the impact of any pollutants on human health is dependent on the concentration and duration of emission production (WHO, 2014). Iran's Environmental Protection Agency uses the US environmental protection agency (EPA) standards to calculate short-term exposure of pollutants. The transportation sector is the largest contributor to carbon monoxide emissions in large cities so that the amount of carbon monoxide is increased with increasing numbers of vehicles in urban areas (EPMC, 2016). According to WHO, the annual production of carbon monoxide in the world is roughly equivalent to 2,600 million tons per year of this, 60% is produced by human activities. Several parameters affect the emission of air pollutants including speed, geometric design of routes, volume, flow and driving cycle. Based on changes in vehicle speed and acceleration, environmental engineers calculate the amount of pollutants produced in urban streets.

There are generally three steps in the development of a driving cycle: route selection, data collection, and cycle construction. Driving cycle is a standard pattern of vehicle movement in each region or city and is introduced using speed-time graph. A standard driving cycle involves a wide range of users. Traffic engineers use driving cycle for traffic

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