Development of an Economic Driving Cycle for Motorcycles and Estimate Emission

Prasad Wijekoon [1] and Loshaka Perera [2]

Abstract

It is estimated that the transportation sector is responsible for almost a quarter of global energy consumption. When fossil fuels are burned, they release high amounts of greenhouse gases (GHG) which have a severe impact on the environment and humans. Since the number of vehicles is growing rapidly, control of such fuel combustion is essential. Therefore, new policies are to be formulated, especially in developing countries. In developing countries like Sri Lanka, motorcycles (MC) are a popular mode of transportation due to their economic implications. This study looks at how an MC operates under various traffic conditions in Sri Lanka and the content of combustion gases emitted to propose emission policies. For this purpose, the driving cycle for the motorcycle was developed in the first stage. A Driving Cycle (DC) is a speed-time profile, and it represents the driving characteristics of a selected region. DCs is widely used to estimate transport air pollutants and for building emission inventories. Thus, knowledge of the driving cycle is essential for the evaluation of exhaust emissions. Driving Cycles can be used for different purposes, such as setting up emission standards and determining the behaviour of the driver and the traffic condition of the selected route. As driving cycles are dependent on the driver's behaviour, mode of transportation, traffic condition, and road conditions factors, existing driving cycles developed for other vehicle types in Sri Lanka or developed for MCs in other countries cannot be used in Sri Lanka because they are different due to above said reasons. One of the main objectives of this study is the development of a driving cycle for motorcycles. For this study, the most popular types of motorcycles ranging from 100cc to 150cc engine capacities, were used. Motorcycles with these engine capacities were more suitable for this study as they are widely used in major cities as well as sub-major cities of the country. For this study, driving data is collected by motorcycle riders who are frequently riding the motorcycle in urban and suburban areas using a handheld GPS device. During the data collection, special attention is paid to the peak times because the traffic is significantly higher during such times, and thus the amount of combustion gases emitted is also high. This GPS-based data collection is more economical than other methods of collecting data for the driving cycle development. The collected data was filtered and removed the unusual characteristics were by using python code, and after that, data was divided into micro trips, including idle time. Micro trip-based cycle development is suitable for developing a driving cycle to estimate emissions. The micro trips thus created are randomly attached to create several candidates driving cycles. From those driving cycles, the best-representing driving cycle is selected by comparing the Speed Acceleration Frequency Distribution (SAFD) graph. The final DC selected has an average speed of 27.26 km/h, an average running speed of 35.31km/h, an average acceleration of 0.284ms$^{-2,}$ and an average decelerate of 0.2846ms^{-2}. Since there are no facilities in Sri Lanka to run the DC developed on a chassis dynamometer to measure the respective emissions, an approximate method was used in this study by referring to similar studies carried out elsewhere. Based on such comparison, the proposed emission factors for motorcycles are CO 0.5-3.0g/km and HC

0.25-0.4g/km for Sri Lankan conditions. These threshold values are suitable for setting up new emission standards for MCs in Sri Lanka or, in other words setting up local emission goals and adopting a carbon tax for MCs. On the other hand, these policies may encourage users to invest in low-carbon transport modes. It can save fuel by performing periodic emission tests for motorcycles and removing or restoring the engines. It helps to minimize fuel and energy wastage.

Keywords: *Motorcycle, Driving Cycle, Emission, Policy*

Authors Details;

1. Undergraduate Student, Department of Civil Engineering, Faculty of Engineering, University of Moratuwa. prasad.lakman@gmail.com

2. Senior Lecturer, Department of Civil Engineering, Faculty of Engineering, University of Moratuwa. loshakap@uom.lk