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REAL-ROAD DRIVING AND FUEL CONSUMPTION CHARACTERISTICS OF PUBLIC BUSES IN SOUTHERN CHINA

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ABSTRACT–In this paper, the annual data of 40 public buses fueled with diesel in four cities in southern China have been analyzed for investigating the driving and fuel consumption characteristics. Results showed that the best traffic condition and smoothest driving style were obtained in Fuzhou, which was exact opposite to the results in Wuhan. And the driving characteristics of each city was weakly affected by the season's variation. The fuel consumption characteristics of the public buses in different cities were studied by the method based on VSP (Vehicle Specific Power) model, and the fuel consumption factors in different cities and seasons have been given. The main factors influenced the fuel consumption characteristics could be summarized by the variations of driving characteristics and air conditioning using. The high fuel consumption was concentrated in region with low vehicle velocity range of 0 ~ 10 km/h, and the proportion of this vehicle range directly affected the average fuel consumption level. The effect of the air conditioning using on fuel consumption was especially obvious in summer and winter, and the using of air conditioning would increase about 10 % of the total vehicle fuel consumption.

KEY WORDS : Public buses, Real-road, Driving characteristic, Fuel consumption characteristic, Vehicle specific power (VSP)

1. INTRODUCTION

The rapid growth of the vehicle population has brought great challenges for air quality, energy security and urban traffic. In order to solve the above problems, developing public transportation is one of effective methods which has been applied in many prefecture-level cities in China, and public bus is an important part of the public transportation (Zhang *et al*., 2014; Kadiyala and Kumar, 2016; Yang *et al*., 2017). Because of the most of the public buses are propelled by diesel engine and drive frequently throughout the day in the urban area, the emissions from the public buses should receive much attention (Yu and Li, 2014; Song *et al*., 2015).

As the technology develops, the regulation testing fuel consumption of the heavy-duty commercial vehicles including public buses decreased rapidly, however, several investigations showed that fuel consumption in real-road driving conditions decreased much slower, and the gap between these two fuel consumption levels is enlarging with years. The real-road fuel consumption is greatly affected by various driving characteristic parameters including driving velocity, acceleration, deceleration and so on. In addition, load set and air conditioning using which influenced the engine operating condition also have impact on combustion and emission characteristics (Zhang *et al*., 2011; Fahd *et al*., 2013; Fontaras *et al*., 2017). These impacts from the real-road conditions could lead to significant uncertainties in fuel consumption and CO_2 emissions of China's on-road public buses (Ou *et al*., 2012; Wu *et al*., 2012), so that, further research on real-road driving and fuel consumption characteristics of the public buses is needed to develop effective fuel consumption and emission control strategies.

For the investigation of evaluating the real-road vehicle fuel consumption characteristics, the method based on VSP (Vehicle Specific Power) model is more and more popular. The concept of VSP was first proposed by Jimenez (1998), which was a function of vehicle velocity, acceleration, deceleration and road slope. VSP was defined as the engine power required to offset vehicle acceleration, wind, rolling and road slope resistances, and could better connect instantaneous driving state, required engine power and fuel consumption together. Frey *et al*. (2008) and Zhai *et al*. (2008) had established the relationship functions between the VSP and fuel consumption factors, which was used to standardize the comparisons of fuel consumption characteristics among different vehicles and routes. In particular the public buses investigations, Wang *et al*. (2018) developed a VSP model based on PEMS (Portable

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