Environmental Engineering and Management Journal xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

RESEARCH ON THE TRANSIENT DISTRIBUTION CHARACTERISTICS AND THEIR FORMATION MECHANISMS OF ACTUAL FUEL CONSUMPTION AND EMISSIONS OF HEAVY DUTY DIESEL VEHICLE ON MOUNTAIN CITY ROAD

Gangzhi Tang[1*], Dong Liu[1], Shuaibin Wang[2], Jiajun Liu[1], Yuxian Luo[1], Xuefei Deng[1]

[1]College of Mechatronics and Automotive Engineering, Chongqing Jiaotong University, Chongqing 400074, PR China
[2]Environmental Protection and Health Test & Evaluation Research Center, China Automotive Engineering Research Institute Co., Ltd., Chongqing 401122, PR China

Abstract

The actual driving of heavy vehicles on mountain city roads with complex and variable slopes is influenced by multiple factors, making their fuel consumption and emission characteristic more intricate. Statistical correlation analysis methods cannot fully explain the formation mechanisms of these characteristics; therefore, it is proposed to conduct multi-factor collaborative analysis from a microscopic instantaneous perspective on test results. This method can simultaneously consider the impact of various factors on each test data, showing potential for successfully deciphering these complex formation mechanisms. So, real driving emission test on heavy vehicles under mountain city roads and multi-factor collaborative analysis on test data were conducted to reveal these formation mechanisms. Results show that method of the proposed multi-factor collaborative analysis successfully uncovered these formation mechanisms. Speed, slope and acceleration alter load through air resistance, rolling resistance, slope resistance and acceleration resistance, respectively, which collectively determine the distribution characteristics of fuel consumption, CO_2 and CO emission. Impact of acceleration on fuel consumption is less pronounced compared to the others, but it increases the instantaneous fluctuations in fuel consumption. Significant acceleration and deceleration behaviors tend to occur at steep slopes, exacerbating change in CO_2 and CO. Rapid acceleration and high speed driving on steep slopes both lead to rich combustion conditions, increasing CO. This results in a greater transient change in CO compared to CO_2. Speed and acceleration cause high temperature and rich combustion through increasing load, thus increasing NO_X and PN. Additionally, temperature affects efficiency of post-treatment devices, significantly impacting NO_X.

Key words: formation mechanism, heavy-duty diesel vehicle, mountain city road, real driving emission, transient distribution characteristics

Received: December, 2024; Revised final: October, 2025; Accepted: November, 2025

* Author to whom all correspondence should be addressed: e-mail: 990201400028@cqjtu.edu.cn; Phone: +86 13658340960