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ENGINE AND EMISSIONS, FUELS AND LUBRICANTS

Load Factor Characteristics of 200 kw Class Excavators in Real-Work Operation Mode

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Abstract
To improve emissions inventory, design a real-work operation mode that simulates the operating characteristics of an excavator. The test was conducted at a specialized construction machinery test site to maintain constant operator and soil conditions. Engine speed and actual engine percentage torque were obtained from the onboard diagnostic terminal through a data acquisition device. In Korea, a fixed LF of 0.48 is uniformly applied to all construction machinery. However, it may not be entirely reasonable to use this LF for construction machines performing a variety of tasks. In practical operation tests conducted on two excavators, the LF was measured as 0.426 and 0.47, demonstrating that the fixed LF may not always be applicable. By implementing an LF that is subdivided for each specific type of construction machine, the error in emission calculations could potentially be reduced by 2% to 12%.

Keywords Construction machinery · Excavators · Engine load factor · Onboard diagnostics · Real-work operation mode

Abbreviations

HP	Average rated power, kW
EF	Emission factor, g/kWh
LF	Load factor
P_c	Engine power, kW
P_w	Rated power, kW

1 Introduction

The indiscriminate emission of pollutants is causing serious concerns regarding global warming and environmental pollution. Every country is taking steps to reduce greenhouse gas emissions and air pollutants. Accurate estimation of air pollutant emissions and identification of their sources are crucial to achieving this goal (Kim, 2023). Air pollutant emission calculations are essential as they help quantitatively analyzing the reduction in emissions and the amount of pollution reduced by implementing environmental policies.

In Korea, the Ministry of National Air Emission Inventory and Research Center used the Clean Air Policy Support System (CAPSS) to determine the levels of nine air pollutants (TSP, PM-2.5, PM-10, SOx, NOx, VOCs, NH_3, CO, and BC) emitted by 13 different types of sources. According to the CAPSS 2020 sector-specific emission statistics, non-road transportation consisting of aviation, ships, railways, agricultural machinery, and construction machinery has the highest emissions, 617,704 tons. Therefore, improving the accuracy of emission calculation formulas, particularly for non-road parts, is crucial to establishing effective policies for reducing air pollutants. The equation for calculating the emissions of construction machinery among current non-road mobile machinery pollutants can be obtained using Eq. (1) (National Air Emission Inventory & Research Center, 2020)

$$E_{ij}(\mathrm{kg}) = N_j \times H_j \times \mathrm{HP} \times \mathrm{DF} \times \mathrm{LF} \times \mathrm{EF}_{ij} \times \frac{1}{10^3}, \tag{1}$$

where N_j is the number of registered construction machinery type 'j', H_j is the operating time of construction machinery

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