

Exhaust Emission Characteristics according to Load Factor of Construction Machinery in Real-work Mode

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Introduction & Goals

- The South Korean government established the Comprehensive Plan for Managing PM (2020-2024) that sets goals for domestic air pollutant emissions reduction, strengthening of international cooperation, public health protection, policy planning, and public awareness-raising.
- Non-Road Excavators are representative construction machines used in urban areas. Particulate matter (PM) is a environmental problem in downtown areas.
 - ✂ Goals : Improvement of **Load Factor** and **Emission Factor** using **Real-work mode**

KOREA CAPSS Equation

$$E_{ij}(kg) = N_j \times H_j \times HP \times DF \times \boxed{LF \times EF_{ij}} \times 1/10^3$$

Population, Activity(h/y), Power(kW), Deterioration Factor, Load Factor, Emission Factor (g/kWh)

* CAPSS(The Clean Air Policy Support System) is a comprehensive emission information system based on the Air Pollutants Emission Inventory.



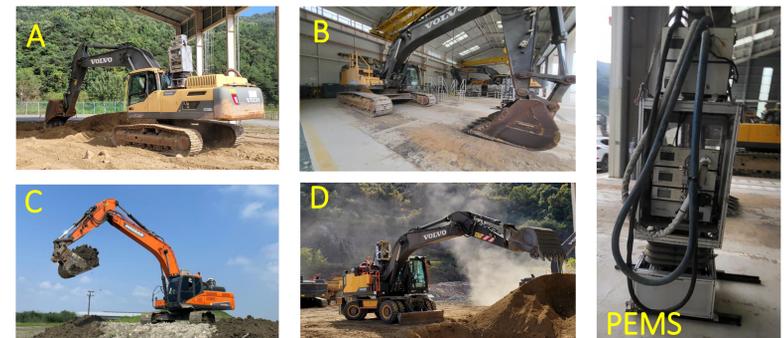
Methodology

- Standardized test modes including Four working modes(Digging, Leveling, Driving, Idle) are configured to eliminate bias in test results

Work	Engine Speed		Time Ratio		WF
	Work	Operation	Work	Operation	
Digging	A	Low RPM	50%	20%	10.0%
	B	Middle RPM		60%	30.0%
	C	High RPM		20%	10.0%
Leveling	A	Low RPM	25%	20%	5.00%
	B	Middle RPM		60%	15.00%
	C	High RPM		20%	5.00%
Driving	E	Middle RPM	10%	80%	8.00%
	F	High RPM		20%	2.00%
Idle	I	800 ~ 900 rpm	15%	100%	15.00%
					100.0%

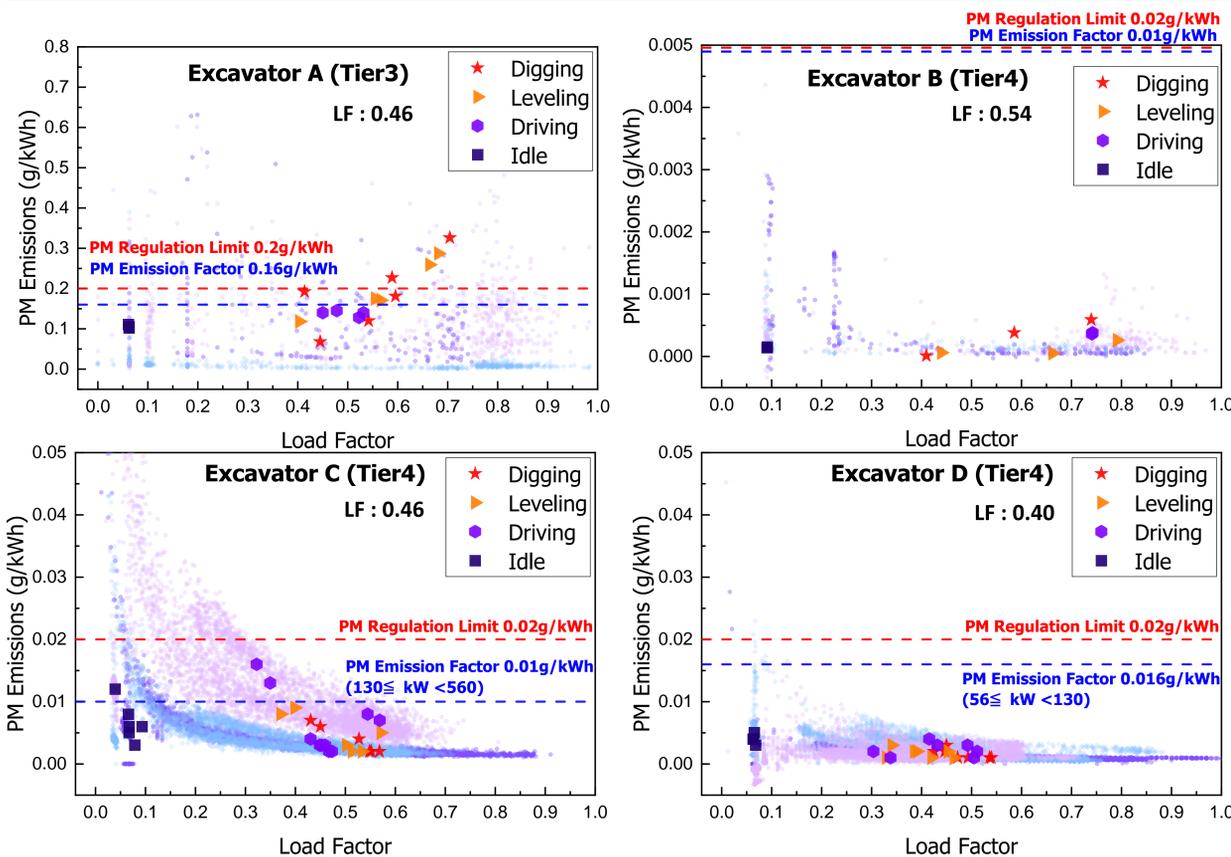
Test Excavator and Measuring Device

- To minimize the impact of the environment, the test is conducted at the construction machinery test site
- Measure PM, NO_x, CO emissions using PEMS(SEMTEC)
- Engine OBD data (power, torque, speed) were collected through an engine CAN communication device

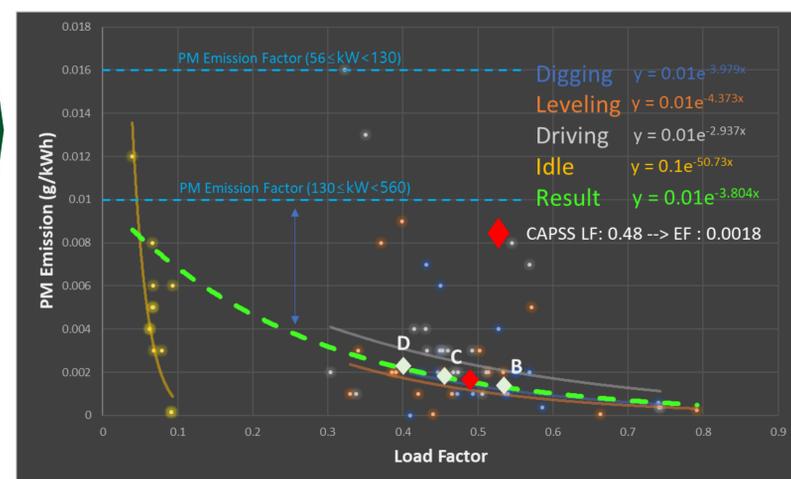


Excavator	Engine (L)	Rated power (kW)	Certification	After-treatment
A (32t)	7.8L	210/1800	Tier-3	DOC, DPF
B (38t)	12.8L	226/1700	Tier-4	DOC, DPF, SCR
C (32t)	8.0 L	202 / 1800	Tier-4	DOC, SCR
D (15.4t)	6.0 L	129.3 / 1900	Tier-4	DOC, DPF, SCR

PM Emissions Result



Tier4 Excavator EF Conclusions



< Emission Factor Expressed by Formula >

- The total emission factor of the three excavators tested is expressed as a formula to indicate the emission factor characteristics according to the Load Factor. As a result emission factor changes exponentially according to the load factor.
- By applying the emission factor that changes according to the load factor, accurate emission calculation is possible.

✂ Acknowledgement

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