講演番号 | 351

文献番号 | 20225351

Effect of ambient temperature on fuel economy and emission performance of some gasoline hybrid vehicles (Second report)

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KEY WORDS: **Environment・energy・resources. Emission/emission gas, Fuel Economy,** Effect of Ambient Temperature[D2]

Four gasoline hybrid passenger vehicles with small motor output (10kW or less) were examined with a chassis dynamometer equipment under some ambient temperature conditions like 266K, 273K, 296K and 308K. Tested were two mild hybrid vehicles with 1.9 or 2.3 kw motor output and two strong hybrids with 10kW motor output as shown in Table1. Driving cycles adopted are Low, Middle, High and extra High phases in WLTC and three phase (Low, Middle, High) and four phase (Low, Middle, High, extra High) were used for each vehicle test under cold start and hot start conditions. Measurement of fuel economy, emission gases, weight of particulate matter and its size distribution, and solid particle number concentration was carried out. Carbon contents (Elemental/Organic), ions and elements of samples captured from dilution tunnel were analyzed.

Mild hybrid vehicles just became internal combustion engine vehicles with only small but unnecessary weight when they were used under low ambient temperature like 266K or 273K. On the other hand, each strong hybrid vehicle used its motor to assist engine output or to drive itself only with electric power under low temperature condition.

While vehicle performance when ambient temperature is 308K was similar to that in 296K, those in low ambient temperature showed around 20% bad fuel economy and more emission of gaseous and particulate matters. It was found that some hybrid vehicles emitted more gases in low temperature condition than emission control standards.

As for emission of particulate matter, particles with the diameter of around 100nm showed large increase under cold start condition in low ambient temperature (Fig.1), while those with the diameter of around 10nm were highly emitted under extra High phase despite of different ambient temperature (Fig.2).

According to the analysis of carbon contents in samples captured, large portion of particles emitted under cold start condition in low ambient temperature was elemental carbon (Fig.3) and in addition to this, organic carbon was highly emitted under extra High phase.

So, it was found that ambient temperature affected hybrid vehicle's performance of fuel economy, gaseous and particulate matters emission under cold start condition much.

Table1 Specification of test vehilces

	Displace-ment (L)	Type of Fuel Injection	Type of Hybrid System*	Motor Output (kW)	First Time Registration (yyyy.mm)	Mileage before Tests (km)	Test Time (yyyy.mm)
vehicle1	0.65	multi port	Mild	1.9	2019.7	9,200	2020. 6
vehicle2	1.24	multi port	Strong	10	2020.3	9,400	2020.11
vehicle3	1.99	direct	Strong	10	2020.7	3,400	2021. 2
vehicle4	0.99	direct	Mild	2.3	2021.3	4,400	2021.10

*__Mild__ means that the motor supports engine output, while __Strong__ means that the motor can drive a vehicle in addition to Mild

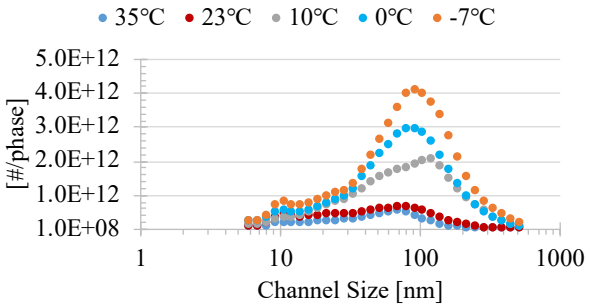

Fig.1 Particle size distribution of vehicle1 at Low phase (cold start)

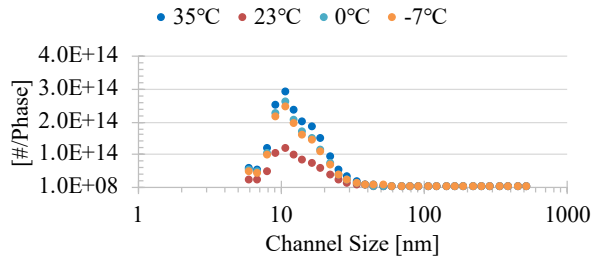

Fig.2 Particle size distribution of vehicle4 at extra High phase

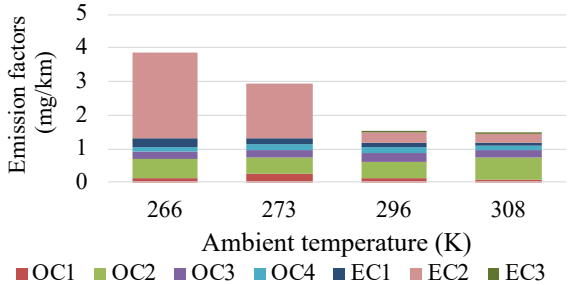

Fig.3 EC and OC of vehicle2 at 4phase (cold start)