

PA22) 가솔린 차량에서 배출되는 나노입자의 특성 연구

Gasoline Vehicle Emitted Nanoparticle Characterization

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1. INTRODUCTION

Nanoparticles have been a concern for several years due to the potential health effects related to their inhalation (Cheng, M.D. et al., 2003; Harrod, et al. 2003) Internal combustion engines, in particular diesel engines, have long been identified as a source of exhaust particles, all of which are sub-micron. In contrast, modern gasoline vehicles with three-way catalysts (TWC) have very low mass emissions of exhaust particles. Studies have shown, however, that gasoline vehicles with TWC can emit high numbers of nanoparticles (Maricq et al., 1999)

2. METHOD

Using three differential mobility analyzers (DMAs), particles generated from a light-duty gasoline pickup truck equipped with with a V-8 engine and TWC, which is driven on a dynamometer over two different drive cycles, were measured and characterized. Two test cycles were the LA4 and US06. The LA4 is a combination of the first two bags of the Federal Test Procedure (FTP 75) for light-duty vehicles, and thus represents an urban driving cycle. The US06 is a high-speed cycle meant to simulate aggressive driving at real-world highway speeds. The dyno speed can be divided by 3 driving cycles. The first (Bag1) cycle is from 0 to 505 seconds with the maximum speed of 57 mph, the second (Bag2 FTP) is from 506 to 1372 with 35 mph, and the third (US06) is from 1373 to 1972 with 80 mph. For the fuel, Indolene, a certification gasoline, was used. The selected sizes of the exhaust particles were 4, 7, 10, 13, 17, 24.2, 34.6, 49.8, 72.2, 106.2 and 159.8, respectively.

3. RESULTS AND DISCUSSIONS

Most particles were observed during the third cycle. During the second cycle, there were almost no measured concentrations above 1.0×10^4 particles/cm³ while there were a few at the beginning of the first cycle. These results indicate that more particles are generated at higher dyno speed, and, at less than about 60 mph, the generated particle concentrations are about 1.0×10^4 particles/cm³ or less. Among the selected particle sizes, both of nuclei mode particles, peaked at 10 nm, and accumulation mode particles, with their lowest end at around 150 nm, were generated from the vehicle.

Particle concentrations are related to not only to speed, but to acceleration. For example, during the aggressive US06 cycle, concentrations of 10 nm particles increase sharply with rapid acceleration. Especially, at high speed from about 1570 to about 1840 s, particle concentration changes match extremely well with the dyno speed changes. In addition, the cold start has a profound effect on particle emissions from gasoline vehicles. Results of the cold start portion of the sequence will be presented.

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