Ash Impacts on Gasoline Particulate Filter Performance and Service Life

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The increasing use of gasoline direct injection (GDI) engines, coupled with the implementation of more stringent particulate matter (PM) emissions regulations, requires new emissions control strategies for light-duty gasoline vehicles. Gasoline particulate filters (GPF) present one approach to reduce PM emissions below required levels. GPFs are proven effective at removing PM emissions from the exhaust stream, but they do create a backpressure on the exhaust system that reduces engine performance and fuel efficiency. Over the service life of the filter the accumulation of incombustible ash leads to a gradual increase in exhaust backpressure and reduction in engine efficiency.

This study utilized an accelerated aging system to study the impacts of lubricant derived ash, which is the leading source of ash in engine exhaust, on GPF performance over the filter's full service life. GPF samples were aged in the laboratory using a gasoline burner to generate a simulated exhaust stream. Lubricant oil was injected into the burner system to create elevated lubricant derived ash levels in the exhaust stream. GPFs were aged to a series of loading levels representing various stages of the filter life up to 150,000 miles.

The impact of ash deposits on the pressure drop sensitivity to soot accumulation was investigated at specific ash levels. The impact of ash deposits on three-way catalyst coating within the GPF was also studied by utilizing core samples on a reactor flow bench. Catalyst light off was determined through progressive temperature ramp experiments. The results highlight the importance of understanding ash impacts on the flow and catalyst performance of GPFs over the full useful life of the filter.

Master of Science in Mechanical Engineering

Naval Architecture and Marine Engineering