S2.6.3 MODELING AND EXPERIMENTATION OF GDI-SIZED PARTICULATE FILTRATION AND PRESSURE-DROP BEHAVIOR IN DPF SUBSTRATES

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Gasoline Direct Injection (GDI) is known to produce lower concentrations of smaller particulate matter (PM) as compared to diesel combustion [1]. This results in the absence of soot-cake formation on the filter channel wall and yields changes in filtration behavior as compared to diesel particulate filters (DPF). Therefore, studies of cakeless filtration regimes for smaller sized particulates is of particular interest for GDI PM mitigation. This work investigates the filtration efficiency of laboratory-generated particulates, representative of GDI-sized PM, in uncoated, commercial DPF cordierite substrates of varying porosities. Size-dependent particulate concentrations were measured using a Scanning Mobility Particle Sizer (SMPS), both upstream and downstream of the filters. By comparing these measured concentrations, the particle size-dependent filtration efficiency of filter samples was calculated. A model suitable for predicting filtration efficiency for these non-loaded particulate traps was further developed from a flow field model [2], with soot-cake related filtration approximations removed. The improved model includes additional sedimentation and thermophoretic modes of filtration. Experimental results showed excellent agreement with model predictions. Our study demonstrated that current DPFs cannot be used as a gasoline particulate filter (GPF) due to its low filtration efficiency for GDI sized particles. Further developments of the GPF are essential and the newly developed filtration model can serve well to facilitate the filter design.