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The Investigation of DPF Model Optimization about Temperature and PM Distribution inside of DPF during Active Regeneration. (First Report)

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Diesel Particulate Filter(DPF) is used as one of the aftertreatment-system component of many diesel engine. Main function of DPF are trapping of particulate matter(PM) in exhaust gas of diesel engine and removing accumulated PM in DPF by oxidation. PM removing process is called “Regeneration process”. There are two kind of regeneration process, “Passive regeneration” and “Active regeneration”. This investigation is focused “Active regeneration”.

In active regeneration process, DPF would be broken due to high regeneration temperature caused by higher PM oxidation rate if PM accumulation exceeds acceptable storage limit. In product design process, DPF size, shape, maximum capacity of PM should be optimized to secure PM trapping and DPF endurance reliability. However, it takes a lot of time and efforts through a trial and error process with CAE and experimental study.

Optimization of 3D DPF model under active regeneration was investigated to improve efficient study in design phase. The DPF model require to output three dimension of PM loading distribution in DPF. We derived the PM loading distribution in DPF before and after regeneration by experimental method. From these results, two parameters of PM oxidation rete were optimized. PM oxidation parameters are Pre-exponential factor and activation energy in Arrhenius equation.

Next, temperature distribution at DPF inlet surface during DPF after regeneration was measured. The flow rate distribution in DOC-DPF aftertreatment system was calculated by three dimensional computational fluid dynamics model. (Fig.1)

Experimental temperature distribution and computed flow rate distributio were input to optimized 3D DPF model.

Optimized 3D DPF model can simulate trend of PM loading distribution after DPF active regeneration.(Fig.2)

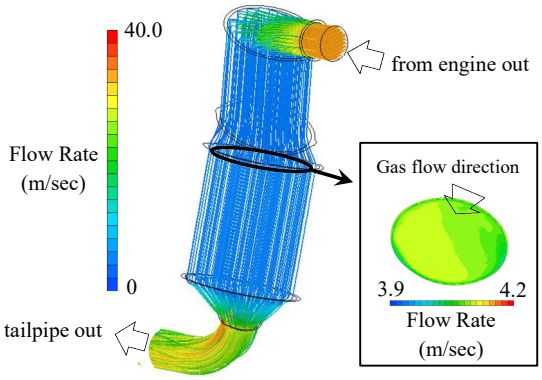

Fig.1 Flow rate distribution calculated by 3D CFD
(left:DOC-DPF aftertreatment system right: Inlet surface of DPF)

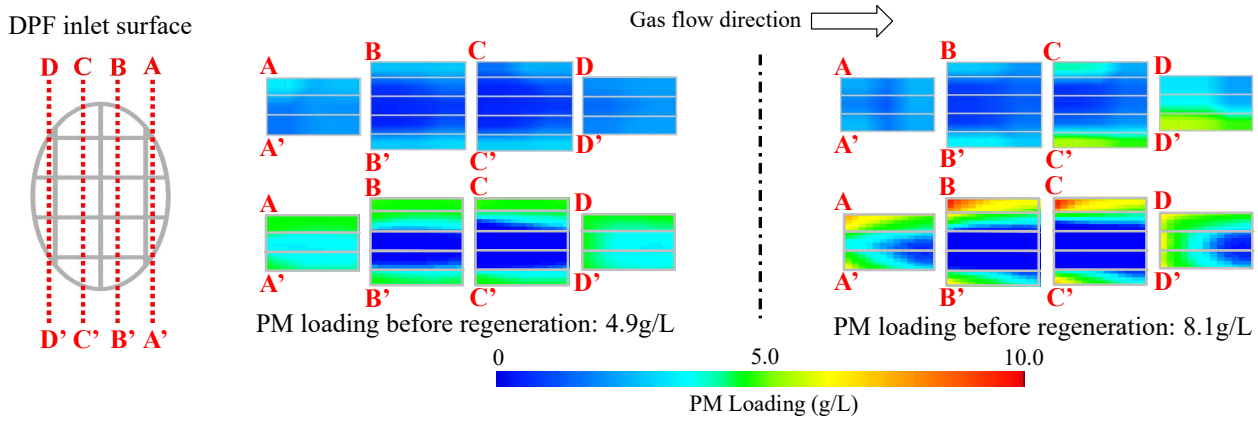

Fig.2 PM Loading distribution in DPF after regeneration of each PM loading cases
(Upper: Experimental Lower: Computational)