WP8: Engine Integrated SCR and combined SCR and DPF

Objectives

Engine Integrated SCR

- Investigation of High Pressure SCR process; injection, mixing, decomposition and flow distribution with the aim of making the SCR components compact while still maintaining the same high performance as best available technology today
- Designing of engine integrated High Pressure SCR with system with unaffected engine footprint and only slightly affected gallery arrangement around the engine
- Testing of compact High Pressure SCR component performance on 4T50ME-X test engine

Combined DPF and SCR

- 80% PM reduction with after-treatment system (based on IMO Tier II engine out emissions)
- 80 % NOx reduction with after-treatment system to reach IMO Tier III limits
- Reduce the necessary installation space for after-treatment system SCR on DPF within IMO Tier III (SCR only) system
- Adaption and integration of the after-treatment system (SCR on DPF) on a marine Diesel engine

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Partners

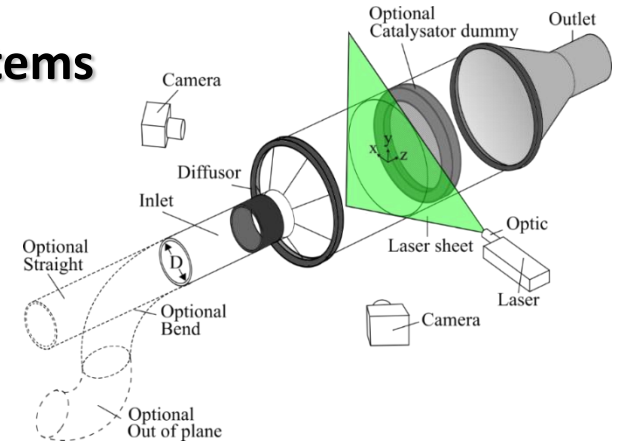
- LUH: Leibniz University Hannover (Hannover)
- DTU: Technical University of Denmark (Copenhagen)
- MDT: MAN Diesel & Turbo

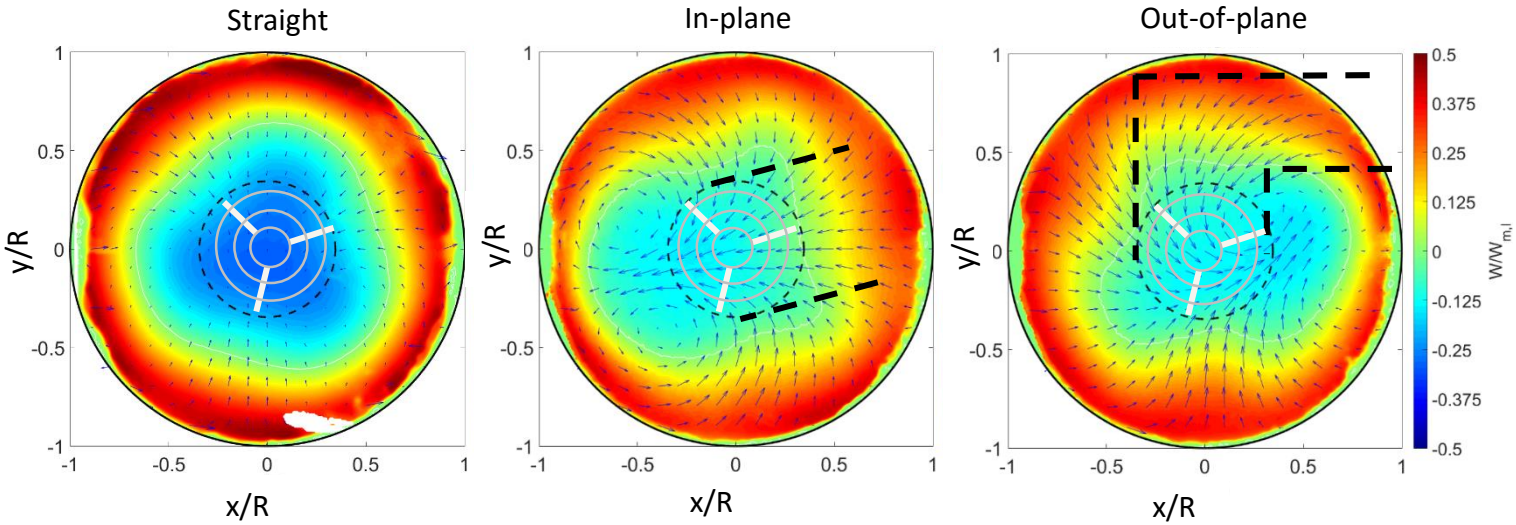
Roles

- LUH: Test rig for investigation of urea injection and decomposition
- DTU: Investigations of SCR mixing and flow distribution.
  Development of mechanism for NH_3 measurements.
- MDT-CPH: Compact mixer, Integrated SCR design and NH_3-slip investigation.
- MDT-Aug: Catalyst coating and filter test bed. Selection & design of SCR on DPF prototype. Modelling of urea injection and decomposition.

Main results achieved during 3nd year – Flow in SCR systems

- The effect of different inlet conditions to the reactor is investigated for A straight pipe, in-plane bend and out-of-plane bend.





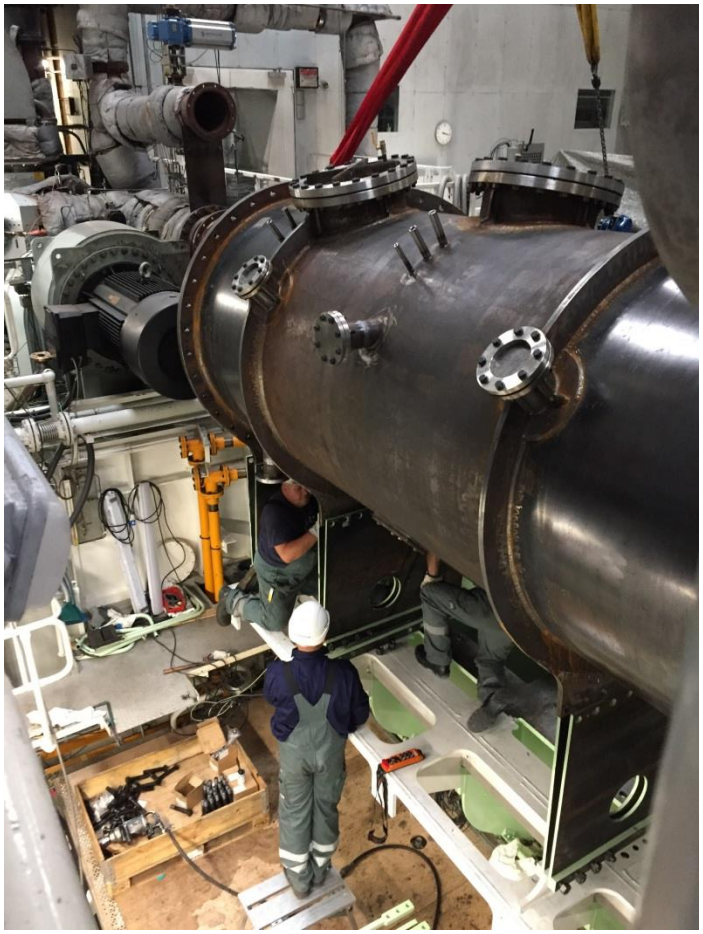
- Ongoing experiments, with pulsation flow in the straight pipe case:
  - Vortex shedding from flow distributor
  - Vortex breakdown due to catalysator dummy

Main results achieved during 3nd year – Engine integrated HP SCR

- Manufacturing of new receiver
  - Inner part – with catalytic filters
  - Outer part
- Assemble new receiver
- Removal of old receiver from test engine

- Installation of new receiver (on-going)

Next step:
- commissioning engine with Integrated SCR
- Test integrated HP SCR

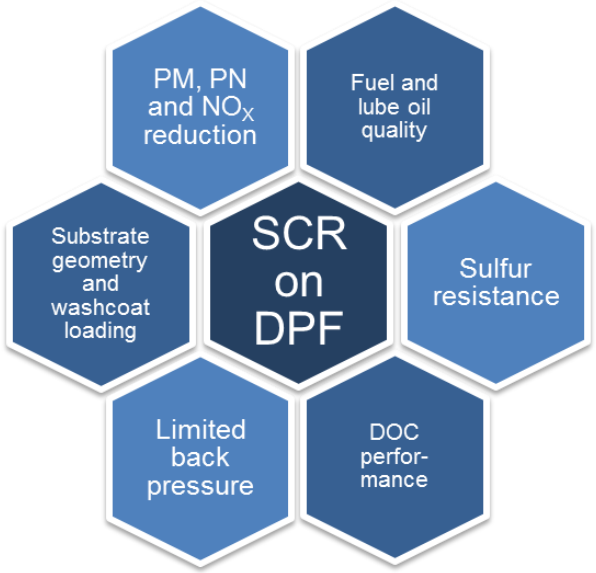


New receiver test mounted on engine 4T50ME-X

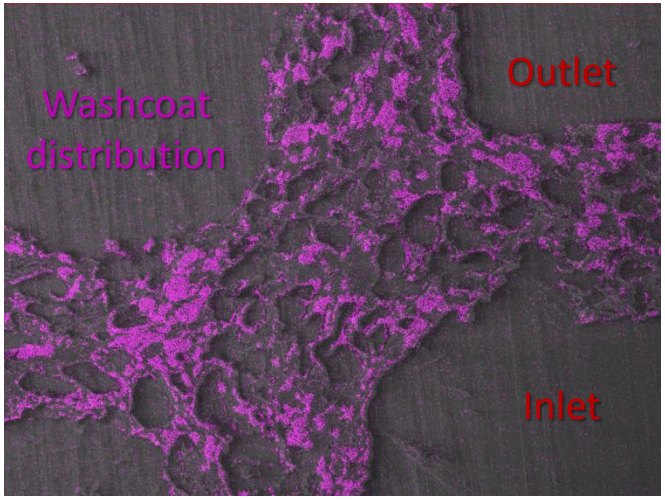
WP8.2: Combined SCR and DPF

Main results achieved during 3nd year

- Benchmark of SCR coated Diesel particulate filters (DPF) in laboratory scale (D8.3)
  - SCR performance test including hydrothermal aging
  - Back pressure investigation
  - Filter efficiency
  - Optical investigation with SEM/EDX
- Procurement of SCR coated DPF system in full scale for validation on engine test bed
- Endurance test of Diesel oxidation catalysts (DOC) on engine test bed with different marine fuels



Factors of the SCR coated DPF

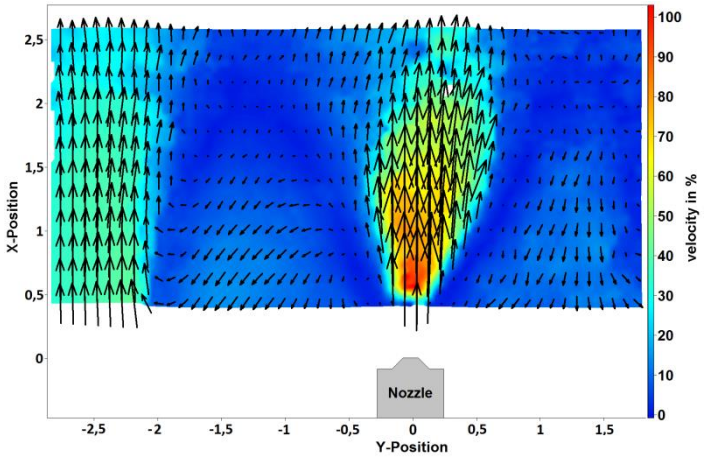


SEM/EDX image of SCR coated DPF

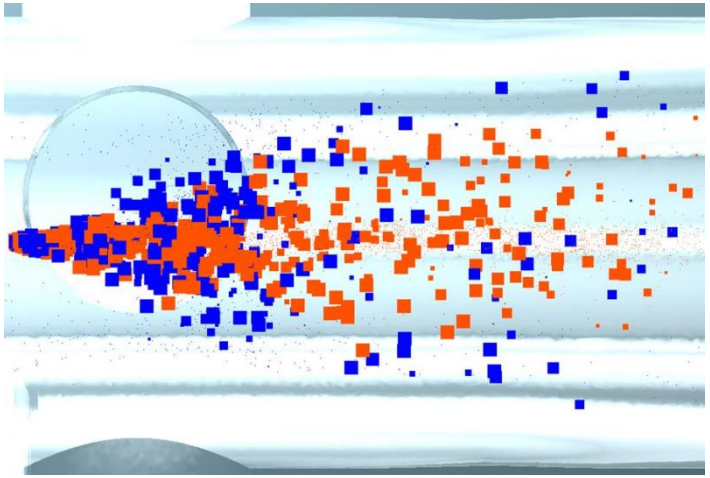
WP8.2: Combined SCR and DPF

Main results achieved during 3nd year

- Study of influence of hot gas pressure and temperature on urea decomposition
  - ➢ Spray configuration and droplet spectra
  - ➢ Chemical components
- Investigation of impact of mixing elements to enhance urea decomposition
- Both tasks carried out experimentally (ITV) and numerically (MDT-AUG)
- All work and results of first two years covered in D8.4



Flow field with mixing element



Simulated spray behavior without (red) and with (blue) mixing element

Future Work

- Commissioning of test engine, with integrated SCR
- Test engine integrated HP SCR on 4T50ME-X

- Experiments with catalyst-like dummy (able to breakdown vortices)

- Endurance test of the DOC system on engine test bed with marine distillate fuel
- Installation and validation of the EAT system comprising DOC, mixing unit and the benchmark system of SCR coated DPFs in full scale on an engine test bed

- Measurements on the hot gas test rig with improved mixing configurations
- Modelling of improved mixers and alternative configuration