

Objectives

- Integration of SCR (Selective Catalytic Reduction) with the existing strong Miller cycle 4-stroke diesel engine and combining it with particulate emission (PM) abatement technology would enable to achieve more than 80% NO_x emission reduction and 25% reduction in PM. Also a combination of integrated SCR and EGR (Exhaust Gas Recirculation) is to be developed. Feasible solutions of combining the above mentioned technologies having as a target the near zero emission engine are also studied.
- Integrating methane and ethane abatement technology into lean burn 4-stroke gas engines will enable compact solutions to reduce methane and ethane slip. The objective is a catalytic system working with the engine and optimization of the engine performance. Also the knowledge on deactivation & regeneration strategies for integrated catalyst solutions and methane formation and location in the engine exhaust system should increase. Target is a greenhouse gas emission decrease up to 15% and fuel savings up to 5%.

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PSI

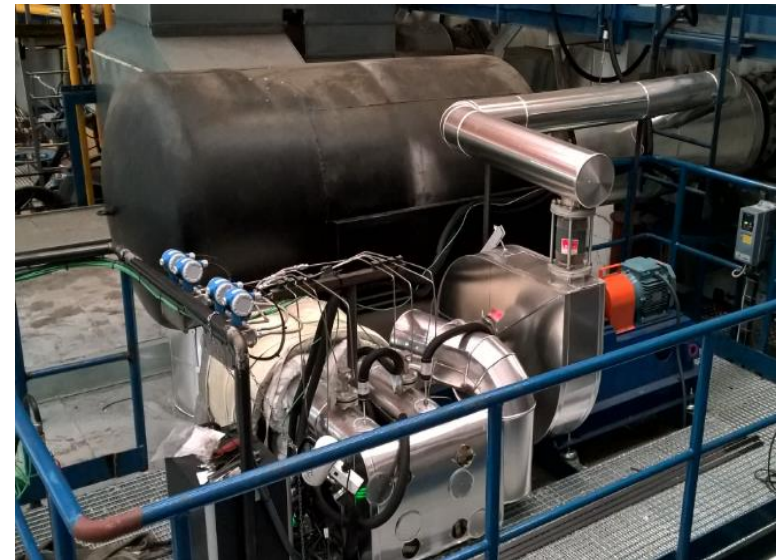
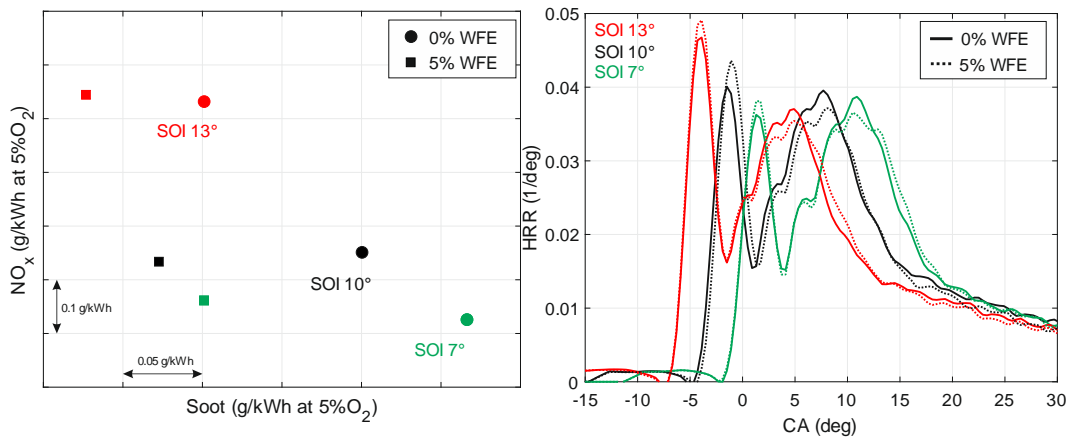
Subprojects

- 7.1 Combined on-engine aftertreatment solutions for 4-stroke diesel engines
- 7.2 SCR reduction agent injection solutions
- 7.3 Integration of methane and ethane abatement technology with gas engines
- 7.4 Emission measurement systems for integrated after treatment technologies

Progress update

- PSI, Feasibility and demonstration of NO_x and particulate reduction with pre-tests on test engine was completed and the available data set has been evaluated and analyzed with regard to engine performance parameters as well as emission characterization. Work will be finalized due to plan.
- WFI, Deliverables 7.3 and 7.6 was submitted due to plan and deliverable 7.7 will be submitted within original schedule (Month 36). Other activities are ongoing and will be finalized within schedule.
- WSP, Feasibility and demonstration of integrated methane and ethane abatement with gas engine testing was ended due to plan.
- UV, Feasibility and demonstration of methane catalyst element has been continued with regeneration method study and experimental study has started and will be closed during spring 2018.
- VTT, NH₃ sensors test results are analyzed and final reporting is prepared. PM emission testing results have been analyzed and final report is under preparation. Deliverable 7.2 was submitted due to plan.

50% Load, 22% EGR, $p_{\text{rail}} = 1500$ bar



Small scale test bench at the roof of engine test cell

Objectives of Work Package 7.5 – Robust Catalyst Element

Development of key technology for integration of the currently separated SCR aftertreatment into existing 2-stroke engine structure, which enables widespread installation of SCR systems on all ship types and additionally increase overall NOx removal efficiency above 80%, reduce overall hydrocarbon emissions (HCs) by 50% or more, reduce PM emissions and lead to potential fuel savings of up to 5%.

Results of past period month 30-35

WinGD - Field test activities

- Testing of vibration resistance in exhaust manifold:
 - Ceramic catalyst - done
 - Metallic catalyst - ongoing
- Catalyst aging by SCR-operation

PSI - Investigation of SCR reaction kinetics under elevated pressure

- Paper going to be published in «Magazin Chemie Ingenieur and Technik»

Dinex-Ecocat - Development of vibration resistant catalyst

- Ongoing washcoat optimization by varying of coating sequence, wash coat formulation and wash coat loading

Johnson Matthey - Development of vibration resistant catalyst

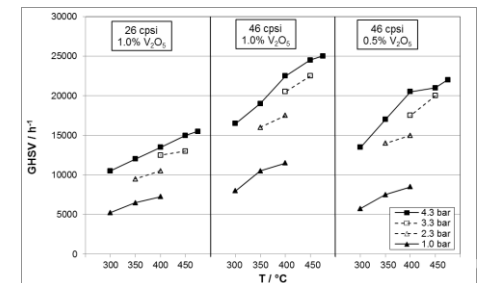
- Condition analysis of Ceramic catalyst after 3200h field test operation without any issue



Vibration test in exhaust manifold



SCR-installation on WinGD field test vessel



SCR reaction kinetics under elevated pressure

Deliverables and Future work

- Hot shake test of newly produced prototypes
Support and follow up of field test
- Condition analysis after field test
- Document and publish SCR reaction kinetics
Performance analysis of field aged catalyst
- Vibration testing of prototype vibration resistant catalyst
on engine operating in the field
Catalyst aging in SCR-operation

