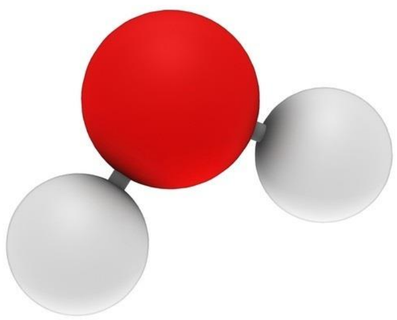
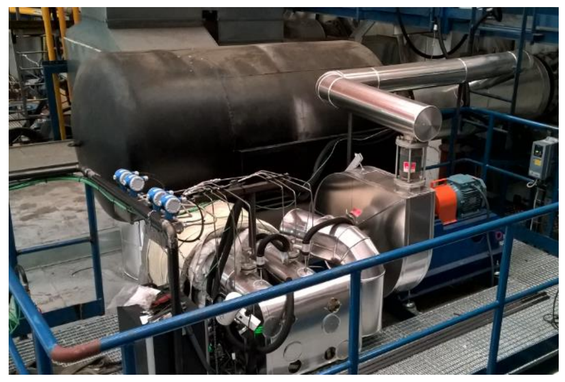


WP 7 On-engine aftertreatment systems.

WP OBJECTIVES

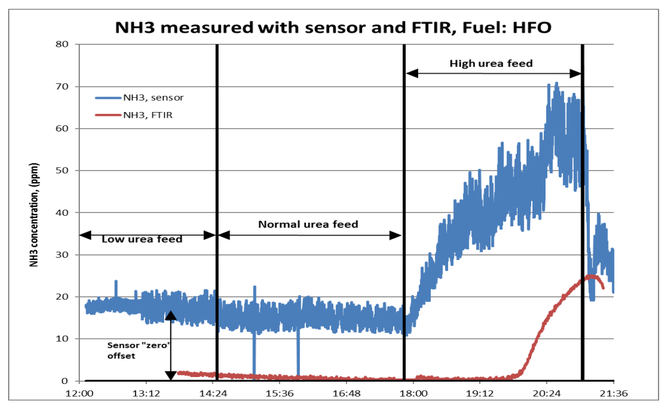
- Integration of SCR (Selective Catalytic Reduction) with the existing strong Miller cycle 4-stroke diesel engine and combining it with particulate emission (PM) abatement technology would enable to achieve more than 80% NOx emission reduction and 25% reduction in PM. Also a combination of integrated 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%.
- Development of key technology for integration of the currently separated SCR after treatment 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%.

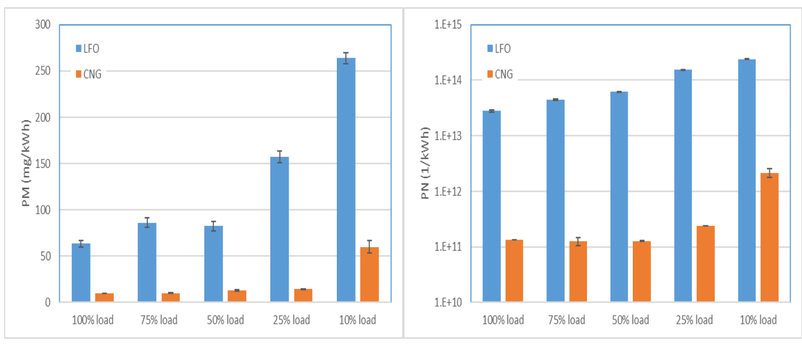


Small scale test bench at the roof of engine test cell

ACHIEVEMENTS & FINAL RESULTS

- Literature review regarding SCR engine integration and particulate abatement.
- Emission measurement systems for SO3, NH3 and PM emissions to support integrated after-treatment technologies
- Experimental assessment of integration of methane abatement technology into gas engine structure
- Concept about catalyst aging from in-field monitoring and laboratory experiments
- Experimental assessment of SCR reduction agent injection systems with sensors for feedback control
- Experimental assessment of selected combined on-engine emission reduction system for strong Miller cycle 4-stroke diesel engines with tests on rig/engine
- Experimental assessment of newly developed vibration resistant SCR catalyst in field





Particle mass (PM) and particle number (PN) results measured with DF marine engine.

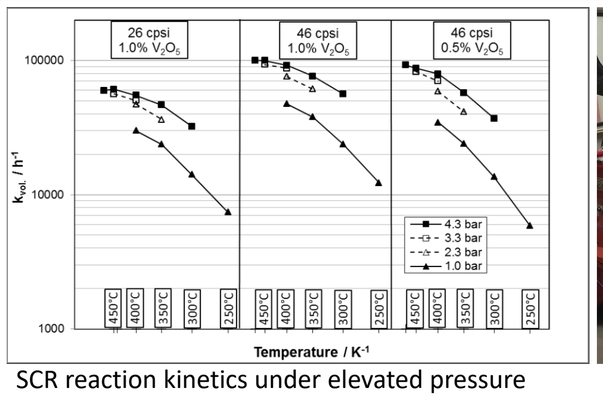
PROGRESS

Wärtsilä

WP 7 On-engine aftertreatment systems GANT CHART - Update 22/05/2017

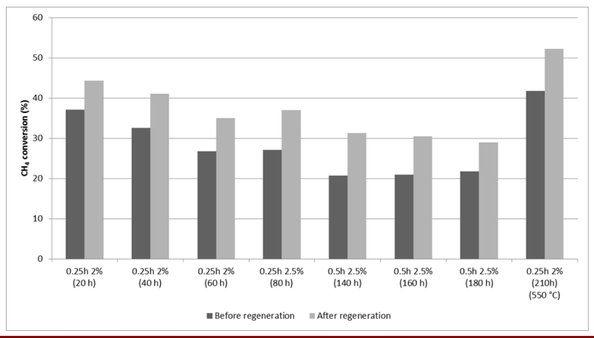
SUB-PROJECT TITLE	ACTIVITIES	Partner	PM
7.1 Combined on-engine aftertreatment solutions for 4-stroke diesel engines	7.1.1 Literature review regarding SCR integration with engine.	VAASAY	6
	7.1.2 Literature review regarding particulate abatement including particulate filters.	VAASAY	6
	7.1.3 Feasibility and demonstration of particulate filters with tests on test rig/engine.	VAASAY	8
	7.1.4 Feasibility and demonstration of NOx and particulate reduction with tests on test engine.	PSI	12
	7.1.5 Feasibility and demonstration of selected optimum set-up for the combined on-engine aftertreatment solution with tests on test rig/engine.	WFI	16
7.2 SCR reduction agent injection solutions	7.2.1 Reduction agent injection in SCR: Modeling of spray, evaporation and reforming to gaseous NH3.	WFI	10
	7.2.2 Development of control strategies, dosing system for reducing agent and sensors for feedback control.	WFI	11
	7.2.3 Feasibility and demonstration of new reduction agent injection systems.	VAASAY	7
7.3 Integration of methane abatement technology with gas engines	7.3.1 Feasibility and demonstration of methane catalyst elements.	VAASAY	8
	7.3.2 Design for integrated methane abatement technology for gas engine structure.	WFI	15
	7.3.3 Feasibility and demonstration with tests on test engine.	WES	45
7.4 Emission measurement systems for integrated emission reduction technologies	7.4.1 NH3 measurements	VTT	12
	7.4.2 SO3 measurements	VTT	2
	7.4.3 PM measurements	VTT	10
	7.4.4 Feasibility and demonstration with tests on test rig/engine	WFI	2
7.5 Experimental assessment of newly developed vibration resistant SCR catalysts under operating conditions	7.5.1 Development of vibration resistant extruded ceramic catalysts	JM	17
	7.5.2 Development of vibration resistant modular catalyst supports and in-house testing on vibration test bench	Ecocat	17
	7.5.3 Laboratory testing of vibration resistant catalysts and investigating catalyst aging	PSI	4
	7.5.4 Define vibration test cycle by measurements from engines and test new catalysts in the field	WCH	25

WINGD



SCR reaction kinetics under elevated pressure

Hot shaker test bench



Average CH_4 conversions during the experiment at 500 °C and at 550 °C.

WP PARTICIPANTS

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