TECNOVERITAS®

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Hydrogen Internal Combustion Engine Lab

H_2 TecnoVeritas Technology

White Paper

April 2010

CARBON CONNECTIONS

Carbon Connections is a R&D program sponsored by the British government which the main objective is to develop clean forms of generating energy.

TecnoVeritas developed for the University of Newcastle upon Tyne , Sir Joseph Institute, one Laboratory power plant based on a compression ignition engine capable of producing electric and thermal energy virtually without carbon emissions.

Hydrogen is to be produced at another NaREC (National Renewable Energy Centre UK) facility, while bio fuels can be blended and conditioned at this lab.

The Compression Ignition engine can be fuelled with hydrogen or with a blend of bio fuels and hydrogen or even only with bio fuels.

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Hydrogen ICE Lab. Hardware

The plant is installed in a 40 ft marine container, and is divided into three compartments, engine room, control room and bio fuels conditioning and storage plant.

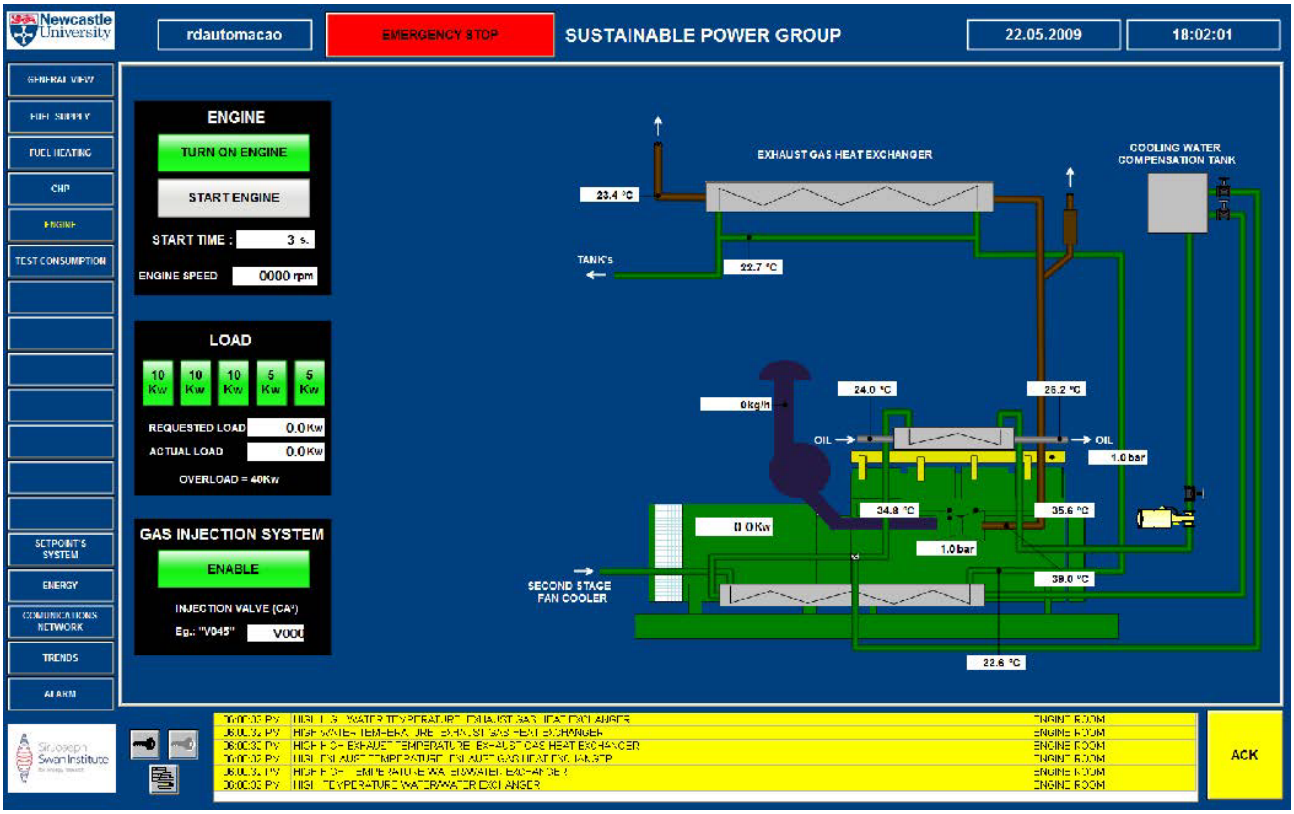
The laboratory container is to be installed at NaREC (NaREC is a leading research and development platform for new, sustainable and renewable energy technologies in the UK)

The plant has an overall efficiency of 89%, resulting from the use of high performance CHP system. From the engine equipped with an hydrogen multi point injection system, heat flows from the cylinder and oil cooling are recovered together with the exhaust gas heat flow, and used to heat up water for domestic heating. The electric power produced 45 kW, is used for the lab facility but can be injected into the grid.

The laboratory is equipped with a SCADA system enabling the local or remote operation of the plant, management of all the sub systems and also incorporating all the safety aspects required to deal with hydrogen.

This real laboratory is to be used in research activities by the Newcastle University post graduated students.

Main Human Interface Of The Scada System



Bio Fuels Room

In this room, there is possibility of having up to four different segregated liquid bio fuels, which can be blended, heated and homogeneised.

All the tanks are equipped with heating coils and ultrasonic level gauges.

Also in this room, there is a small laboratory for the physical properties of the fluids, like viscosity, density, and water contents.

The Engine Room

The engine is of a compression ignition type and can be fuelled with Hydrogen under the HCCI operation mode, or with bio fuels.

Heat Recovery

An overhead engine exhaust gas heat economiser and an oil heat economiser were fitted to recover 90% of the heat.

Hydrogen Injection System

Hydrogen multipoint injection system VTec installed beside the cylinder heads.

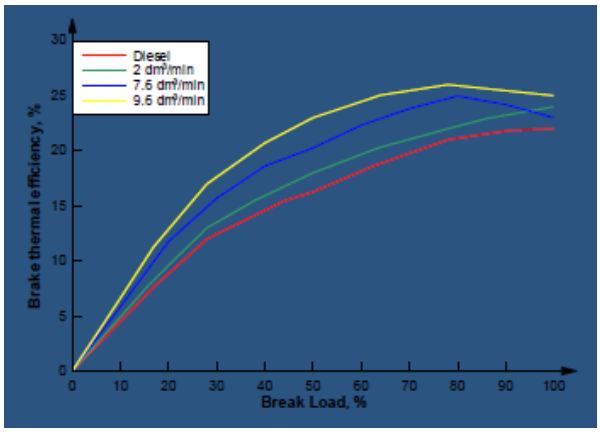
Another aspect of the Hydrogen Injection System VTec by TecnoVeritas, showing the pressure Hydrogen and boost pressure transducers as fitted on the engine.

The VTec Common Rail

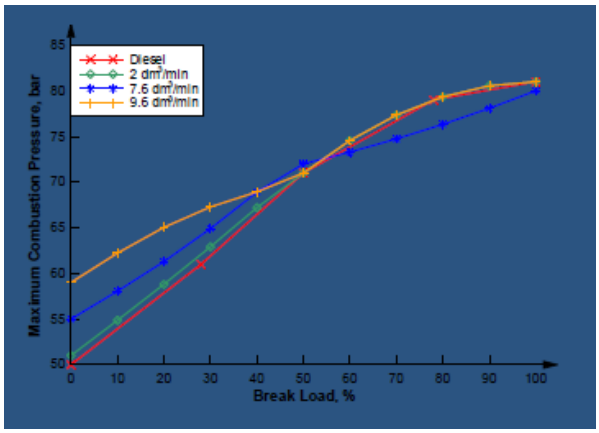
It can be seen the four injectors, and pressure and temperature transducers.

KDS Knocking Detection System was also implemented into the system to protect the engine against knocking and misfiring but also to optimize the engine operation with hydrogen.

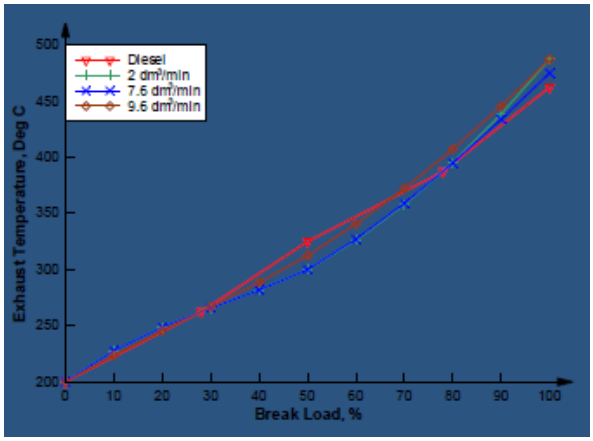
Some Experimental Results



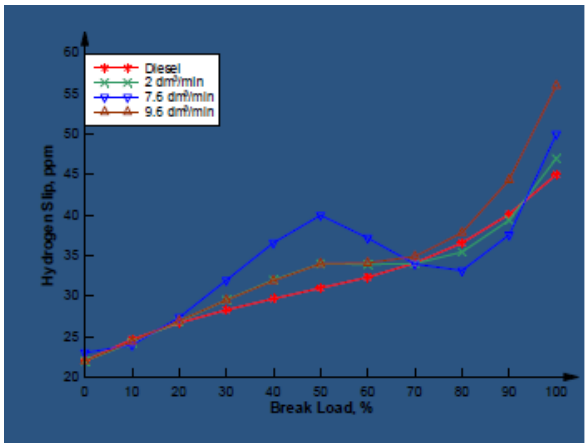
Break Thermal Efficiency as a function of Break Load for different hydrogen flow rates



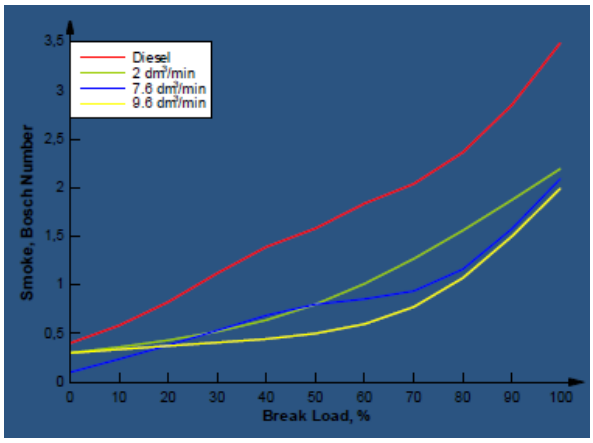
Maximum combustion pressure as a function of break load for different hydrogen flow rates



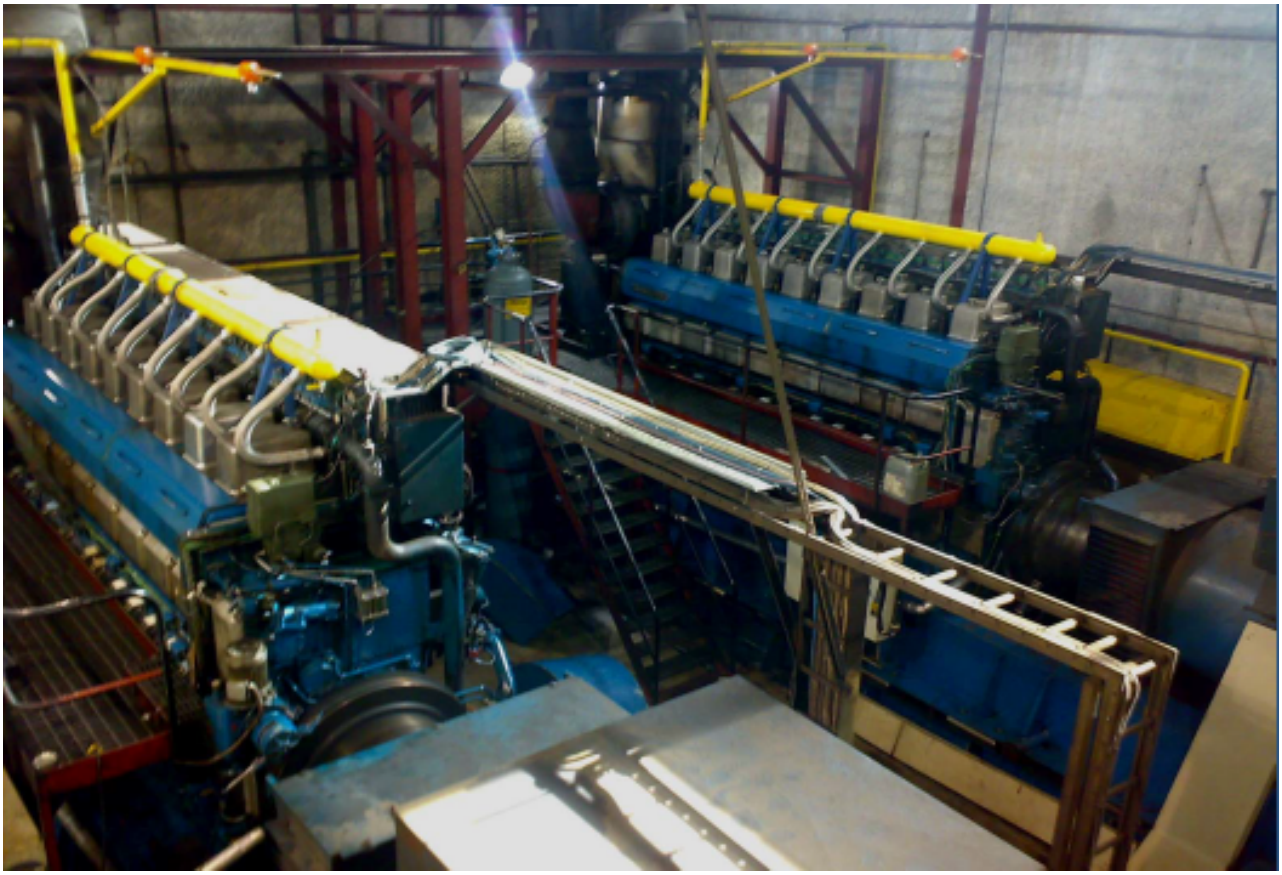
Comparision of exhaust gas temperatures between diesel and various hydrogen flows



Hydrogen slip into the exhaust gases for different hydrogen flow rates and engine loads.



Particulate matter emissions compared for various hydrogen flow rates and diesel operation



VTec Technology was used to convert two 4.0MW Diesel Engines to Natural Gas but can be used for H2 at Estarreja Portugal.