GHENT UNIVERSITY - UGent

Faculty of Engineering
Department of Flow, Heat and Combustion Mechanics

Laboratory of Transporttechnology

Hydrogen internal combustion engines

Research activities

Since 12 years our main research topic has been the development of hydrogen fuelled internal combustion engines.

Different engines have been adapted to hydrogen combustion: Valmet 4.4l 4 cyl, GM 7.4l V8, single cylinder CFR engine.

These engines have been optimised for power output, fuel consumption and exhaust gas emissions. The first tests were carried out with a gas carburettor mixing system. Later all engines were equipped with sequential timed multipoint injection systems and electronic control units. Ignition timing, injection timing (start of injection and duration) and place of the injector have been examined.

The laboratory has been a partner in two European projects to develop hydrogen city buses.

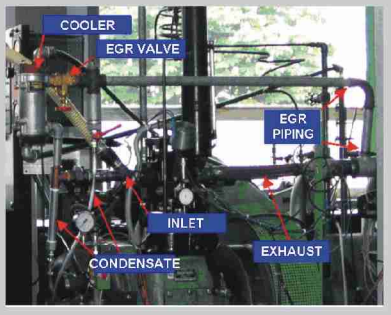
Present day research

EXPERIMENTAL

Our experimental work focusses on two single cylinder engines:

- A single cylinder CFR (low speed) engine, which is presently used for the study of EGR application (backfire-safe operation, low NOx emissions)
- A single cylinder prototype Audi (high speed) engine, where the focus is on in-cylinder pressure measurements. This engine will also be equipped with an EGR system in the near future

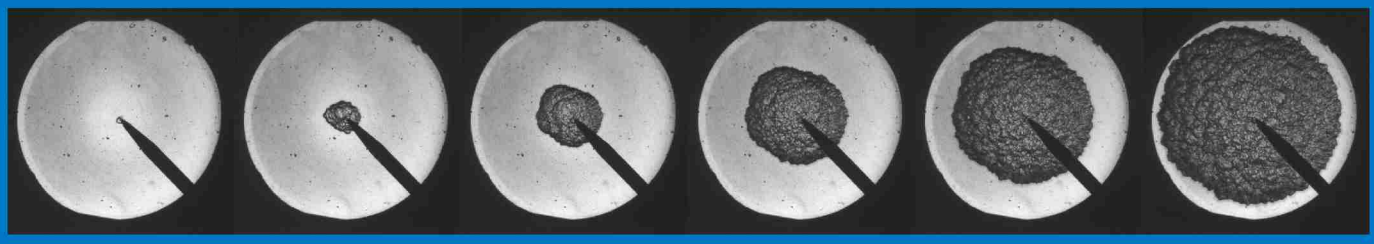
We have also started the conversion of a passenger car equipped with a V6 engine to bi-fuel operation (gasoline and hydrogen). This comprises engine modifications, fuel storage and safety aspects. The dynamometer test facilities of the laboratory will be used to simulate road conditions.



SIMULATION

We are developing a computer code to simulate hydrogen fuelled internal combustion engines. This code is intended for the support of the experimental work, it will allow rapid evaluation of engine parameters and easier optimisation of the engine settings.

The main object is the development of a turbulent combustion model for hydrogen. Extensive measurements have been done on a turbulent combustion bomb to determine laminar and turbulent burning velocities.



Previous research on alternative gaseous fuels

Alternative gaseous fuels have been the subject of several projects for a long time. Fuels considered were LPG, natural gas, and mixtures of hydrogen and natural gas:

- The development of a liquid LPG injection system
- The development of a natural gas rotary engine
- Experimental study of natural gas - hydrogen mixtures
- Partner in a European project on "Low emissions vehicle with integrated natural gas storage"

Some relevant publications

EXPERIMENTAL

- SIERENS R., VERHELST S.: 'Influence of the injection parameters on the efficiency and power output of a hydrogen fueled engine'. Journal of Engineering for Gas Turbines and Power, April 2003, Vol. 125, pp. 444-449.
- VERHELST S., SIERENS R.: 'Aspects concerning the optimisation of a hydrogen fuelled engine. 'International Journal of Hydrogen Energy, September 2001, Vol 26/9, pp 981-985.
- VERHELST S., SIERENS R.: 'Hydrogen engine - specific properties'. International Journal of Hydrogen Energy, September 2001, Vol 26/9, pp 987-990.
- SIERENS R., VERHELST S.: 'Experimental study of a hydrogen fuelled engine'. Journal of Engineering for Gas Turbines and Power, January 2001, Vol. 123, pp. 211-216.
- SIERENS R., VERHELST S.: 'Comparison between a carburetted and a port injected hydrogen fuelled single cylinder engine'. EAEC European Automotive Congress, Bratislava, June 2001, SAITS 01009
- SIERENS R., ROSSEEL E.: 'Backfire mechanism in a carburetted hydrogen fuelled engine'. 12th World Hydrogen Energy Conference, Buenos Aires, June 1998.
- ROSSEEL R., SIERENS R.: 'Knock detection in a hydrogen engine'. SAE paper 970039, 1997 Conference Detroit.

SIMULATION

- VERHELST S., SIERENS R.: 'Development of a simulation programme for hydrogen fuelled spark-ignition engines'. 2nd International Conference on Heat Transfer, Fluid Mechanics and Thermodynamics, June 2003, Zambia; Paper nr. Vs1.
- VERHELST S., SIERENS R.: 'A laminar burning velocity correlation for hydrogen/air mixtures valid at spark-ignition engine conditions'. ASME Spring Engine Technology Conference, Salzburg, May 2003, paper ICES2003-555.
- VERHELST S., SIERENS R.: 'Simulation of hydrogen combustion in spark-ignition engines'. 14th World Hydrogen Energy Conference, Montreal, June 2002.

Previous research on alternative gaseous fuels

- CABELLO C., SIERENS R.: 'Flow resistance and capacity losses by the storage of natural gas on activated carbon'. SAE paper 2001-01-1916, 2001 Spring Fuel and Lubricants Conference, Orlando, USA, May 2001.
- SIERENS R., ROSSEEL E.: 'Variable composition hydrogen/ natural gas mixtures for increased engine efficiency and decreased emissions'. Journal of Engineering for Gas Turbines and Power, January 2000, Vol. 122, pp. 135-140.
- SIERENS R.: 'An experimental an theoretical study of liquid LPG injection'. SAE paper 922363, 1992 International Fuels and Lubricants Meeting, San Francisco, USA.

Contact us

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Best regards,

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We are in the 'Technicum' building, shown on the map by the number 2.

CAR:
Coming from the motorway E40 Brussels-Ostend or from the E17 Antwerp-Kortrijk, take the exit Gent-Centrum and then 'alle richtingen'. Take a left at the crossing (underneath the fly-over), take the ring road until the second traffic lights where you take a right, into the Overpoortstraat. Straight on, passed the Sint-Pietersplein, to the Sint-Pietersnieuwstraat. The 'Technicum' is situated at your right.

TRAIN:
At the Gent-Sint-Pieters station, take a tram 1, 10, 11, 12 or 13. Get off at the fifth stop and walk through the Plateaustraat (nr 1 on the map) to the 'Technicum'.