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Development of a NOx fast sampling system for Marine Diesel Engines

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Abstract: Cylinder specific NOx measurements for large marine engines can provide important information for the combustion system that can be used by the engine design and development engineers. In addition, significant cost savings can result from reduced test bed running times which are usually required to characterise the combustion system. Furthermore, detailed NOx measured data can be used for the development and calibration of combustion system simulation models.

Emission measurement equipment that allow cylinder specific measurements are currently only available to automotive industry applications. Due to the size of marine diesel engines, and more specifically the exhaust system, these equipment need to be suitably modified in order to be used in large engines.

The work reported here describes the further design and development of a NOx fast sampling system applicable to marine diesel engines towards a more reliable and robust system.

The most important considerations when sampling exhaust gases from a marine engine is the strong possibility of probe's blockage due to excessive soot deposition and the mechanical reliability, without compromising the performance of the measuring system. All these factors were considered during the design phase and the developed sampling system satisfies all requirements successfully.

The main design parameters of the sampling system were first evaluated though theoretical analysis, followed by flow bench investigations, and the final evaluation of the design was done on the test bed by performing NOx measurements on a marine diesel research engine. The emission measurements were supported by detailed measurements of the engine performance parameters.

The final probe design is a customised sampling system for a fast response chemiluminescence detector that can measure NOx in the exhaust gases downstream the exhaust valve of a specific cylinder of a marine diesel engine.

The extremely fast response time of the system enables the characterisation of NOx during an engine cycle with a one degree crank-angle resolution.