



Anti-pollution pillars of Hercules

Doug Woodyard

Marine engine designers in recent years have had to address the challenge of stricter controls on noxious exhaust gas emissions imposed by regional, national and international authorities responding to concern over atmospheric pollution.

Attention has focused on nitrogen oxides (NOx), generated thermally from nitrogen and oxygen at high combustion temperatures in the cylinder; sulphur oxides (SOx), produced by oxidation of sulphur in the fuel; hydrocarbons (created by the incomplete combustion of fuel and lube oil, and the evaporation of fuel); and particulate matter, which results from incomplete combustion, partly unburnt lube oil, thermal splitting of hydrocarbons from the fuel and lube oil, ash in the fuel and lube oil, sulphates and water.

Although not itself toxic, carbon dioxide contributes to the greenhouse effect (global warming) and hence to changes in the Earth's atmosphere. The gas is an inevitable product of combustion of all fossil fuels but CO₂ emissions from diesel engines – thanks to their thermal efficiency – are the lowest of all heat engines.

Diesel engine designers have risen to the challenge through substantial internal research commitments and inter-industry co-operative projects, a notable example of the latter being the Hercules (High efficiency R&D on Combustion with Ultra Low Emissions for Ships) project started in 2004. Supported by the European Commission and the Swiss Federal Government, Hercules demonstrates that intense market competition need not preclude a common approach to solving problems.

A common challenge has resulted in unprecedented co-operation between the leading marine engine designers MAN Diesel, Wärtsilä Corporation and Wärtsilä Switzerland, who together represent around 80 per cent of the world market for low and medium speed marine engines.

MAN Diesel and Wärtsilä have led a 41-member partnership in the Hercules project which is due for completion this year, the other consortium participants including universities, research institutions, component suppliers and shipping companies.

The Hercules target for the year 2010 is a reduction in NOx levels of 30 per cent below the IMO limit, increasing to a 60 per cent reduction in 2020. For other emissions, the project has set goals comparable with current 'best available technology in service' of a three per cent reduction in CO₂ levels by 2010 and five per cent by 2020, and a 20 per cent reduction in other emissions (hydrocarbons and particulates) by 2010 and 40 per cent by 2020.

Structured into nine work packages, 18 tasks and 54 sub-projects, Hercules has pursued integrated work in the following areas:

- thermo-fluid dynamics of combustion engine processes
- internal (in-engine) measures for emissions reduction as well as external measures (after-treatment of exhaust gases)
- new methods for high pressure air charging with multi-stage intelligent units, allowing engines with extreme operating parameter values to achieve higher efficiency
- use of microelectronics and advanced control for engines, offering optimum adaptability to different conditions, including adverse operation and failure compensation as well as accommodating component ageing over the lifetime of the plant
- new primary sensors and signal analysis software, enabling much more detailed research of engine processes along with higher precision and reliability for continuous real-time monitoring in service
- power plants for extremely emissions-sensitive applications, meeting the requirements of ports dictating minimum NOx and smoke emissions.

With several prototypes running, impressive results are reported and give confidence that the project goals will be fully met.

Encouragingly, MAN Diesel and Wärtsilä have proposed a further co-operative research project (Hercules-B) to the European Union to raise the fuel efficiency of marine diesel propulsion systems to a level higher than 60 per cent, thereby substantially cutting both fuel consumption and CO₂ emissions. The four-year project also has the aim of attaining ultra-low exhaust emissions from marine engines by 2015. *MP*

(We will report the key elements and results from the Hercules project in our next issue.)

THE MARINE PROPULSION CONFERENCE

Our two-day technical conference being held in London on 12-13 March 2008 will really address the operational challenges facing ship operators today. The Marine Propulsion Conference's platinum sponsor is Rolls-Royce, and the event has also attracted sponsorship from other prestigious names, including ABB, ClassNK, Infineum, Lloyd's Register and Vacon. Details are being updated on the conference website as the programme develops.

www.mpropulsion.com/conference