

Hydrogen Lean+Stoichiometric Combustion Engine Using Dedicated EGR System

- (1st Report) Numerical Simulation of the System -

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Hydrogen engines operated under lean combustion can achieve high thermal efficiency and low NO_x emissions. However, because of the high oxygen concentration in the exhaust gas, a three-way catalytic converter (TWC) cannot be used and SCR systems are required. To overcome this issue, a hydrogen engine system using dedicated EGR and diluted stoichiometric combustion is proposed.

The proposed engine consists of two lean-burn cylinders ($\lambda=2$) and two diluted stoichiometric cylinders ($\lambda=1$). All exhaust gas from the lean cylinders is routed through an EGR cooler and supplied as 100% dedicated EGR to the stoichiometric cylinders, enabling stable combustion and TWC operation.

The turbocharger maps were optimized to satisfy the torque target of the base diesel engine at 1400 rpm. Compared with the original turbocharger, the modified system achieved equivalent full-load torque over the operating range as shown in Fig.1.

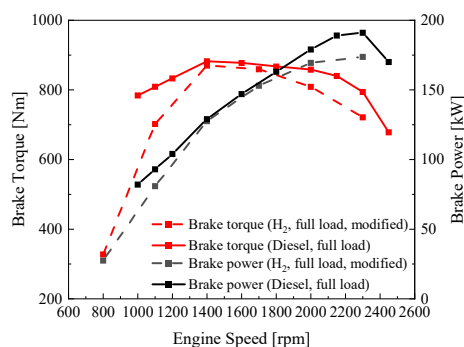


Fig.1 Brake torque, brake power at full-load operation with hydrogen using the modified VGT + WGT

Compared with the conventional lean hydrogen engine, the proposed concept exhibited higher brake thermal efficiency at low engine speeds as shown in Fig.2. Although the efficiency became slightly lower at higher speeds, the elimination of the SCR system and the application of a TWC provide superior overall system performance.

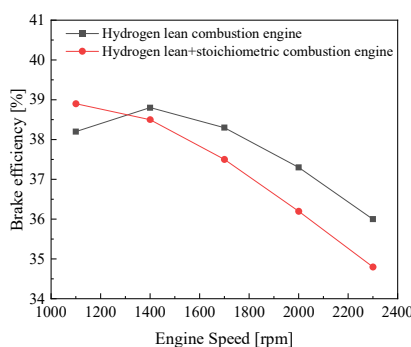


Fig.4 Brake Efficiency of Hydrogen Lean Combustion Engine and Hydrogen Lean+Stoichiometric Combustion Engine

The proposed hydrogen lean + stoichiometric combustion engine using dedicated EGR can achieve diesel-equivalent torque while enabling TWC application, demonstrating better overall system performance than a conventional lean hydrogen engine with SCR.