Combined Effect of Boost Pressure and Injection Timing on the Performance and Combustion of CNG in a DI Spark Ignition Engine

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ABSTRACT

There is an increasing interest in supercharging spark ignition engines operating on CNG (compressed natural gas) mainly due to its superior knock resisting properties. However, there is a penalty in volumetric efficiency when directly injecting the gaseous fuel at early and partial injection timings. The present work reports the combined effects of a small boost pressure and injection timing on performance and combustion of CNG fueled DI (direct injection) engine. The experimental tests were carried out on a 4-stroke DI spark ignition engine with a compression ratio of 14. Early injection timing, when inlet valves are still open (at 300°BTDC), and partial injection timing, in which part of the injection occurs after the inlet valves are closed (at 180°BTDC), were varied at each operating speed with variation of the boost pressure from 2.5 to 10 kPa. A narrow angle injector (NAI) was used to increase the mixing rate at engine speeds between 2000 and 5000 rpm. Similar experiments were conducted on a naturally aspirated engine and the results were then compared with that of the boosting system to examine the combined effects of boost pressure and injection timing. It was observed that boost pressure above 7.5 kPa resulted in an improvement of performance and combustion of CNG DI engine at all operating speeds. This was manifested in the faster heat release rates and mass fraction burned that in turn improved combustion efficiency of the boosting system. An increased in cylinder pressure and temperature was also observed with boost pressure compared to naturally aspirated engine. Moreover, the combustion duration was reduced due to concentration of the heat release near to the top dead center as the result of the boost pressure. Supercharging was also found to reduce the penalty of volumetric efficiency at both the simulated port and partial injection timings.

KEYWORDS

CNG, Direct-injection, Boost pressure, Injection timing, Performance, Combustion

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