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Numerical investigation of hydrogen enriched natural gas effects on different characteristics of a SI engine with modified injection mechanism from port to direct injection

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Highlights

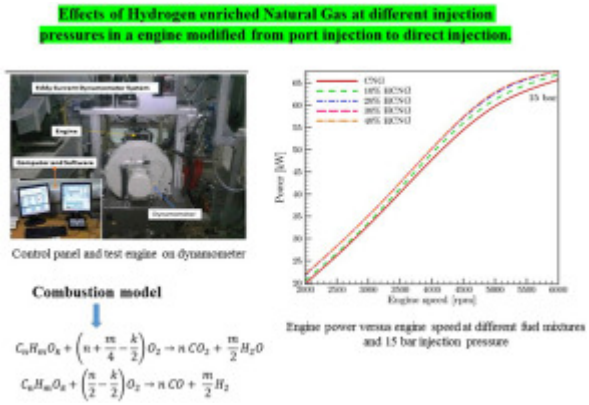
- Effect of different hydrogen blends at different speeds on engine exhaust emissions.
- Effect of variable injection pressure on performance parameters.
- Carbonic emission reduction of CNGDI compared to MPFI gasoline engine.

- Hydrogen addition is profitable for increasing fuel conversion efficiency.
- Piston bowl shape is beneficial for air-fuel mixing quality.

Abstract

This research investigates two main stages of conversion of port fuel-injected engine to direct-injection. The firs one is the modification of Injection mechanism of CNG direct-injection engine. The second stage is the investigation of Hydrogen effects as an alternative gaseous additive on CNG. The Results were measured at different injection pressures (15, 20, and 25 bar) and various hydrogen enrichment as additive fuel to CNG. At the first stage, results show that compared to the Gasoline port injection system, a CNG direct-injection engine can decrease CO_2 emission up to 59.5% and increase NO_x emission up to 56.9%. In the second stage, when Hydrogen being used in the fuel mixture, and an increase in the injection pressure (from 15 to 25 bar) in the DI engine along with 30%HCNG applies, the amounts of engine power and torque enhanced about 5.92% and 6.55%, respectively. Also, fuel conversion efficiency increased by up to 6.87% with 25 bar of injection pressure compared to conventional system. Emission reduction up to 32.5% for CO observed in case of using 40%HCNG relative to pure CNG. NO_x emission had a reverse correlation with Hydrogen concentration, it increased about 22.5% while using 40% of Hydrogen in volumetric blend HCNG.

Graphical abstract



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Keywords

Modified injection mechanism; Hydrogen; Natural gas; Direct injection; Fuel conversion efficiency

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