Numerical Investigation of Hydrogen Enrichment Effects on Combustion and Emissions in a Natural Gas/Diesel Dual-Fuel Engine

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Abstract:

Using gaseous fuels is a promising strategy for meeting strict emission regulations in internal combustion engines. The dual-fuel (DF) mode is a promising technique for natural gas (NG) utilization in internal combustion engines. However, maintaining engine performance and low emissions at low loads can be challenging, particularly regarding unburned hydrocarbon (HC) and carbon monoxide (CO) emissions. The use of Hydrogen can improve the combustion process of the engine at low loads. Hydrogen's unique physiochemical properties, such as higher flame speed and diffusivity in air, can effectively improve the performance and combustion characteristics of dual-fuel engines. As a carbon-free fuel, hydrogen can also reduce harmful emissions. The purpose of this research was to analyze numerically the effect of adding hydrogen on the combustion and exhaust emissions properties of a natural gas/diesel dual-fuel engine at different engine loads. In this aim, CONVERGE CFD code was used to simulate the 1/5th of the combustion cylinder covering the compression, spray, combustion and expansion strokes. The effect of hydrogen enrichment on the heat release rate, brake thermal efficiency and exhaust emissions were investigated.

Keywords:

Computational fluid dynamics (CFD), diesel engine, alternative fuels, Hydrogen, exhaust emissions.