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| **Title** | FUEL SAVING WITH HCNG IN THE INTERNAL COMBUSTION ENGINE |
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## ABSTRACT

Hydrogen and Compressed Natural Gas are great alternatives to the pure fossil fuels. Many researches confirm the advantages of using hydrogen and natural gas blended together for the internal combustion engine in both areas of improving performances and reducing emission levels. In a short to medium range terms, the air pollution around the globe could be significantly reduced by using HCNG in the internal combustion engine and in many other applications with the substitution of using HCNG as a main source of fuel or as a secondary source of fuel such as the dual fuel operation system in the diesel vehicle.

This paper investigates the performance characteristics, emission characteristics, smoke and fuel economy of using HCNG as a secondary source of fuels on a four cylinders D4D commonrail direct injection diesel engine comparing to the original diesel operation with diesel and HCNG blended operation. The experiment has been conducted with minimum pilot diesel injection into the engine and maximum additional HCNG as a secondary source of fuel to the internal combustion engine. It also examined the diesel consumption on the actual road with both pure diesel operation and diesel with HCNG operation on the chosen experimental diesel vehicle. In this experiment, the pilot diesel and HCNG blended were operated with special designed electronic controlled closed loop stepping motor diesel to CNG dual fuel system and hydrogen electrolyzer for the supply of hydrogen.

The results show that horsepower, torques and brake thermal efficiency of the engine increase with the diesel HCNG dual fuel operational mode comparing to the pure diesel operation by the average of 30%. The overall smoke also decreases by 10% with diesel HCNG operation as comparing to pure diesel operation resulting from increases of better engine efficiency and better lean burned combustion stability. With the total mass fuel consumption, the results reported that the distance travel per kilometer increased by 177% comparing to the normal distance travel with pure diesel alone. The results on the emission test in this experiment also indicated that the average CO emission decreased by 12.97%, HC emission decreased by 15.84%, $NO_x$ emission decreased by 1.16% and PM emission decreased by 9.14% with the diesel HCNG dual fuel mode comparing to the pure diesel operation from lowest RPM of 800 rpm to highest RPM of 4000 rpm.