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Simulations of Multi Combustion Modes Hydrogen Engines for Heavy Duty Trucks

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Abstract

The paper presents the numerical study of a diesel direct injection heavy duty truck engine converted to hydrogen. The engine has a power turbine connected through a clutch and a continuously variable transmission to the crankshaft. The power turbine may be disconnected and by-passed when it is inefficient or inconvenient to use. The conversion is obtained by replacing the Diesel injector with a hydrogen injector and the glow plug with a jet ignition device. The hydrogen engine operates different modes of combustion depending on the relative phasing of the main injection and the jet ignition. The engine generally operates mostly in Diesel-like mode, with the most part of the main injection following the suitable creation in cylinder conditions by jet ignition. For medium-low loads, better efficiencyiy is obtained with the gasoline-like mode jet igniting the premixed homogeneous mixture at top dead centre. It's permitted at higher loads or at very low loads for the excessive peak pressure or the mixture too lean to burn rapidly. The hydrogen engine has better efficiency than Diesel outputs and fuel conversion. Thanks to the larger rate of heat release, it has the opportunity to run closer to stoichiometry and the multi mode capabilities. The critical area for this engine development is found in the design of a hydrogen injector delivering the amount of fuel needed to the large volume cylinder within a Diesel-like injection time.

Keywords: heavy duty truck engine, hydrogen, alternative fuels, power turbine

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