DEVELOPMENT AND PERFORMANCE EVALUATION OF A HYDROGEN FUELLED SPARK IGNITION ENGINE FOR VEHICULAR APPLICATION

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By

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CERTIFICATE

1. We are satisfied that the thesis presented by Mr. Kumar G.N. is worthy of consideration for the award of the degree of Doctor of philosophy and is a record of the original bonafide research work carried out by him under our guidance and supervision and that the result contained in it have not been submitted, in part or full to other university or Institute for the award of any degree/diploma.
2. We certify that he has pursued the prescribed course of research.

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ABSTRACT

An experimental study was conducted to determine the performance of a single cylinder spark ignition engine fuelled with Hydrogen gas and was subsequently prepared for the vehicular application. The conventional engine was modified with the mountings of gas injector and sensors. The sensors were connected to electronic control unit (ECU) for actuation of solenoid injector and spark plug. The purpose of using ECU is to control precisely the quantity of fuel injection and ignition timing so that backfire and pre-ignition problems could be minimized.

During the developmental phase, emphasis was given to the optimization of operating parameters like Duration of Injection, Start of Injection, hydrogen fuel supply pressure to the injector and Ignition timing using ECU by restricting an emission level of 1 gm/Kwhr at the exhaust.

The experiments were conducted using hydrogen fuelled engine test rig at several throttle positions and at different engine speeds by applying load on the engine. It was observed that, the maximum power produced by the engine for hydrogen operation is at 60% throttle position with a power of 2.70KW corresponding to 2400 rev/min as compared to 3.3KW for petrol operation. The improved thermal efficiency was also observed in the hydrogen fuelled engine because of high flammability limit and high burning velocity of the hydrogen fuel. In all the operating conditions it was observed that NO_X was limited to nearly 1 gm/KWhr.

Further, the AVL-BOOST software was used to simulate a single cylinder four stroke spark ignition engine to predict engine behavior over wide range of operating variables to screen concepts prior to major hardware programs, to determine trends and tradeoffs. A model was developed using BOOST program in an interactive preprocessor, which assists

with the preparation of the input data for the main calculation program. Results analysis were supported by an interactive post-processor and the output is the performance of engine at different speeds and WOT conditions. The simulation results studied including BMEP, BSFC, air-fuel ratio, Brake power, and volumetric efficiency. It was observed that the engine simulation data satisfactorily followed the experimental data.

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