THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE PERFORMANCE AND EMISSION CHARACTERISTICS OF COMPRESSION IGNITION ENGINES WITH BIO-GAS SUBSTITUTION

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by

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CERTIFICATE

This is to certify that the thesis entitled 'Theoretical and Experimental Investigations on the Performance and Emission Characteristics of Compression Ignition Engines with Bio-Gas Substitution' being submitted by Mr. Y. Nagendra Prasad, for the award of the degree of Doctor of Philosophy and is a record of the candidate's original bona fide research work carried out by him under our guidance and supervision. The matter embodied in the thesis has not been submitted in part or full, elsewhere for the award of any degree/diploma.

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ABSTRACT

The theoretical and experimental investigations undertaken to visualise the potential of bio-gas as a compression ignition engine fuel are reported in this thesis.

The analytical study contemplates the simulation of all the engine processes in a four stroke, single cylinder, direct injection compression ignition engine. The salient features of the simulation model include (1) a thermodynamic combustion model for the neat diesel and dual fuel (with diesel and bio-gas) operations; (2) a kinetic model to predict pollutant species such as carbon monoxide and nitric oxide; (3) a gas exchange model based on a finite difference scheme for evaluation of properties in intake and exhaust systems; (4) estimation of wall temperatures; and (5) evaluation of indicated efficiency and power output. Significant parametric studies have also been conducted to indicate the predictive capabilities of the developed model.

Comprehensive experiments have been conducted on a single cylinder direct injection compression ignition engine, not only to obtain the necessary data to validate the model, but also to study the performance and emission characteristics of dual fuel operation at several

proportions of bio-gas substitution relative to neat diesel operation, over the entire range of engine operating conditions,encompassing broad changes in compression ratio, injection timing, speed and load. Methods to improve performance of dual fuel operation have been outlined.

Experiments have also been conducted on an indirect injection compression ignition engine to study the performance and emission characteristics of dual fuel operation,relative to neat diesel operation until the presence of knock is sensed.

A satisfactory correlation has been found between the theoretically predicted and experimentally obtained performance and exhaust emission data generated for both neat diesel and dual fuel operations.

The above comprehensive theoretical and experimental studies have shown that bio-gas is a versatile substitute fuel for compression ignition engines,which can be used in the existing diesel engines without significant engine modifications. Its use can go a long way to meet the energy needs of the agriculture sector and also reduce the menace of diesel smoke from compression ignition engines.

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