Studies on the Nitrogen Oxides Emissions and Performance of a Spark Ignition Engine with Exhaust Gas Recirculation (E.G.R.) using Gasoline and Methanol Fuels

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CERTIFICATE

I, the undersigned, certify that the thesis entitled "STUDIES ON THE NITROGEN OXIDE EMISSIONS AND PERFORMANCE CHARACTERISTICS OF A SPARK IGNITION ENGINE WITH EXHAUST GAS RECIRCULATION (E.G.R.) USING GASOLINE AND METHANOL FUELS" which is being submitted by Mr. J.P. Subrahmanyam in fulfilment of the requirements for the award of the degree of 'Doctor of Philosophy' in the Faculty of Engineering of the Indian Institute of Technology, New Delhi, is a record of the candidate's own bonafide research work carried out under my guidance. The matter embodied in this thesis has not been submitted in part or in full, elsewhere, for the award of any degree or diploma.

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TO MY PARENTS

ABSTRACT

Theoretical and experimental investigations have been carried out to study the effect of exhaust gas recirculation (EGR) on performance and nitric oxide emission characteristics of a spark ignition engine operating on gasoline and methanol.

The theoretical study involves the application of a combustion model to predict the engine combustion characteristics, a chemical kinetic model to predict exhaust nitric oxide emission characteristics, and calculations to predict performance characteristics. Significant parametric studies have also been carried out to indicate the capabilities of the model.

Extensive experiments have been conducted on a single cylinder and two different automotive type four cylinder four stroke spark ignition engines. Exhaust gas has been tapped from the exhaust manifold and cooled to ambient temperature before being admitted into the intake manifold below the carburetor.

Experiments have been conducted not only to validate the theoretical model but also to generate extensive data at different operating conditions like speed, equivalence ratio, and quantity of recirculated exhaust gas for methanol relative to gasoline.

An empirical correlation between equivalence ratio and exhaust nitric oxide for different rates of EGR has been obtained.

A very good correlation has been found between the theoretical predictions and experimental observations for both gasoline and methanol fuels.

These studies show that for low rates of EGR (upto 10 per cent), there is a considerable reduction in emission of exhaust nitric oxide with a very small loss in power and a slight gain in specific energy consumption. The superior combustion characteristics of methanol relative to gasoline makes it more tolerant to charge dilution by EGR. By providing charge dilution, flame speeds are reduced. This is beneficial when fuels with high flame speeds, like hydrogen, are used in spark ignition engines.

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