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Design and Analysis of Petrol Engine to Increase the Efficiency by using Water Injection

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Abstract: In internal combustion engines, water injection, also known as anti-detonate injection, is spraying water into the cylinder or incoming fuel-air mixture to cool the combustion chambers of the engine, allowing for greater compression ratios and largely eliminating the problem of engine knocking (detonation). This effectively reduces the air intake temperature in the combustion chamber, meaning that performance gains can be obtained when used in conjunction with a supercharger, turbocharger, altered spark ignition timing, and other modifications. The reduction of the air intake temperature allows for a more aggressive ignition timing to be employed, which increases the power output of the engine. Depending on the engine, improvements in power and fuel efficiency can also be obtained solely by injecting water. Water injection may also be used to reduce NOx or carbon monoxide emissions. used in 150cc petrol engine.
Keywords: SI engine; water injection; co emissions; fuel consumption; temperature emissions reduction; engine knocking.

I. INTRODUCTION

Water has the very high heat of vaporization. As the ambient temperature water is injected into engine, heat is transferred from hot cylinder head/intake air into the water. This causes it to evaporate, cooling the evaporate charge. The water vapour will displace some air, negating some of the denser intake charge benefit. Knocking is generally more of a problem in forced induction engines rather than naturally aspirated so this can be a useful aid in its prevention. On Electronic ignition system the ignition timing is generally retarded to prevent knock from occurring but with water injection it can be advanced closer to Maximum Brake Torque (MBT) timing for additional power.The Electronic fuel injector consists of a small tank, pump, microcontroller unit, engine set up and fuel injector. The microcontroller unit is used to setting the fuel injection period. The fuel pump is used to suction the fuel in to deliver the fuel injector. The 12 volt fuel injector is used to inject the fuel in to the cylinder. This 12v fuel injector is controlled by the microcontroller unit.

A. Stages Of Combustion In Si Engines

A typical theoretical pressure crank angle diagram during the process of compression (a-b) combustion(b-c) and expansion (c-d) in an ideal four stroke spark ignition engine. In an ideal engine as can be seen from the diagram the entire pressure rise during combustion takes place at constant volume i.e., TDC. However in an actual engine this does not happen. The detailed process of combustion in an actual engine SI engine is described below.

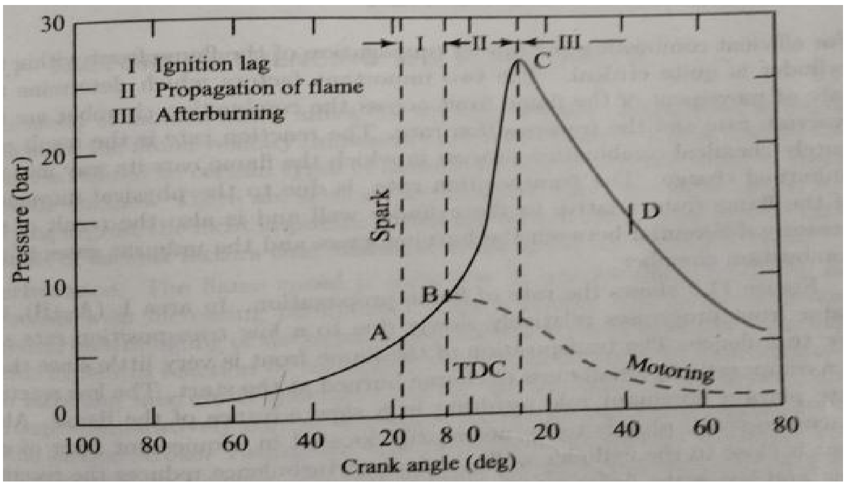

Fig 1.0.Combustion In Si Engines

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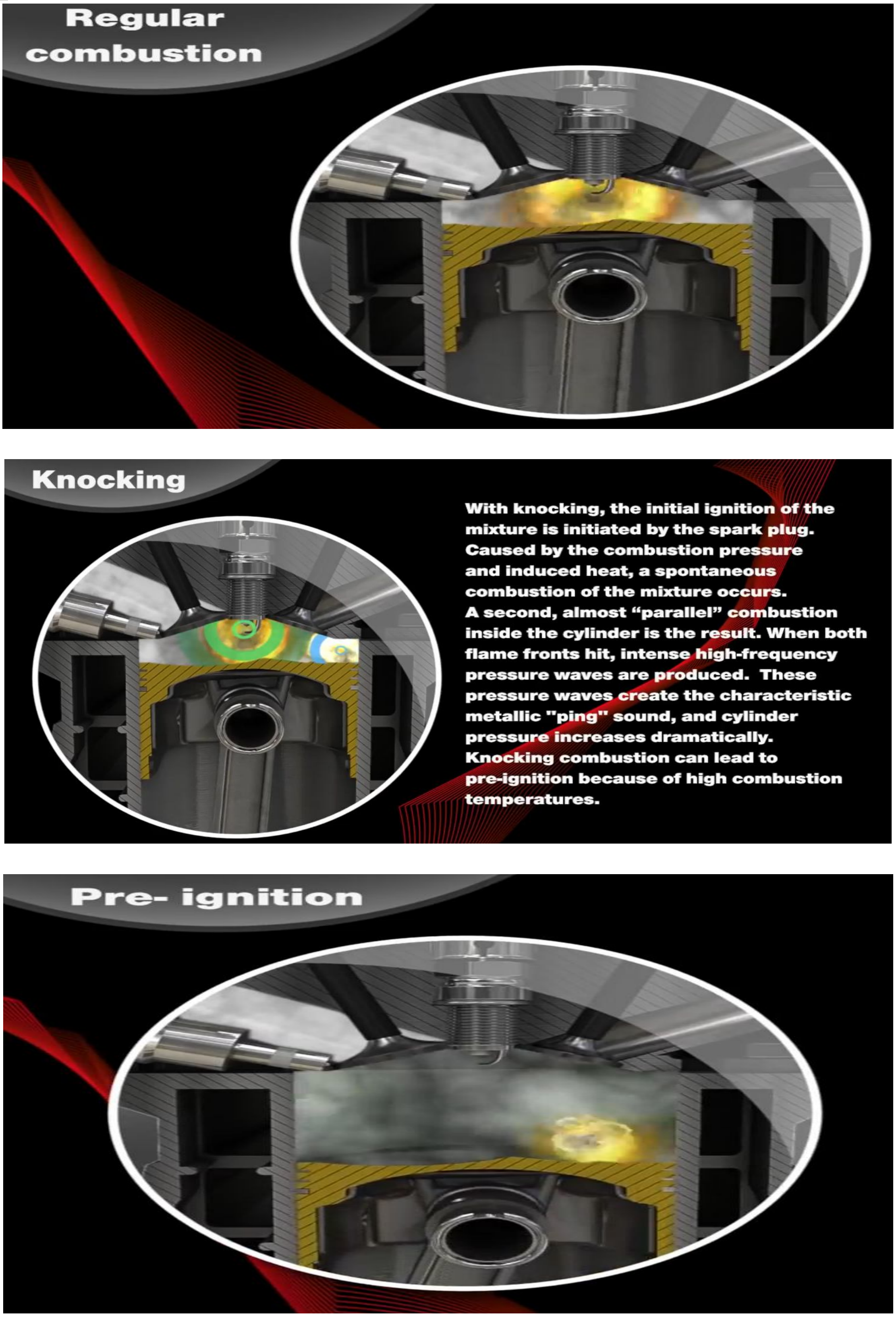

Fig 1.0 regular compretin,knocking,pre ignition

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II. METHODOLOGY

A. 2D Model

The two dimensional model is a basic view of any object in which the object is projected. The 2D model is created using any two axes, say x and y axes. The basic software used to create a 2D model is auto cad. In this modeling, we can create a single view of the object. It is similar to the drafting of engineering graphics. The basic 2D sketch can be converted to 3D model.

B. 3D Model

The Three dimensional models is one which shows the natural viewing of the object as we see in real. It is very useful in establishing the object in human understandable view. To create a 3D model, we use of three axes x, y and z. There is much software for creating a 3D model. Some software which is used to create 3D model are AUTO CAD, PRO E, CREO, solid works, etc.

C. Specification of Engine

TABLE I

PARAMETER	DETAIL
Engine	Single Cylinder, 4-Stroke, SI engine
Cooling	Air Cooled
Bore	57.3mm
Stroke	57.8mm
Max .Brake Horse Power (BHP)	13.4bhp @ 8500rpm
Maximum .Torque	12.84Nm @ 5500rpm
Transmission	5speed gear box
Type of Fuel used	Petrol
Arrangement	Vertical
Cubic capacity	149.1cc

III.DESIGN

A designer's sequence of activities is called a design process while the scientific study of design is called design science.
Another definition of design is planning to manufacture an object, system, component or structure. In a broader sense, design is an applied art and engineering that integrates with technology.Design can be created using various design software. We have lots of design soft wares for creation of a design according to our specifications.
Types of design software:

1) AUTO-CAD
2) PRO-ENGINEER
3) ANSYS
4) SOLIDWORKS
5) CFD
6) CATIA
7) CREO

Auto-CAD is a commercial computer aided design and drafting software application. It was developed and marketed by “Autodesk. Auto-CAD is used across a wide range of industries, by architects, project managers, engineers, graphic designers, town planners and many other professionals.
Software used for design the vehicle:
We use of the Auto-CAD mechanical 2018 version for better designing.

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A. Design Parameter

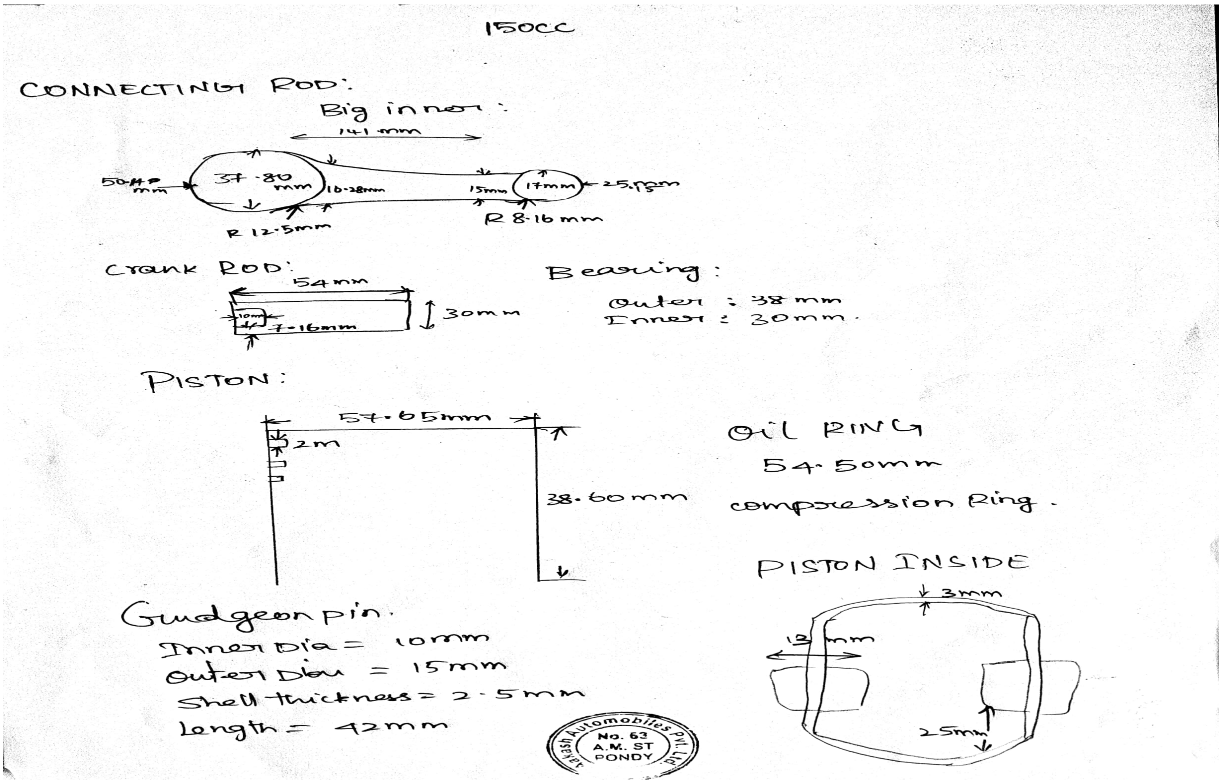

Fig A.1 Design parameter

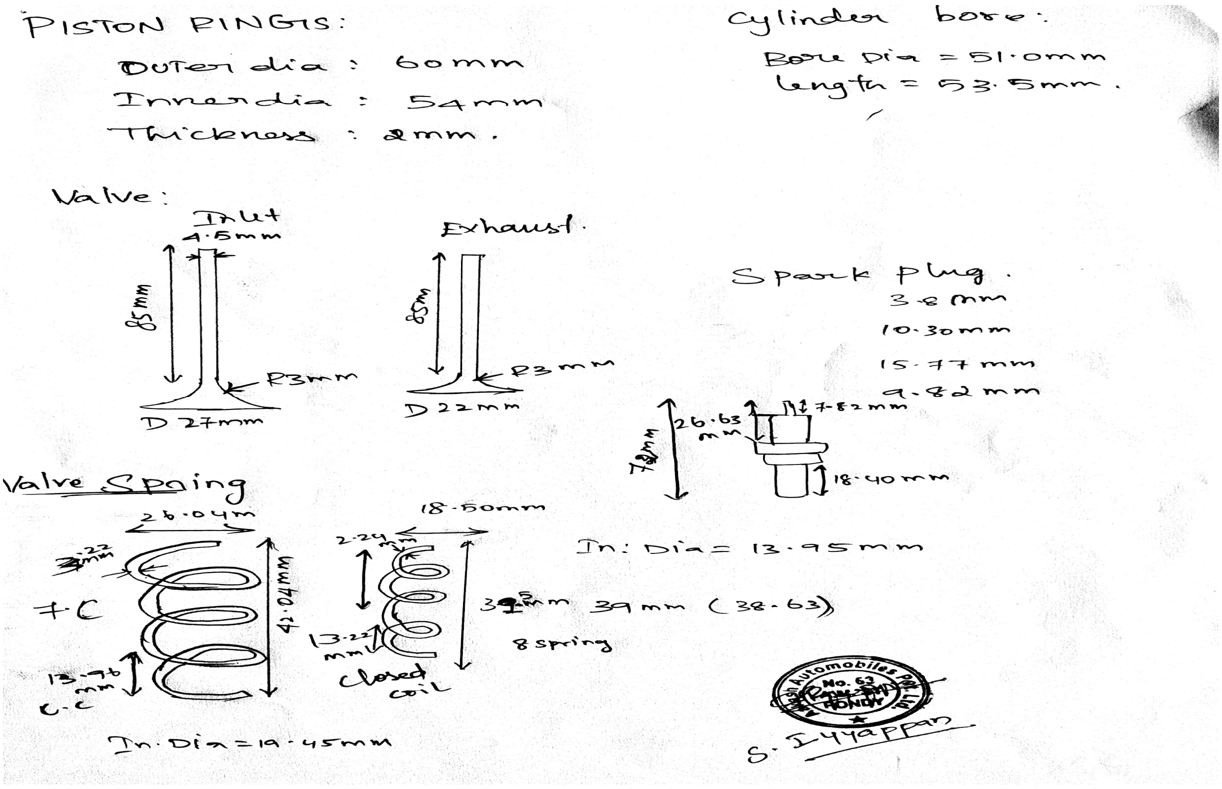

Fig A.1 Design parameter

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B. Design for 3D Model

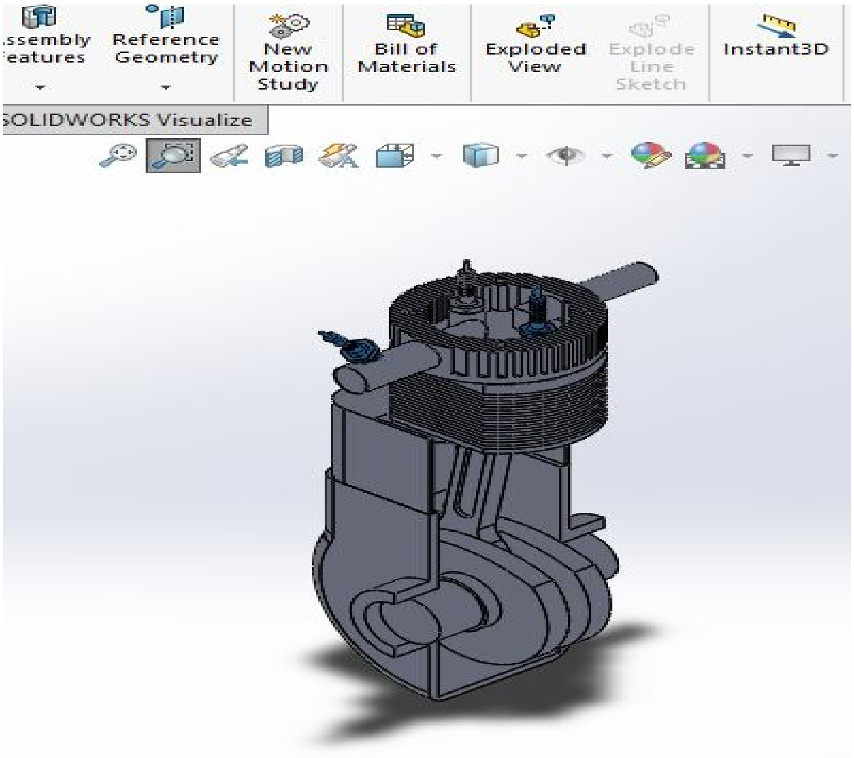


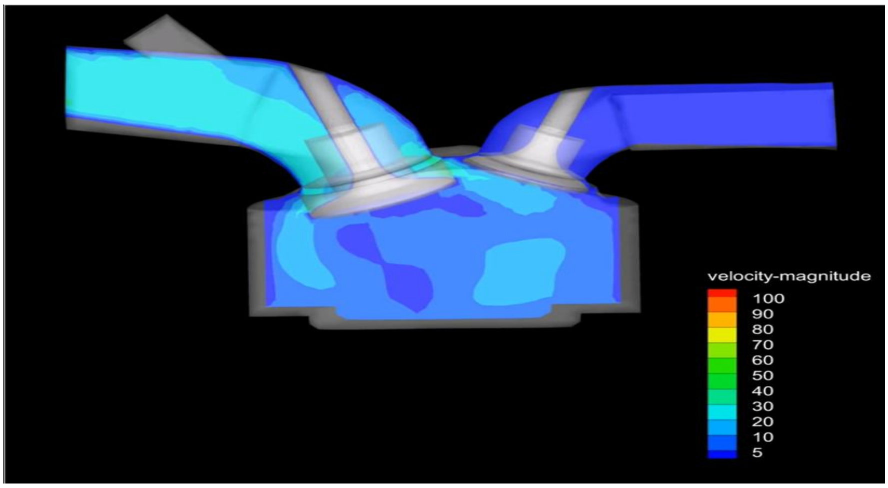
Fig b. Design model

IV.FINAL OUTPUT

The present project work has provided design research investigates the effects of water injection on the engine performance, fuel consumption and exhaust gas temperature for a four stoke SI engine, the following conclusions were investigated from the experiment.

A. The exhaust gas temperature decreases as the mass of water to fuel ratio increases
B. In the exhaust gas the level of carbon monoxide decreases as the mass of water to fuel ratio increases
C. The consumption of fuel decreases as the mass of the water to fuel ratio increases

1) Section Stroke



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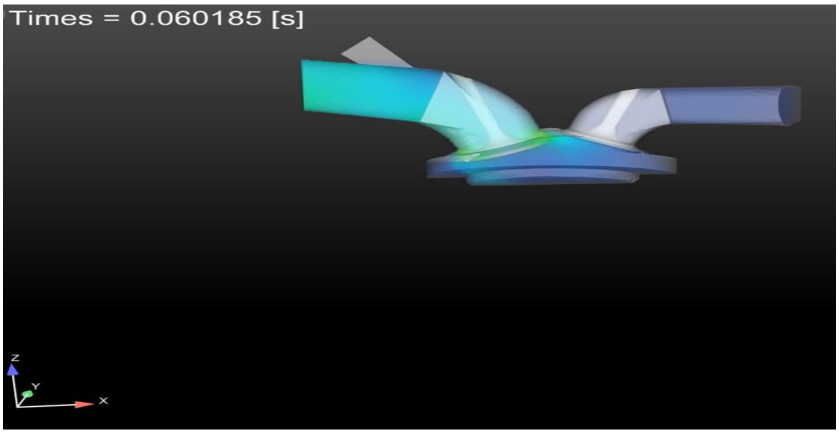
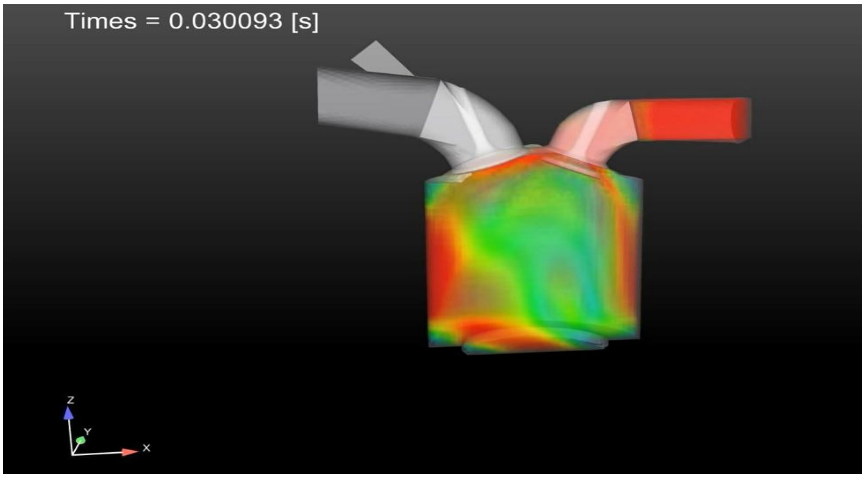
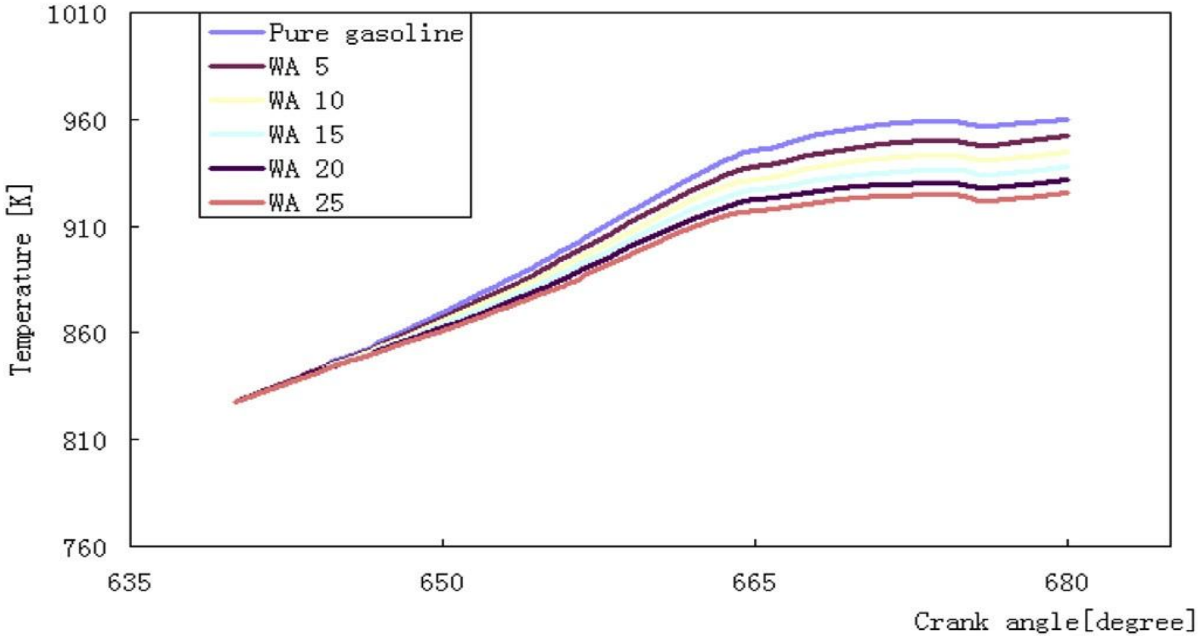
2) Compression Stroke





3) In-Cylinder Temperature



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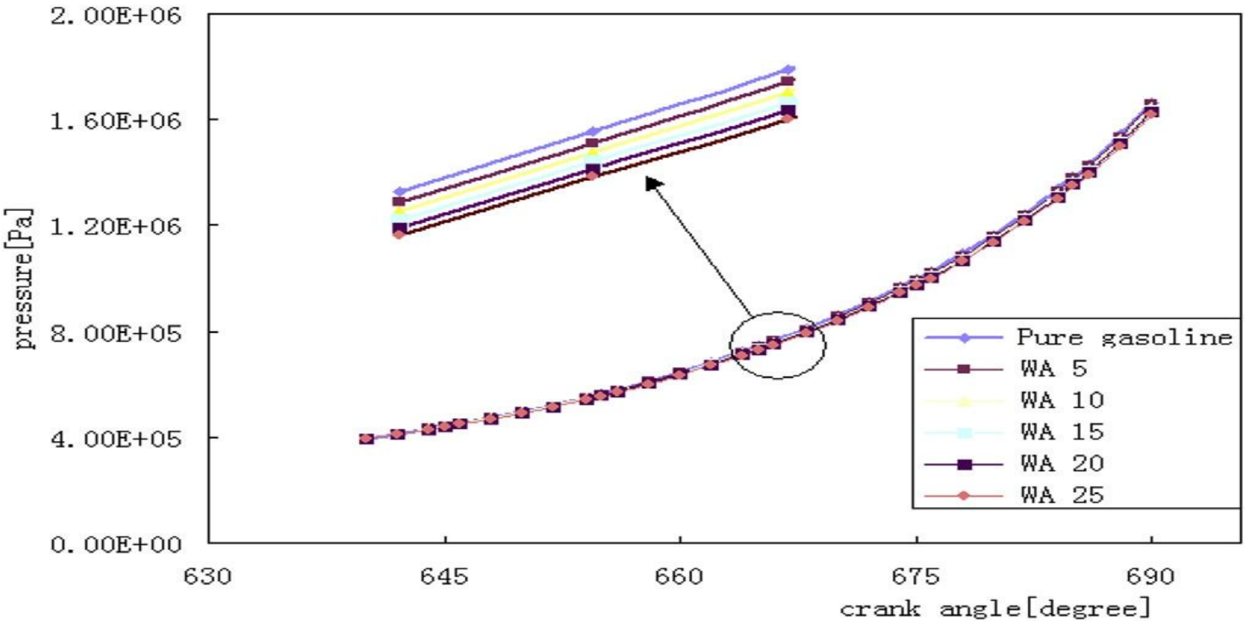
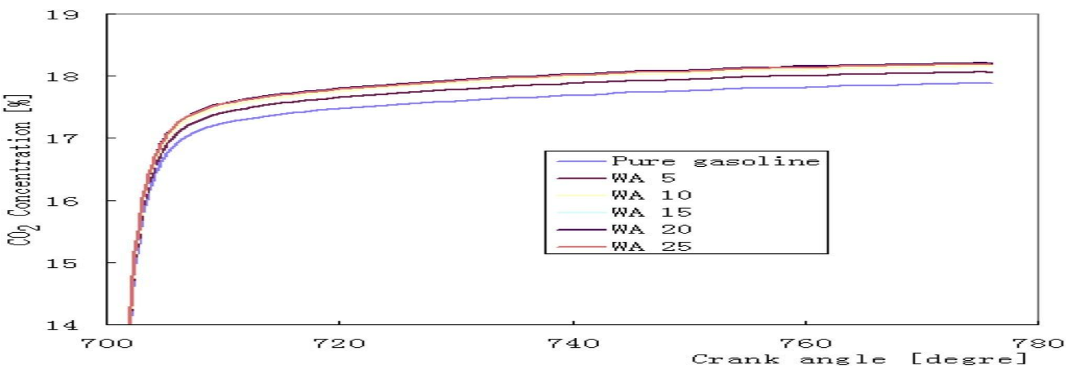
4) Intake Pressure



5) Exhaust Emission



V. CONCLUSIONS

Gasoline engine have been investigated. The various water mass ratios were injected directly into the cylinder at the latter part of the compression stroke. The optimum water ratio was determined as 15% for a given fuel mass in terms of engine performance and emissions (including NOx and CO). The results were compared with those obtained for the pure gasoline case. It was seen that the mean indicated pressure in cylinder at combustion stroke increased leading to an increase in power output. Similarly, the NOx emissions were decreased by 34.6% on the average.

The important effect of direct water injection was the reduction of inlet temperature as a direct consequence of water vaporization, which resulted in a large decrease in in-cylinder temperature at the latter stages of the compression stroke. Water injection was helpful for improving the anti-detonation properties of the fuel, higher performance in the form of higher compression ratios. Using water injection could also permit the use of fuel with lower octane number ratings. Water injection does not only improve the power output of an engine, but also improves the fuel economy by careful design in of the engine. The use of water in the cylinder has to be studied in detail at different engine speed and load conditions. By experimental studies, the aspects such as the effect of water vapor on the combustion process integrated with the fuel metering and spark timing control system of the engine needs further research. Once these problems are dealt with, the system could be applied to engines for the purpose of emission reduction and improved power output as well as downsizing of the engine for further reduction in emissions.

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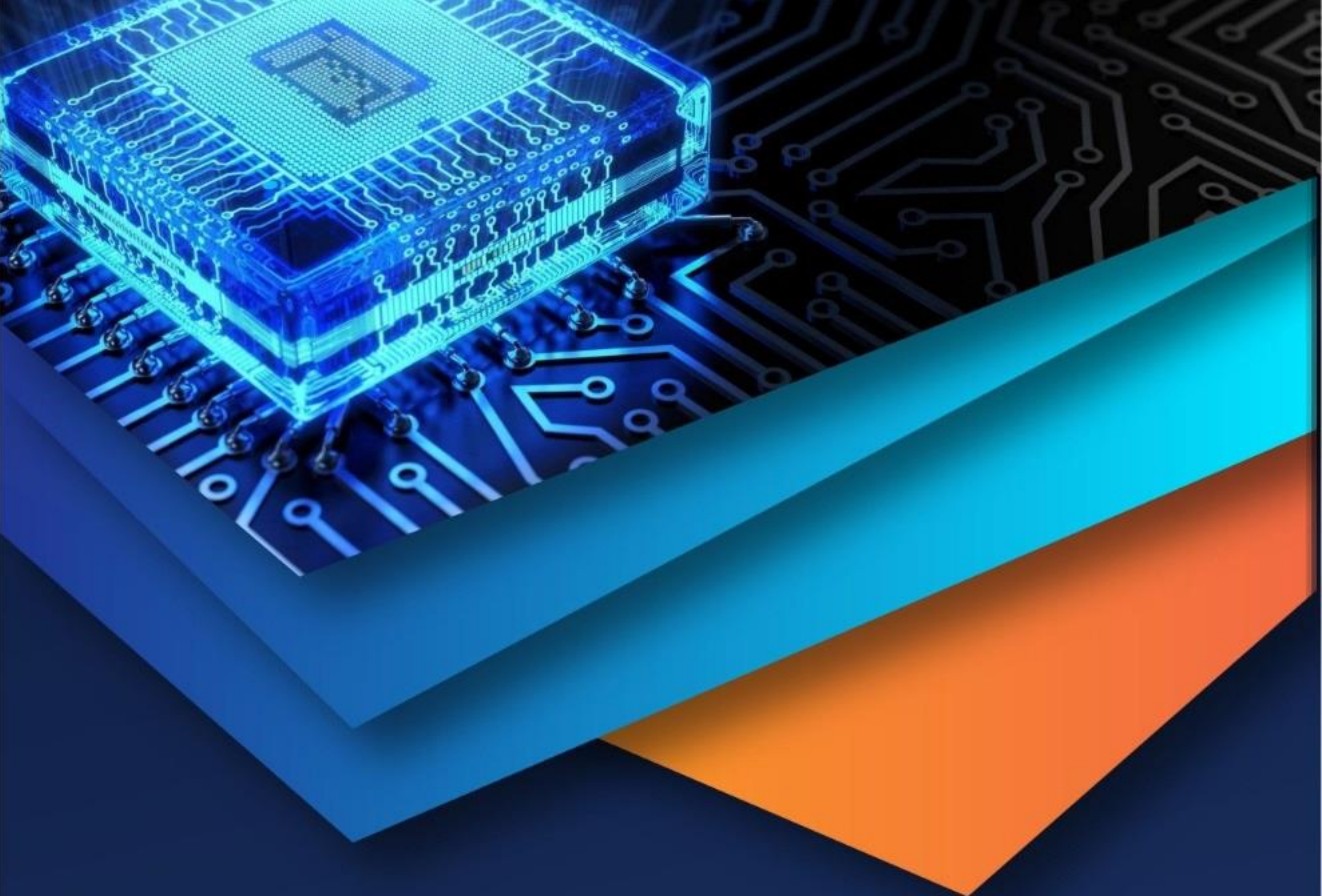

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