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Experimental Setup of Water Injection in Four Stoke SI Engine

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Abstract: ***Faster economic growth all around the globe makes the market competitive. Market challenges need industry to be more focused and qualitative as well as quantitative in all industry. The SI (spark ignition) engine has become widely used, inventors have sought ways to improve its performance and reduce emission. Introduction of water into gasoline SI engines has been researched for many years to improve the engine in various ways, including: to lower NOx (oxides of nitrogen) emissions, to lower CO2 (carbon di oxide) emissions, to boost power output, to increase efficiency, to cool the engine. One detrimental effect of water addition is that it tends to increase the HC (hydrocarbon) emissions. There are various methods for adding water in SI engines such as: inlet manifold water injection, water mixed with fuel and direct injection of water into the combustion chamber. Water at room temperature is injected into the cylinder during the combustion through the intake manifold to control the oxy fuel combustion temperature and reaction rate. Moreover, evaporation of the water mist increases the mass of working fluid so indicated thermal efficiency of the cycle is enhanced. However, limited research has been found on water injection in combination with increased compression ratios. These experiments were done using manifold water injection on a single cylinder SI engine. The results shows that brake thermal efficiency increases significantly and considerable amount of NOx emission decreases.***

Keywords: ***direct injection, SI engine, water injection, compression stoke.***

I. INTRODUCTION

Today, automobiles play an unimaginable role in the social, economic and industrial growth of any country. After the introduction of internal combustion engines, the automobile industry has seen a tremendous growth. The internal combustion engine is an engine in which the combustion of a fuel (generally, fossil fuel) occurs with an oxidizer (usually air) in a combustion chamber. In an internal combustion engine the expansion of the high temperature and high pressure gases, which are produced by the combustion, directly applies force to components of the engine, such as the pistons or turbine blades or a nozzle and by moving it over a distance, generates useful mechanical energy. The components of SI engine. The components are piston, cylinder head, cylinder block, crankshaft, connecting rod, camshaft, cam and spark plug. Gasoline or petrol engines are also known as spark-ignition engines. Petrol engines take in a flammable mixture of air and petrol which is ignited by a timed spark when the charge is compressed. As shown in figure 1.2, The first four stroke spark-ignition engine was built in1876 by Nicolaus August Otto ,a self-taught German engineer at the Gas-motor eufabrik Deutz factory near Cologne, for many years the largest manufacturer of internal-combustion engines in the world. It was one of Otto's associates-Gottlieb Daimler-who later developed an engine to run on petrol which was described in patent number4315 of1885. He also pioneered its application to the motor vehicle Four stroke Spark-ignition engines require four piston strokes to complete one cycle an air-and-fuel intake stroke moving outward from the cylinder head, an inward movement towards the cylinder head compressing the charge, an outward power stroke ,and an inward exhaust stroke. Emissions of many air pollutants have been shown to have variety of negative effects on public health and the natural environment. Emissions that are principal pollutants of concern include• Hydrocarbons (HC) - A class of burned or partially burned fuel, hydrocarbons are toxins. Hydrocarbons are a major contributor to smog, which can be a major problem in urban areas. Prolonged exposure to hydrocarbons contributes to asthma, liver disease, lung disease, and cancer. Regulations governing hydrocarbons vary according to type of engine and jurisdiction; in some cases, "non-methane hydrocarbons" are regulated, while in other cases, "total hydrocarbons" are regulated • Carbon monoxide (CO) - A product of incomplete combustion, inhaled carbon monoxide reduces the blood's ability to carry oxygen; overexposure (carbon monoxide poisoning) may be fatal. (Carbon monoxide persistently binds to hemoglobin, the oxygen-carrying chemical in red blood cells, where oxygen (O2) would temporarily bind; the bonding of CO excludes O2 and also reduces the ability of the hemoglobin to release already-bound oxygen, on both counts rendering the red blood cells ineffective • Sulphur oxide (SOx) - A general term for oxides of Sulphur, which are emitted from motor vehicles burning fuel

containing Sulphur. Reducing the level of fuel Sulphur reduces the level of Sulphur oxide emitted from the tailpipe. •Volatile organic compounds (VOCs) - Organic compounds which typically have a boiling point less than or equal to 250 °C; for example chlorofluorocarbons (CFCs) and formaldehyde. Volatile organic compounds are a subsection of Hydrocarbons that are mentioned separately because of their dangers to public health.

II. PROBLEM DEFINITION

A. *Existing System*

1) Brake thermal efficiency of SI Engine is in the range of 15%
2) NO_X emissions are more in nature.

B. *Objectives Of Project Work*

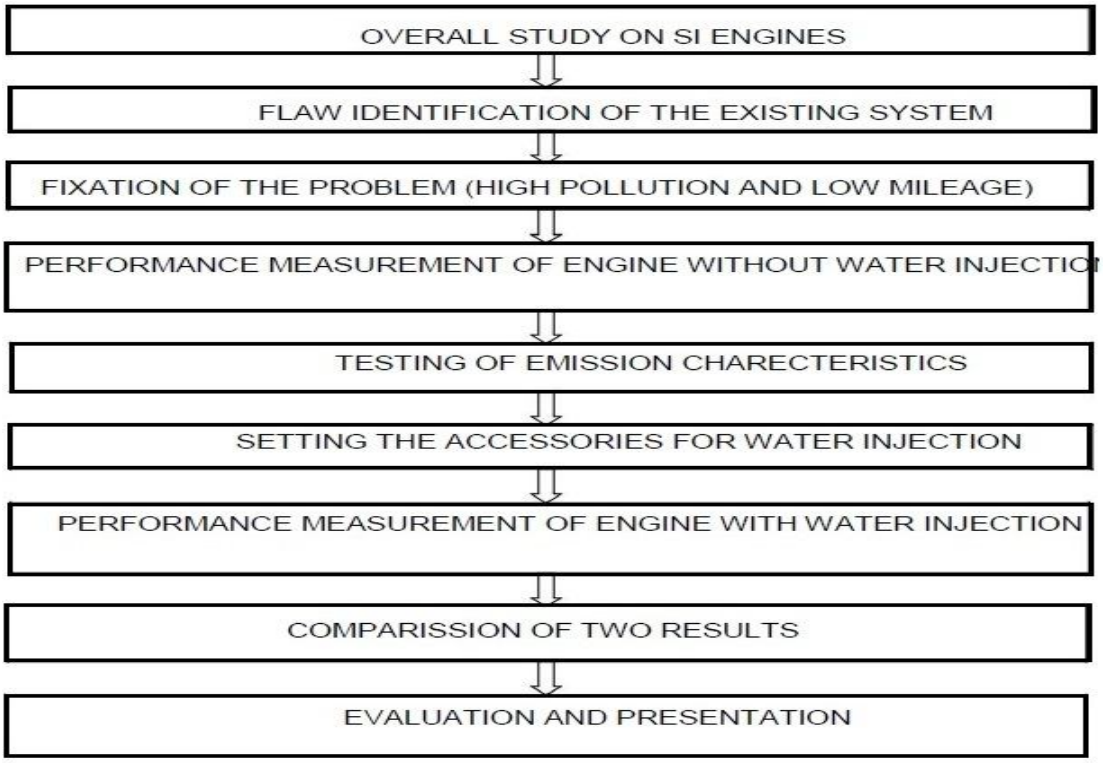
1) To increase the saturation level of inlet air.
2) To decrease the temperature of inlet air.
3) To ensure complete combustion of air-fuel mixture.
4) To decrease hazardous emission of exhaust gas.
5) Efficiency is to be increased.

C. *Proposed System*

Here in our project inlet air has to be supplied at its saturation point to the spark ignition engine. It can be done by fitting an injector nearer to the inlet manifold which injects the water into the inlet air in the mist form. Thus with the help of this setup inlet air can be made to attain its saturation point. Thus by this technique there occurs an increase the engine's performance through perfect combustion of the air fuel mixture because the saturated air has high amount of hydrogen and oxygen within it and the oxygen present in the air enhances the combustion process and hence the utility of the fuel is also optimized which results in the enhancement of vehicle's mileage and the prodigious amount of harmful emission gets reduced by perfect combustion of air-fuel mixture.

III.SOLUTION METHODOLOGY

Planning and execution are the heavy weights of any work, So here the total work flow pattern of this project work which can be clearly defined by this as follows



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A. Test Procedure

1) Experiment With Normal Air: The e platina engine present at automobile engineering laboratory and by using this setup the time consumption for 10cc of fuel at load conditions and no load conditions and by using the readings the efficiency of engine is measured. The table shows the readings taken in platina engine without water injection. The readings are taken for 10cc fuel consumption at 3500 rpm when normal air given as inlet. The set of readings are taken for both load and no load conditions.

Load condition	Torque	Fuel consumption(cc)	Time(sec)
No load (3500 rpm)	0	10	52
With load (3500 rpm)	5	10	46

2) Experiment With Humidified air: The following shows the experimental setup for water injection at inlet manifold. The table shows the readings taken in platina engine with water injection. The readings are taken for 10cc fuel consumption at 3500 rpm when normal air given as inlet. The set of readings are taken for both load and no load conditions.

Load condition	Torque	Fuel consumption(cc)	Time(sec)
No load (3500 rpm)	0	10	60
With load (3500rpm)	5	10	54

B. Comparison Of Emission In Different Air Inlet Condition: The table shows the comparison of emission in different inlet air conditions in Bajaj platina 102cc engine. The elements of exhaust air is compared for two different air conditions such as normal air and humidified air with various speed.

Elements of exhaust gas	Normal air		Humidified air	
	1000 rpm	2000 rpm	1000 rpm	2000 rpm
CO (%vol)	0.36	0.21	0.4	0.3
CO_2(%vol)	5	2.6	3.10	1.90
HC(ppm)	270	203	300	215
O_2(%vol)	14.45	16.25	16.7	17.58
NO_X(ppm vol)	52	28	24	15

IV. RESULTS AND DISCUSSION1 DISCUSSION ON PERFORMANCE

Hence from the above done experimentation and calculations we could clearly infer that saturated air cuts down the prodigious amount of hazardous emission of exhaust gases and also gives a hike in brake thermal efficiency, indicated thermal efficiency, IMEP and BMEP as shown in table 7 but the value will remain same in mechanical efficiency.

S.NO	DESCRIPTION	NORMAL AIR	HUMIDIFIED AIR
1	Fuel Consumption(kg/sec)	$1.606x10^{-4}$	$1.368x10^{-4}$
2	Fuel Power(Kw)	7.70	6.56
3	Specific fuel consumption (kg/Kw.hr)	0.315	0.268
4	Brake Power(KW)	1.83	1.83
4	Indicated Power(KW)	2.83	2.83
5	Mechanical Efficiency(%)	64.66	64.66
6	Brake Thermal Efficiency(%)	23.76	27.89
7	Indicated Thermal Efficiency(%)	36.75	43.14
8	Brake mean effective pressure(bar)	6.15	6.15
9	Indicated mean effective pressure(bar)	9.51	9.51

C. Discussion On Emission

The greatest payback of this project lies in this area because we could witness a dramatic reduction in the hazardous emission of exhaust gases humidified air is given as an inlet here which decreases the temperature slightly which in turn decreases the emission of NOx slightly as shown in the table 4.1. NOx is considered normal air has 52ppm vol at 1000rpm and 28ppm vol at 2000rpm and humidified air has decreased NOx percentage of 24ppm vol at 1000rpm and 15ppm vol at 2000rpm. And HC, CO, CO2gases are increases slightly.

V. CONCLUSION

A. Combustion Process Gets Smoother and Complete due to the Require Amount of Oxygen Inclusion

1) Torque and pickup gets increased due to better combustion.
2) Air pollution gets decreased
3) Brake thermal efficiency is increased
4) Considered amount of NOx decreases.

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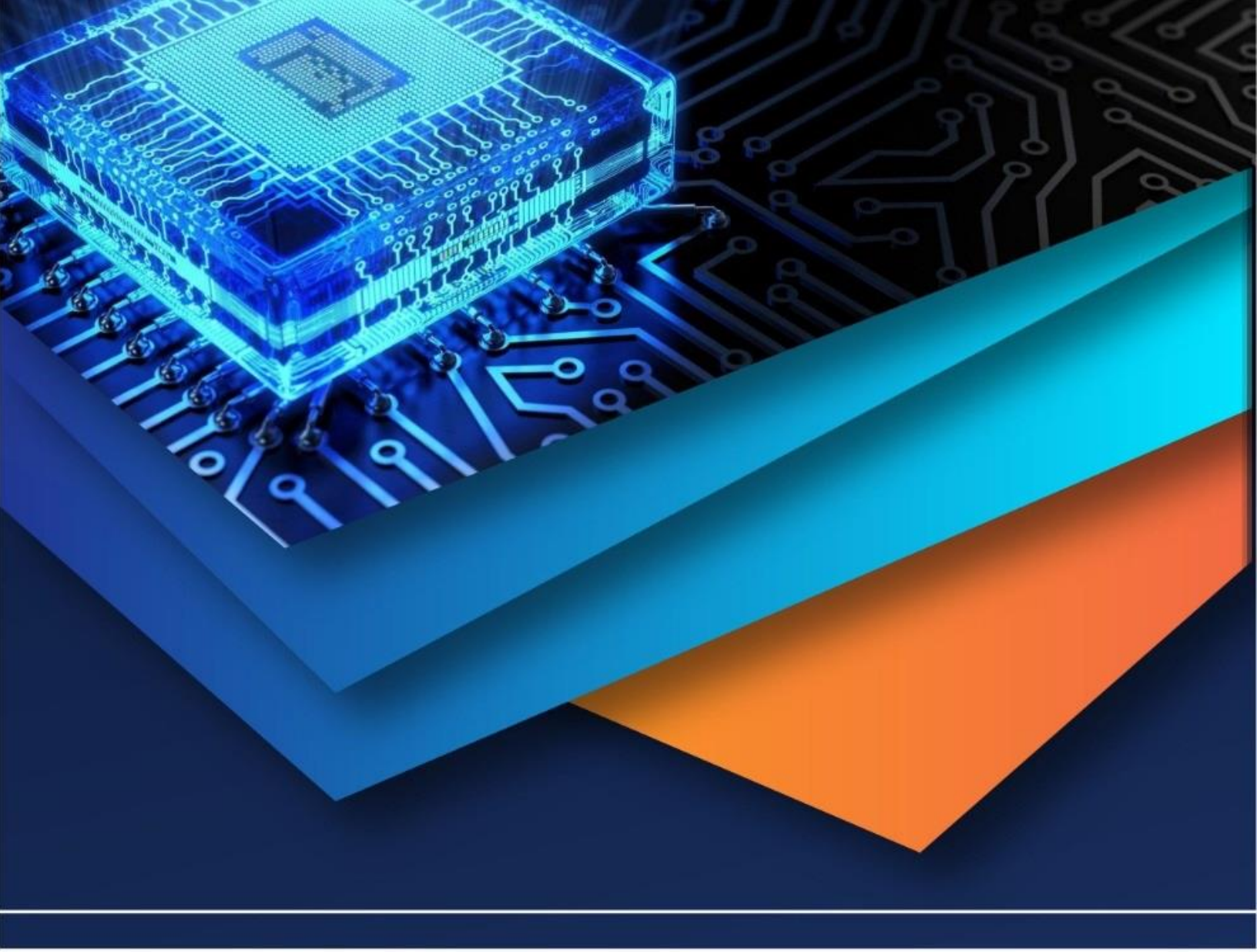

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