Water Methanol Injection based Four Stroke Single Cylinder SI Engine Using an Electronic Control Unit

P. Vignesh, G. Mahesh, P. Manikandan

Abstract*: Now a days there is an Increasing rate of pollution which cause the environmental as well as human hazards. Pollutions are mostly caused from two main areas one is from industrial areas and another one is automobiles. In recent technologies, researchers have found various alternative methods to reduce emission, we taken an initiative to introduce water with alcohol in precise measure to increase performance and reduction of emission in all standards of automobile. Reduction of exhaust emission is attained by adding a secondary fuel along with the SI engine primary fuel. Water and methanol mixture is a secondary fuel injected into the combustion chamber with the support of an injector. An inlet manifold is modified to fix the injector and the flow of H_2O (water) and CH_3OH (methanol) mixture and injection timing is controlled by electronic control unit (ECU). By the experimental investigation of this project, we had studied that the emission from the engine is reduced, the fuel consumption of the vehicle is decreases, and it has improve the inter-cooling capacity of engine and efficiency of the engine improved.

Keywords* : Fuel efficiency; Emission; Four Stroke Single Cylinder; SI Engine; Water Methanol Injection.

I. INTRODUCTION

The objective is to provide a good combustion in a four-stroke SI engine with the help of anti-detonate injection and to reduce the major exhaust emissions [1]. Using additives is one of the acceptable choices among all available measures. Introduction of additives into the internal combustion engine represents the Best Available Technology (BAT) [2]. There is no chance for abnormal influence of exhaust gas emission through this system. A modified inlet manifold is used in the present investigation it helps to spray the additives in correct ratio; these will not be directly injected into the combustion chamber because it may affect the normal engine function [3]. As of late, the worry over the earth has prompted generous activity by the official and authoritative parts of government both the state and bureaucratic level (USA) [4]. The wellspring of air contamination is predominantly autos, modern units and power plants. It is evaluated that 20% to 30% of air contamination emerges from vehicles outflows [6]. The real emanation from oil motors are particulate issue (PM), smoke and NOX. The NOx presentation to daylight discharge zone. This expansion the lung disease. Ozone likewise gets away to rustic regions where it decreases harvest yields. The present examination means to lessen the fumes discharge by utilizing water and methanol infusion [7-8].

II. EXPERIMENTAL INVESTIGATION

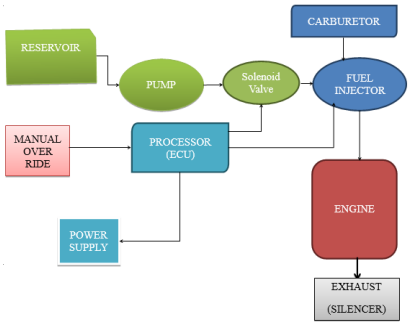

Fig.1. Block Diagram of Experimental Setup

Water Methanol Injection

The controlled water methanol is given to the fuel injector. The 12V pump is employed to suck the water from the water methanol fuel storage tank and is given to the fuel injector via solenoid valve [9]. The fuel injector and solenoid valve is controlled by means that of the manage unit. The gas fuel and air is provided from carburetor, which is already employed in SI engine. The 12v power deliver is given to the fuel injector via ECU. The solenoid valve is actuated as the fuel injector coil in this project. The injection timing of the fuel injector may change by using the ECU control Switch. Hence, the injection of water methanol in the engine reduces the engine temperature so that the water and methanol should not inject in idling of the engine. The injection of water methanol should be done when the engine rpm is high.

ECU Board

We have used an ECU kit in our investigation to control the timing of the injector. The time gap is very important to mix the additives into the combustion chamber at a correct ratio and correct time interval.

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With the help of the ECU kit, the Methanol and Water mixture is sprayed at a correct interval into the combustion chamber with the pre-planned time interval.

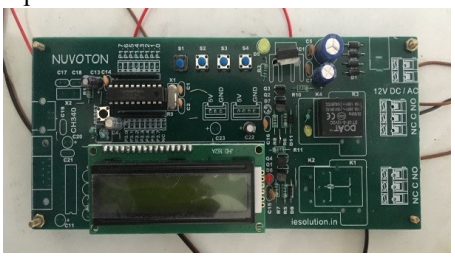

Fig.2 ECU Board

Fuel Injector

Injector is used to inject the mixture of Methanol and water in to combustion chamber along with fuel (petrol) [10]. The injector is placed in intake manifold of the engine from the carburetor. We have modified the manifold to fix the fuel injector.

Fig.3 Fuel Injector

Modified Intake Manifold

The below picture shows the modified intake manifold. Injector is placed in it, to inject the mixture of Methanol and Water into the combustion chamber along with the fuel. We have drilled the manifold using the 8mm drill bit to fix the injector and fixed the injector with the help of araldite [11].

Table.1 Properties of Various Fuels

Types of fuels	Chemical Formula	Density	Freezing Point	Boiling Point	Auto Ignition Temperatu re	Flash and Fire Point	Viscosity
		g/cm3	C	C	C	C	Centistokes
Gasoline	C_8H_{18}	0.708	-40^0C to -50^0C	Initial 35^0 Final 200^0	247^0 - 280^0	-43^0C & -13^0C to -23^0C	0.88 @ 15^0C 0.71 @ 37^0C
Diesel	$C_{12}H_{23}$	0.832	undefined	Initial 180^0 Final 360^0	210^0	$>52^0$C & undefined	2-6 @ 37^0C 1-3.9 @ 54^0C
Water	H_2O	1	0^0	100^0	536^0	Undefined	1.13 @ 15^0C 0.55 @ 54^0C
Methanol	CH_3OH	0.792	-97.6^0	64.7^0	470^0	11^0C to 12^0C & undefined	0.74 @ 15^0C 1.04 @ 0^0C

Fig.4 Modified Intake Manifold

Fig.5 Prototype- Experimental Setup

III. RESULTS AND DISCUSSIONS

The emission and total fuel consumption test are conducted under constant rpm of engine from 1000 rpm to 4000 rpm. The tabulations for various test are given below. The readings are taken with water methanol injection and typical carburetor system. The HC and CO emission test and total fuel consumption are conducted as mentioned above. Various graphs are also plotted and are shown later part of this chapter.

Table.2 RPM vs Fuel Consumption

RPM	Fuel Consumption(ml)	
1500	3	4.5
2000	5.4	7.2
2500	7	8.4
3000	8	10
3500	10.11	11.15

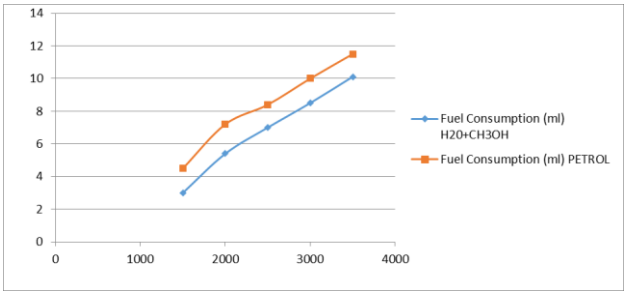

Fig.6 Graph-RPM vs Fuel Consumption

Table.3 Flash and fire point-Petrol and Water Methanol mixture

Fuel	Density	Auto ignition temperature	Flash point	Fire point
Gasoline	0.708	247^0 to 280^0	-43^0C	$-13^0$to 23^0c
Water	1	536^0	Undefined	Undefined
Methanol	0.762	470^0	11^0c to12^0c	Undefined

Table.4 Ash content test for petrol and water methanol mixture

Weight of the Testing Bowl (g)	Fuel	Weight of fuel (grams)	Weight of fuel after burning (g)	Weight of ash content (g)
21.10	Petrol (10ml)	6.3	0.04	0.03
21.10	Petrol + water methanol mixture (10ml)	7.18	0.02	0.01

Emission Test-Petrol (Before Modification)

Fig.7. Emission certificate-Petrol (before modification)

Emission Test- Petrol (After Modification Without Water Methanol Injection)

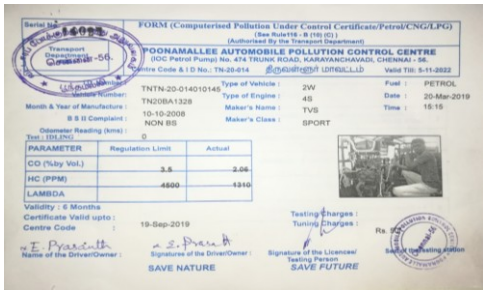

Fig.8. Emission Certificate – Petrol (after modification without water methanol injection)

Emission Test- After Modification (With H_2O + CH_3OH)

Fig.9 Emission Certificate - Petrol+Water+Methanol

HC Emission in SI Engine

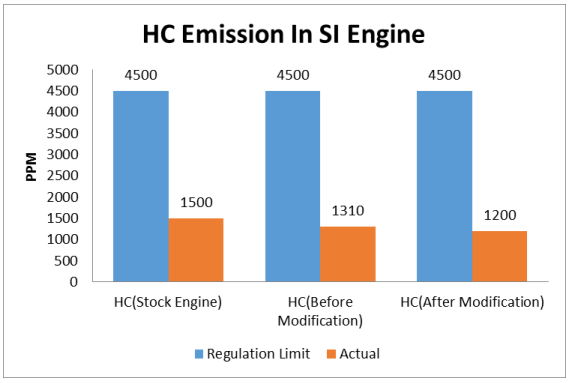

Fig.10. HC emission in SI engine

CO Emission in SI Engine

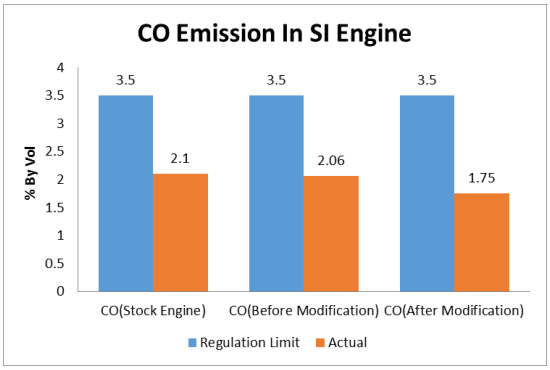

Fig.11. CO Emission in SI Engine

IV. CONCLUSION

The following conclusions are drawn from the investigation carried on the SI engine by injecting water and methanol mixture into the combustion chamber.

- Specific rate of HC and CO emission can be reduced.
- The performance of the engine may be increased by using this process.
- As methanol and water is an anti-detonant there is less possibilities of knocking.
- Fuel efficiency may also be increased.
- Usage of petrol will be reduced slightly.

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