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Performance Improvement of IC Engine Using Blends of Ethanol fuel: A Review

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Abstract - *This paper reviews the literature performance of IC engine by blend of ethanol. Due the development of all the country now a day's all the country require good transportation.so that the use of vehicle is increasing and we require good alternative renewable fuel. Need to use renewable energy in the form of ethanol fuel derived using agriculture waste to reduce load on petrol derived from crude oil, which is available in limited quantity. This is mostly due to stock of petroleum product are depleting day by day, hence more use of renewable fuels gets attraction in developing country like India. In recent years, Considerable efforts made to develop and introduce alternative renewable fuel, to replace conventional petroleum-based fuels. The main objective of the current work id to investigate influences of blends of ethanol-petrol blend used in IC engine performance using energy and exergy analysis. This literature study is about the changing load according for different blends of ethanol, and find the specific fuel consumption, brake power, Exhaust gas energy, Colling water energy. On this performance parameter, check the performance of the SI Engine.*

***Key Words*: Blends of ethanol fuels, performance, IC Engine, emissions, Exergy**

1. INTRODUCTION

An internal combustion engine is one type of heat engine, which means that some energy is converts into mechanical energy. Heat is there in the heat engine, and it is a poor form of energy due to its lower efficiency, but the efficiency of the mechanical energy is high. It is slightly different from the external engine.
Hugens and gunpowder as fuel made the first IC engine. It consists of pistons, rope, cylinder, cylinder head and pulleys. This engine has been worked only with a single blast of gunpowder that move the piston towards up and with the help of air pressure return stroke is done. After this, many engines developed like Lenoir engine, Otto-Lange free piston engine, four stroke Otto engine and diesel engine. These all engine are stroke piston engine. Now a day is for rotary type of engine. They are widely used, because speed was low in the lifting piston engines.
IC engine mainly divided in two types, SI (spark ignition) engine and CI (compression ignition) engine. There are many components use in the IC engine.

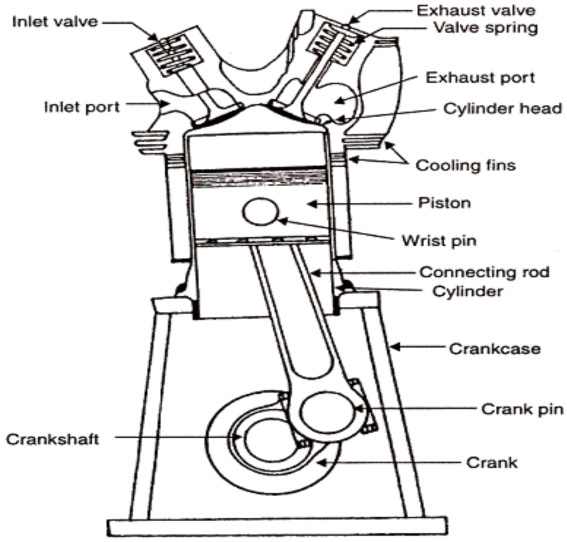

Fig-1: Diagram of I.C Engine

1.1 IC Engine and Its Components

The cylinder and the piston are main components of internal combustion engine, cylinder is the main body of the IC engine moving back and forth to develop power.
Cast iron and alloy steel used for making of cylinder & to withstand the wear and tear of the parts, one end of the cylinder is closed with the help of the cylinder head. Piston rings used in the IC engine. Pistons compress the charge and forcing them towards the crank via connecting rods.
It is made of cast steel and aluminum alloy to prevent the leakage of high-pressure gas piston rings. Connecting rods and crankshaft are also main component of the IC engine. Small end of connecting rod is connecting with piston and big end is connecting to crank through the crank pin. Crankshaft used to generate power; it is the backbone of the engine.
Intake valves and exhaust valves important, fresh charge enters the inlet valve and the removal of gas is form the exhaust valves. Camshaft, an exhaust manifold and follower, intake manifold, cam, crankcase, carburetor, spark plugs, fuel pump and nozzle are all component for IC engine.

1.3 Working of IC Engine

The cycle of engine completes in four-stroke:

(1) Suction stroke

(2) Compression stroke
(3) Power stroke
(4) Exhaust stroke

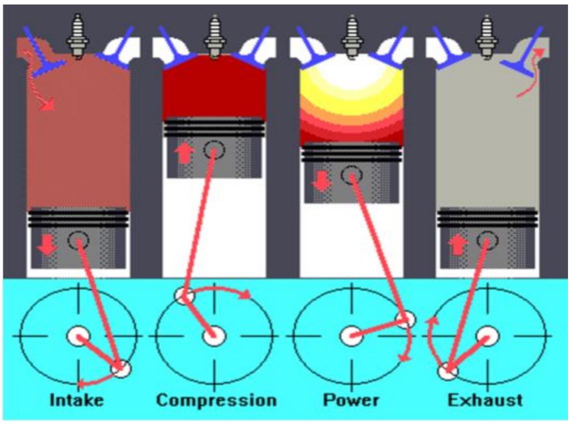

Fig-2: Working of CI Engine

(1) Suction Stroke

The piston is at the top of the dead center (TDC) and is willing to move down, when the piston move down the fuel and air mixture enterers through the inlet valve and suction begins and will continue until the piston range in the bottom dead center (BDC). Now, the inlet valves are closed and this vacuum hub called where crank turns 180.

(2) Compression Stroke

Now there is load in cylinder as the piston moves upward in the direction and compress the charge during the intake and exhaust valves are closed. Here the temperature and pressure are increase, and if the piston reaches TDC the spark ignites the mixture, so the pressure and temperature of the gases is increasing during the volume remain constant.

(3) Power Stroke

Due to the high pressure of the mixture, it forces the piston towards the bottom. When the piston moves from TDC to BDC, the intake and exhaust valves are closed and the pressure and the temperature of the gas very high, when the piston at the BDC, the outlet valve is opened and that suddenly falls high-pressure at constant volume to atmospheric pressure. The work done in this cycle, so it called the power stroke.

(4) Exhaust Stroke

In this measure is the piston in the direction upwards and the exhaust valve open and the inlet valve is closed. When the piston goes upward, it pushes through the burnt gases from the outlet valve. If the piston to the top dead center reached, the intake valve is open again, fresh batch is input, and the cycle repeats.

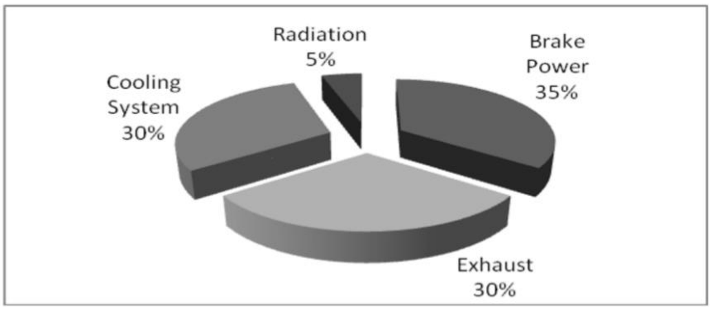

Fig-3: Percentage of Exhaust Emission

1.4 Application of IC Engine:

The engines are in all areas of industry and transport. They used for water, land and air & navy transport. CI engines used for generating electricity. 2-stroke engine used in scooters and used lawnmowers at 2000 to 5000 RPM.

They are very simple and maintenance costs are very low. 4-stroke petrol engine used in auto-vehicles like cars, trucks and buses. In the mobile generating sets, these engines are also used. 4-stroke diesel engines are very important now for days, because it has high speed around 100 to 5000 rpm.

They also used in cars, buses and trucks. ICEs instigated some of the large electric generators, that the power grid. They found in the form of combustion turbine in combined cycle power plants with a typical electrical output in the range of 100MW to 1GW.

1.5 Introduction of Alternative Fuel:

- An alternative fuel defined as material, substance, or petroleum, which can provide energy for power an engine.
- Alternative fuel is source of energy, which used in IC engines.
- This research has find out suitability of bio fuel, which used in IC engine and which renewable.

Some types of alternative fuel

- Bio diesel
- Bio fuel
- Bio alcohol (methanol, ethanol, butanol)
- Bio gas
- Battery and fuel cells
- Hydrogen
- Vegetable oil

- Bio mass

Petrol

It is the most valuable and most fuels used for transport. Petrol is a liquid with a strong solvent order is its natural state. Gasoline is produced from petroleum developed the thick crude oil due to the effects of heat, pressure and time on organic matter below the surface.

Diesel

It is used a liquid fuel in diesel engines, and it is a mixture of hydrocarbons by distillation of crude oil be obtained. The characteristic of diesel fuel is viscosity, ceten number, volatility, cold behavior, density, and Sulphur content. It is very dense and oily.

Table -1: Property of Ethanol, Petrol, and Diesel.

Fuel property	Ethanol	Petrol	Diesel
Chemical formula	CH_3CH_2OH	C_8H_{18}	$C_{12}H_{23}$
Octane no	108.8	88	25
Cetane no	9	8.14	54
Boiling point ^{0}c	78	85	149
Density kg/m3	785	765	837.8
Latent heat KJ/Kg	846	339	267
Calorific value KJ/Kg	26900	48000	44893
Auto ignition temp ^{0}c	363	246	210

Ethanol

Ethanol is an alternative energy source. Ethanol is an alcohol, which made from fermenting corn or similar biomass material. Ethanol can have used in three ways as transportation fuel:

(1) Blend ethanol of 10 percent with gasoline by 90 percent unleaded called "E-10 Unleaded".

(2) As a component of reformulated gasoline, both directly as ethyl tertiary butyl ether (ETBE).

(3) Consider primary fuel as a ethanol with 85 percent and blended with gasoline 15 percent unleaded, it's called "E-85".

Ethanol in liquid form and called ethyl alcohol. Ethanol can have used as a fuel when blended with gasoline or in its original state and use as a raw material in various industrial processes. Ethanol made from starch or sugar, grains such as corn and sorghum are good sources; but potatoes, sugar cane and farm plant wastes are suitable.

Ethanol is alternative fuel

There is increasing of use of "E-10 Unleaded" gasoline because the fuel performs well in automotive engines and the priced with "conventional" gasoline.

✓ Reasons for using of ethanol.

1. Ethanol can reduce country's dependence on imported oil, it should foreign supplies be interrupted.

2. Farmers has increased demand of grain, which helps to stabilize prices.

3. The ethanol is improving quality of the environment. It reduced Carbon monoxide emissions, lead and other carcinogens (cancer causing agents) which removed from gasoline.

4. Ethanol-blended fuels can clean the fuel system also absorb moisture.

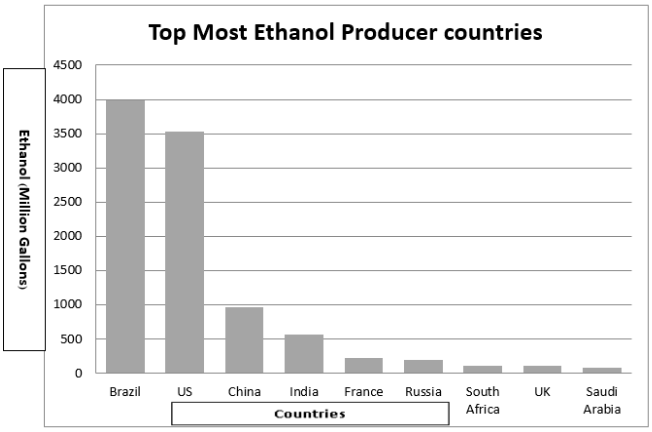

Fig-4: Production of Ethanol by Various Countries

Exergy

Exergy defined as the maximum theoretical useful work obtained from a system when system is an equilibrium state. Exergy generally not conserved as energy but destroyed in the system. It is an extensive property of the system and depends on both the state of the system and on the properties of the environment. The state of the environment referred to as the dead state, defined by the environmental temperature, pressure and composition.

In availability analysis of thermal systems, it is customary to divide the availability content of a system into two parts:

(i) The Thermo-mechanical availability: It refers to the maximum useful mechanical work extractable as the system comes into thermal and mechanical equilibrium with the surrounding atmosphere. The mass of the system not permitted to pass or chemically react with the environment. The thermal and mechanical equilibrium achieved when both the temperature and pressure of the system are equal to that of the environment. This specific state of the system called the restricted dead state.

(ii) The chemical availability: One part of the chemical availability of a system concerns only the system's species that are also present in the environment, known as diffusion availability. Whereas, the other part, called reactive availability, concerns the amount of work developed by allowing species of the system and chemically react with substances of the environment in order to form also environmental species (Chavannavar and Caton 2006). The system achieves the chemical equilibrium when any of its components unable to interact in any way with those of the environment in order to produce work.

The exergy of a system is the maximum useful work possible during process that brings the system into equilibrium with a heat reservoir. When the surroundings are the reservoir, exergy is the potential of a system to cause a change as it achieves equilibrium with its environment. Exergy is then the energy that is available to use. After the system and the surroundings, reach equilibrium. The exergy becomes zero.

Energy never destroyed during a process; it changes from one from to another. In contrast, exergy accounts for the irreversibility of a process due to increase in entropy. Exergy always destroyed when a process involves a temperature change. This destruction is proportional to the entropy increase of the system together with its surroundings.

The portion of thermal energy input in cyclic engine, which converted into mechanical work, referred to as an available energy. The portion of thermal energy, which is not utilizable and rejected to the sink (surroundings), known as unavailable energy. The terms exergy and anergy are synonymous with available energy and unavailable energy.

Energy = Exergy + Anergy

Energy = Available Energy + Unavailable Energy

Exergy is always conserved in a reversible process, but is always a consumed in an irreversible process and destroyed by irreversibility's

Exergy in= Exergy Out + Exergy Destroyed (Anergy)

There are four different type of exergy.

(1) kinetic exergy. (KE)

(2) potential exergy. (PE)

(3) physical exergy. (PhE)

(4) chemical exergy (CE).

EXERGY= K.E + PE + PhE + CE.

KE and PE have the same meaning as the corresponding energy terms.

2. Literature Survey

Recent Study

Some reviews studied on Ethanol fuel with multi fuel along with experimental analysis of power output from engine, Emission Characteristics, combustion effect and specific fuel consumption efficiency and exergy analysis.

Research Papers :

2.1 Bioethanol Fuel Using in IC Engine

Yu cesu hSet al [2016] [1] are worked on ethanol burns with lower flame temperature and luminosity owing to the decrease of the peak temperature inside the cylinder so that the heat loss and NOx emissions are lowered. Ethanol has high latent heat of vaporization. The latent heat cools the intake air and hence increases the density and volumetric efficiency. However, the oxygen content in ethanol reduces the heating value more than gasoline does. It is evident that ethanol can be used as a fuel in SI engines. Gasohol gain importance within these recent years as alternative fuel due to this high octane number, especially with ethanol, which has low carbon.

A. Lacke [2012] [2] worked with Alternative renewable fuels such as bioethanol-gasoline blended fuels are becoming essential due to increasing oil prices, environmental concerns and their potential to preserve the agricultural activity. Ethanol–gasoline blends which has high octane rating can be used as fuel in order to substitute some part of gasoline in engine applications as it has higher heat of vaporization compared to gasoline, which means that freezes the air allowing more mass to be drawn into the cylinder and increases the power output.

L.G. Reeser et al [2015] [3] increasing the octane rating, which is particularly important in unleaded fuel, and reduce carbon monoxide (CO) emissions from the engine. This led the gasohol (a mixture of 10% alcohol with 90% gasoline) to be a commercial fuel in over 35 countries of the World including the USA, Canada and France.

2.2 PRODUCTION OF BIOETHANOL

Anubhuti Gupta et al [2015] [4] have worked on Agro-residues biomass has been proposed to be one of the main renewable resources for cost-effectively attractive bio ethanol production. Due to increasing population and industrialization, the demand of energy is increasing day by day. Simultaneously, the worldwide Bio ethanol production is increasing constantly. The maize, sugarcane and sugar beets are major traditional agricultural crops used as bio ethanol production. Bio ethanol from agro residues could be a promising technology that involves four processes of Pre-treatment, enzymatic hydrolysis, fermentation and Distillation. These processes have several challenges removing the lignin from the lignocelluloses agro residue. The hypothetical ethanol yields from sugar and starch are superior compared to lignocelluloses agro residue.

Nour sh. El–gendy et al [2013] [5] statistical model was developed in this study to describe bioethanol production through a batch fermentation process of sugarcane molasses by locally isolated Saccharomyces Cerevisiae Y-39. Response surface methodology RSM based on central composite face centered design CCFD was employed to statistically evaluate and optimize the condition for maximum bioethanol production and study the significance and interaction of incubation period, initial pH, incubation temperature and molasses concentration on bioethanol yield. With the use of the developed quadratic model equation, a maximum ethanol production of 255 g/L was obtained in batch fermentation process at optimum operating condition of approximately 71h, pH 5.6, 38 C, molasses concentration 18 wt% and 100rpm.

Shanmugam Periyasamy et al [2015] [6] Saccharomyces cerevisiae is the cheapest strain available for the conversion of biomass substrate. In the present study, it used for bio-ethanol production from sugar molasses. The influencing parameters that affect the production of bio-ethanol from sugar molasses optimized. The optimal values of the parameters such as temperature, pH, substrate concentration, and enzyme concentration and fermentation period found to be 35°C, 4.0, 300 gm/l, 2 gm/l and 72 h respectively. Under this optimum operating condition, the maximum of 53% bio-ethanol yield achieved.

Jan Baeyens et al [2010] [7] is investigated to how to ethanol produce from renewable feedstock such as e.g. sugar cane, corn, wheat, cellulose biomass and algal biomass. The conversion pathways for the production of bio-ethanol from disaccharides, from starches, and from lignocelluloses biomass examined. Bio-ethanol, as a clean and renewable fuel, is gaining increasing attention, mostly through its major environmental benefits.in this paper there different 5-method use to improve the quality of ethanol.

- An integrated Net energy ratio-pinch of condensers and rebuilders in the bio-ethanol distillation train;
- The use of Very High Gravity (VHG) fermentation;
- The current development of hybrid processes using evaporation membranes;
- The substitution of current ethanol dewatering processes to >99.5 wt% pure ethanol by membrane technology; and

Additional developments to improve the plant operation such as the use of microfiltration of the fermented broth to protect heat exchangers and distillation columns against fouling, or novel distillation concepts.

Mixtures of water and ethanol are important throughout the bio-ethanol process. The knowledge of mixture flash points, as presented in Fig needed for their safe handling, storage and transportation

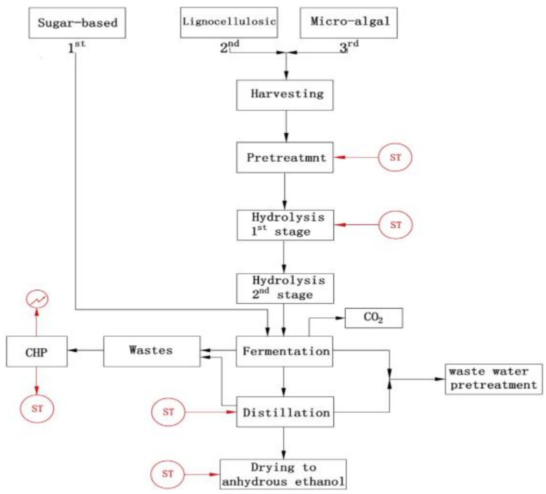

Fig-5: Production of Bio-Ethanol

2.3 Performance and Emission of an On IC Engine

Paolo Iodice et al. [2016] [8] is investigated that the Effect of ethanol–gasoline blends on CO and HC emissions in last generation four stork SI engines within the cold-start transient. Which work with ethanol-gasoline mixture by

10%, 20%, and 30% by volume called G10, G20, and G30. This paper is reducing the CO and HC emission at cold-start transient commercial gasoline, with the 20% v/v ethanol blend achieving the highest emission reduction.

Table 2: Type of Fuel and Co and HC Emissions

TYPE OF FUEL	Oxygen content [wt.%]	CO Cold extra emissions [g]	HC Cold extra emissions [g]
G0	0	10.75	2.5
G10	5	9.25	1.35
G20	10	7.3	1.25
G30	15	11	2

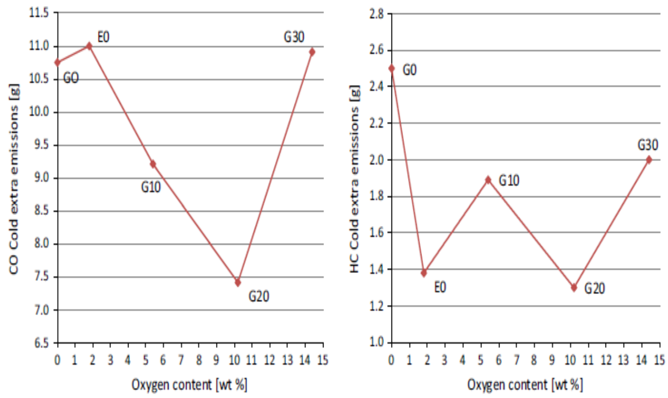

Fig-6 : Co and HC Emission Vs Oxygen Content [Wt %]

Namo Kim et al. [2015] [9] investigated that the effect of petrol direct injection & ethanol valve fuel injection system influenced the emission characteristics & engine combustion at maximum load condition & fuel mixing ratio were accordance to the engine condition at two variable C.R & different ethanol injection timings. The reduction of emission measured high over the other ratio of 13.3 the reduction of emission measured high over the other ratio & ethanol injection timing increased as reduced knock frequency. These lower emissions have been given to the increased oxidation than with add the large amount of ethanol. Reduces knocking occurrence, such as the ethanol injection timing maintained while the intake valves were open. Slight reduction the carbon monoxide, whole hydrocarbon and particle emission observed a compression ratio of 9.5

W.M. Ambrós et al. [2016] [10] is worked on Experimental analysis and Modeling of internal combustion engine operating with wet ethanol. In this paper using ethanol with different mixture of different percentage of ethanol and water and improving the efficiency of SI and di engine. The experiment take place based on first law of thermodynamic. The trials and the results found confirm that the engine is capable of operating with mixtures of wet ethanol up to 40% by volume of water. E70W30 blend showed the best values of power, torque, efficiency and specific consumption.

Venugopal Thangavel et al [2016] [11] is investigated that simultaneous injection of ethanol gasoline and n-butanol gasoline in the intake port of a four stroke SI engine. The two separate injector used to inject the gasoline and ethanol simultaneously in single cylinder SI engine. The amount of fuel of mass depends on the spark timing. The net gasoline gives the higher thermal efficiency and mixing of 305 ethanol with gasoline gives the highest torque efficiency. When efficiency and torque can better at the mixture of 1:1(50% ethanol & 50% gasoline) because of faster combustion. Due to faster combustion the mixture of fuel, take place bitterly. This paper is also work on emission and performance of Ethanol gasoline and n-butanol gasoline on SI engine. The amount of butanol increase with increase in torque efficiency and better performance with lower emission. However, mixture of gasoline and ethanol gives maximum torque efficiency. The graph represented the fuel ratio vs emission of NO and HC. In graph, emission of NO is lower in n-butanol- gasoline. Emission of HC is lower in ethanol and gasoline fuel mixture.

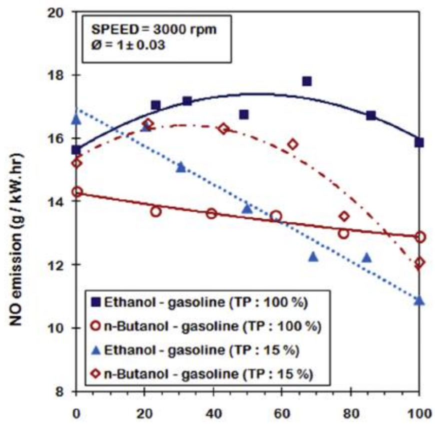

Fig-7: No Emission Vs Fuel Ratio (% by Mass)

Golmohammad Khoobbakht et al. [2016] [12] worked on Optimization of operating factors and blended levels of diesel, biodiesel and ethanol fuels to minimize exhaust emissions of diesel engine using response surface methodology. Aim of this paper investigated on operating of engine speed and load as well as different level of blends of ethanol in biodiesel. It is work on the diesel engine. This experiment is work on the statistical tool known as Design of Experiments (DoE) based on central composite rotatable design (CCRD) of response surface methodology (RSM). Surface methodology is also use to predict the amount of fuel emission like CO, HC, NOX, and THC. This paper indicated that the amount of CO and HC is reducing at the end of experiment. When the amount CO2 is increasing at the end of the experiment but adding diesel fuel blend in ethanol is reducing the amount of CO2. An engine load of 80% of full load bar, speed of 2800 rpm and a blend of 26% biodiesel, 11% ethanol and 63% diesel were found to be optimal values with a high desirability of 74% for the test engine having 0.013% of CO, 41 ppm of HC, 643 ppm of NOx, 12% of smoke opacity and 7.3% of CO2.

Gholamhassan najafi et al . [2015] [13] investigated 1.3 SOHC, four cylinder and four-stroke and SI gasoline engine enhancing the performance and exhaust emission of SI engine, which works with ethanol-gasoline mixtures by 2.5%, 5%, 7.5%, 10%, and 15% called E2.5, E5, E10, E15, E12.5, and conditions at various speeds for each test fuel and 45 different constructs. Optimization of the independent variable performed with the desirability approach of RSM with the aim of reducing emissions and the maximizing the performance parameters. The experiments designed based on known RSM Using a statistical instrument as Doe (design of experiments). The achievement parameters for different biofuel gasoline mixture were found nearby gasoline, and engine power improves clearly along with emission qualities, CO and HC issues was reduced and also CO2 and NOX issues was raised if ethanol was to be added in gasoline. A mixture of 10% bio-ethanol and 90% of gasoline and an engine speed of 3000 rpm to optimum values found.

Ashraf Elfasakhany . [2015] [14] is worked on the spark ignition engine with ethanol and check the performance and emission analysis. Main objective is reducing the emission of CO, NOX, CO2 . Improving the thermal efficiency, torque and volumetric efficiency. At the end of experiment, its find improve the thermal efficiency, torque and volumetric efficiency.

Rakhi Maheta et al [2012] [15] have experimentally investigated that the alcohol like ethanol and butanol properties compare with diesel and experimental analysis of ethanol-diesel blend or butanol-diesel bland use as fuel. This paper is show the different characteristics of both ethanol and butanol compare with diesel as per ASTM standards. The ethanol shows properties like calorific value, density, flash point, cetane number with pure diesel. There is only flashpoint reduce due to alcohol blend.

Alvydas Pikunas et al [2015] [16] have to investigate experimentally and compare the engine performance and pollutant emission of a SI engine using ethanol–gasoline blended fuel and pure gasoline. The results showed that when ethanol added, the heating value of the blended fuel decreases, while the octane number of the blended fuel increases. The results of the engine test indicated that when ethanol–gasoline blended fuel is used, the engine power and specific fuel consumption of the engine slightly increase; CO emission decreases dramatically result of the leaning effect caused by the ethanol addition; HC emission decreases in some engine working conditions; and CO2 emission increases because of the improved combustion. Using ethanol–gasoline blend, CO emission reduced by 10–30%, while CO2 emission increases by 5–10% depending on engine conditions. The engine power and specific fuel consumption increase approximately by 5% and 2–3%, respectively, in all working conditions.

Jitendra kumar et al [2013] [17] in this work gasoline is taken as reference which is blended with ethanol. Physical properties relevant to the fuel were determined for the four blends of gasoline and ethanol. A four cylinder, four stroke, varying rpm, Petrol engine connected to eddy current type dynamometer was run on blends containing 5%,10%,15%,20% ethanol and performance characteristics were evaluated. We can conclude from the result that using 10% ethanol blend is most effective, we can utilize it, and further use in SI engines with little constraint on material used to sustain little increase in pressure.

Dattatray Bapu et al . [2014] [18] have worked about injection timing on which ethanol blend run the engine. The blends tested are D70/E20/B10 (blend A), D50/E30/B20 (blend B) D50/E40/B10 (blend C), and Diesel (D100). The blends are prepared to get maximum percentage of oxygen content but keeping important properties such as density, viscosity and Cetane index within acceptable limits. Experiments conducted on a multi cylinder, DI diesel engine, whose original injection timing was 13° BTDC. The engine did not run on blends B and C at this injection timing and it was required to advance timing to 18° and 21° BTDC to enable the use of blends B and C Respectively However advancing injection timing almost doubled the NO emissions and increased peak firing pressure. Smoke reduced remarkably for blends especially at medium and high loads of both speeds and all injection timings. Maximum reduction is about 60% to 70% at higher loads for respective high ethanol content blend at all injection timing and speeds. Advancing injection timing reduced the smoke for all blends and diesel fuel at both speeds. Significant reduction in smoke observed for high ethanol content blends; however, reduction in smoke does not indicate the reduction in particulate matter in same proportion.

Eknath R. Deore et al [2016] [19] have experimentally investigated to compression ratio for ethanol diesel blend. Kirloskar make tested for blends of diesel with ethanol. Tests conducted for three different compression ratios. Engine test setup developed with moving cylinder head for variation of compression ratio to perform investigations using these blends. The engine performance studies conducted with rope-break dynamometer setup. Parameters like speed of engine, fuel consumption and torque measured at different loads for pure diesel and for blends of diesel with ethanol at different compression ratio. Break Power, BSFC, BTE and heat balance evaluated. Paper represents the test results for blends 5% to 20% and three different compression ratios. The 20% mixture of ethanol blend with diesel has a very good efficiency compared with pure diesel and blend of kerosene. It observed that the 20 % ethanol blend is having higher volumetric efficiency compare with diesel and kerosene blend. Exhaust gas temperature for ethanol blend has not shown any substantial increase compare with pure diesel. Hence blending of ethanol at about 20 % can lead to a better performance of engine compare with pure diesel.

R senthilkumar et al [2014] [20] have worked on that the performance and emission behavior of the diesel engine using ethanol diesel blend. Ethanol is a bio-based renewable and oxygenated fuel, thereby providing potential to reduce the PM emission in diesel engine and to provide reduction in life cycle of carbon die-oxide. The main objective of this project has to study the performance, and to control the emissions of the diesel engine using blended fuel by preheating the inlet air. The present work carried out using single cylinder, four strokes, and watercooled diesel engine. In this phase, experiment investigations are conducted using five sets of blended fuels I.e 10%, 15%, 20%, 25%, 30% Ethanol – Diesel blend have been prepared and preheating the inlet air to 40ºC, 50ºC and 60ºC. The performance and emission characteristics studied and compared with the base fuel. The Brake thermal efficiency of ethanol diesel blend is lower without pre heating condition, but at 40ºCand 50ºC inlet air condition, for 10% ethanol diesel blends gives the much better BTE compare to the neat diesel fuel On emission characteristics CO and HC emission is increasing. Addition of ethanol will lead to complete combustion so that HC and CO emission should reduce, but here the introduction of ethanol in diesel fuel, HC emission increased at various load condition. CO and HC emission is higher for the pre-heated condition compare to without pre heating condition. The NOx emissions were reducing because it absorbs heat during combustion due to its higher latent heat of vaporizations.it reduces the peak combustion temperature. When using ethanol diesel blends. Generally, smoke opacity increased as load increases. Without preheating condition, produces less smoke compare with the preheating conditions for ethanol diesel blends.

Sandeep kumar et al [2016] [21] worked on the effects of unleaded iso-octane, unleaded isooctane–ethanol blend (E5) and iso-octane-methanol (M5) blends on engine performance are investigated experimentally in a single cylinder four-stroke spark-ignition engine at a constant 8 Kg load. The engine speed changed from 1100 to 1800 rpm. The results of the engine test showed that ethanol addition to unleaded iso-octane increases the value of IP, FP and IMEP with E5 fuel. The results also showed that the indicated power, brake power, friction power, indicated mean effective pressure, torque, exhaust temperature, and thermal efficiency increases with increase in engine speed. At a constant load of 8 Kg for E5, M5 and iso-octane fuels. Thermal efficiency was maximum for E5 fuel (38.13%) at a speed of 1750 rpm.

Abdel–Rahman and Osman [2012] [22] had tested 10%,20%, 30% and 40% ethanol of blended fuels in a variable compression- ratio engine and found that the increase of ethanol content increased the octane number, but decreased the heating value. Under various compression ratios of engine, the optimum blend rate found to be 10% ethanol with 90% gasoline.

B. K. Venkanna et al [2015] [23] have experimentally investigated on the pressure effect is more important while we would work with biodiesel and diesel blend use as fuel in Kirlosker single cylinder diesel engine. Use of row-honge oil blend with diesel fuel in diesel engine with enhanced injection opening pressure appears to be scare. This research work presented some findings of use of row-honge oil blend with diesel fuel in direct injection diesel engine with increased injection opening pressure. No problem faced at the time of starting the direct injection diesel engine run smoothly. Brake specific fuel consumption of H20 is slightly increasing then diesel. There is performance; emission and combustion parameter of H20 are almost nearer to diesel. For getting best result work with H30, increase pressure from 200 to 225 bars.

R. Jensrakoo et al [2014] [24] they proposed a simple ethanol estimation technique which uses only the measurement of engine-speed at a fixed starting condition. The engine speed response modeled as a first-order system. It found that the steady-state characteristics of the model were able to capture the effect of changing fuel composition. By applying a nearest-mean classifier based scheme, we could select the best feature from the model. Five different blends are E10, E20, E50, E85, and E100 used. Formulate the model and experimentally validated the proposed technique. Estimation of ethanol concentration in flex fuel motorcycle using the engine speed sensor which is normally installed in vehicle control system is presented.When operating at a fixed start up condition, the engine speed responded as first-order systems.It was clearly observed that the steady state characteristics of the engine speed varied according to different ethanol concentration.

Talal Yusaf et al [2013] [25] in theoretical study a quasi-dimensional SI engine cycle model has been adapted for spark ignition engines running on gasoline ethanol blends. A mathematical model using Matlab software developed using first law of thermodynamics and conservation equation to predict the SI engine performance for different blend ratios. The model used to evaluate the engine emission and the mechanical and heat losses in the engine. Experiments performed with the blends containing 5, 10, 15 and 20% ethanol. The result show that increasing ethanol-gasoline blended will marginally increase the power and torque output of the engine. For ethanol blends, it found that the brake specific fuel consumption (bsfc) decreases using 5% and 10%ethanol while the brake thermal efficiency and the volumetric efficiency were increased. Exhaust gas emissions measured and analyzed for unburned hydrocarbons (UHC), carbon dioxide (CO2), and carbon monoxide (CO), Oxygen (O2) and Oxide of Nitrogen NOx at engine speeds ranging from 1000 to 5000 rpm. The concentration of CO and UHC emissions in the exhaust pipe found to decrease when ethanol blends introduced. The concentration of CO2 and NOX found to increase when ethanol introduced.

Dr. Alok choube [2012] [26] investigated that of four stroke petrol engine is carried out to analyze the engine performance and emission characteristics. In this engine, performance and exhaust emission determined by different blend ratio of ethanol with gasoline (E0, E20, E40, E60, E80, and E100) for the best performances. With the suitable ratio, the emission will be less. The E60 and E40 gave the best result for all measured parameters at all engine loads. .in this he has proven that E60 gives better results as compared to E0 and E20.

2.4 Exergy Analysis

N. M. Al–Najem et al [1992] [27] is worked on energy-exergy analysis of diesel engine. This analysis based on first and second low of thermodynamic. Exergy analysis based on second low of thermodynamic. Using this law, we can find the availability of energy, losses of energy in diesel engine.2nd law indicated different between high-grade energy and low-grade energy. First law indicated some lost energy due to the process. First and second law combined indicated the datum (zero level) of energy and exergy. At that level, we find the enthalpy losses and other losses, which take place at near of datum. Diesel engines have efficiencies of about 35% and about 50% of the input fuel energy is lost in cooling water and exhaust gases. The wasted energy in the cooling water usually considered useless due to its low temperature level. In this paper, we focused upon the exhaust-gas waste heat the present analysis is to illustrate the capability of the exergy analysis to provide a systematic approach to pinpoint the waste and lost energy within diesel engines.

S. Jafarmadar [2014] [28] is worked on Exergy analysis of hydrogen/diesel combustion ina dual fuel engine using three-dimensional model. The experiment take place at different gas-fuel ratio at constant diesel amount of fuel 6.48 mg/cycle. The gas fuel-air ratio is varying between 0.3, 0.4, 0.5, 0.6, 0.7, and 0.8at engine speed of 2600 rpm. The experiment take place on Extend Coherent Flame Model-Three Zone model and exergy take place on three-dimension CFD code. Fuel-air ratio increases from 0.3 to 0.8, the exergy efficiency decreases from 43.7% to 34.5%.value of irreversibility decreases from 29.8% to 26.6% of the mixture fuels chemical exergies

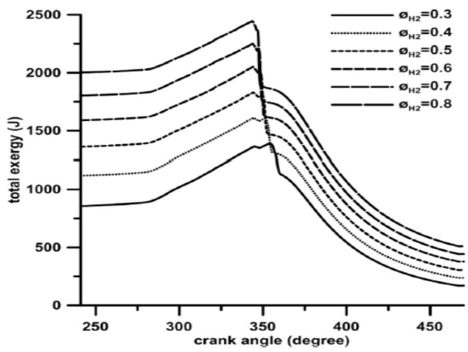

Fig-8: Crank Angle vs Exergy

Chongqing Feng et al [2016] [29] is worked on Availability analysis of using is-octane/n-butanol blends in spark ignition engine. This is representing a detailed energy and exergy analysis of an iso-octane/n-butanol blend-fueled spark-ignition (SI) engine, investigate exergy loss mechanisms, and understand how the exergy destruction changes with different iso-octane/n-butanol blend fuels.

2.5 Summery of Literature Review

After study, this literature review outcome found that now a day the performance of the vehicle is reducing and the entire automobile vehicle is only depending on fossil fuel. So requirement is of alternative renewable fuel which improve the performance of engine and control the emission. Ethanol is good renewable fuel and which is improve the performance of SI engine. Different authors are using ethanol; check the different parameter of SI engine like specific fuel consumption, brake power, torque, volumetric, and brake thermal efficiency. Ethanol has high octane number, low flame temperature, high density, and high latent heat of vaporization. Ethanol provides reduction in emission and increases the performance of SI engine, like specific fuel consumption, brake power, torque, volumetric and brake thermal efficiency. After this literature review, it concluded that pure ethanol could be use directly as fuel in SI engine. However, performance of pure ethanol is low compare to the ethanol blend with base fuel. So to improve the performance and reducing the emission of SI engine blending of ethanol with base fuel (petrol) required. E85(15% ethanol & 85% petrol), E90(10% ethanol & 90% petrol) are best blends of bio-ethanol fuel to improve the performance of SI engine and also producing low emission like NOX, CO2, CO and HC. Not all the fuels are sufficient to producing the 100% efficiency. Due to some amount of the losses, the efficiency is less. Exergy analysis is utilizing to find the available and unavailable energy of SI engine using principal of second law of Thermodynamic.

2.6 Objectives:

- ✓ To blend ethanol with petrol fuel and observe the performance of I.C. Engine and improve performance of engine.
- ✓ To do the analysis of the Ethanol on various parameters like input parameter like load, output parameter like specific fuel consumption, brake power, and brake thermal efficiency.
- ✓ Experimental energy and exergy analysis on SI engine by Ethanol-Petrol blend (E0, E100, E25, E40)

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