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A Comparative Analysis Study Of Alternative Fuels For Ic Engine

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ABSTRACT

Alternative fuels for automotive engine application for both spark ignition (SI) and compression ignition (CI) Engines.Internal combustion (IC) engine is a heat engine that converts chemical energy into mechanical energy, in the form of rotating shaft. Chemical energy of the fuel is first converted to thermal energy by means of combustion or oxidation with air inside the engine.And also each alternative fuel are briefly summarized, and are followed by discussions on the main research motivations for such alternative fuels. And also explained about the detailed information about internal parts IC engine with their advanced development in alternative fuel sector. This paper study that biodiesel-diesel-ethanol blend can be used as a substitute of petro-diesel fuel to reduce dependency on fossil fuel as well as the exhaust emissions of the engine.

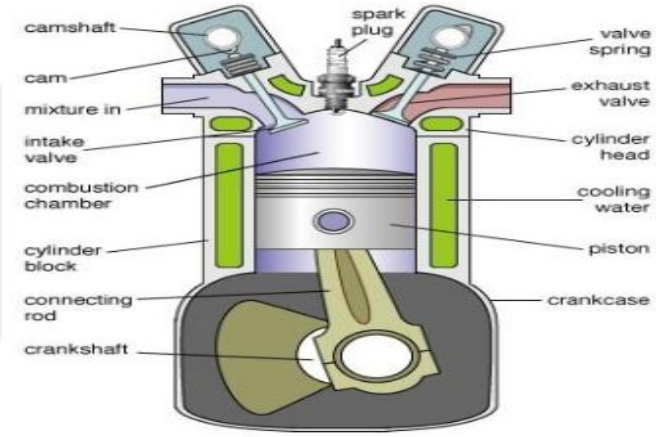
Key words: *Alternative fuels, Internal combustion Engines, components of IC Engine.*

1.0INTRODUCTION

Internal Combustion Engines

The main subjects of this paper are reciprocating engines, such as spark-ignition (SI) and compression-ignition (CI) engines. They have been widely adopted as power sources for passenger and commercial vehicles, electricity power generation, and in other industrial fields, due to their high power density and high efficiency

Basically two types of I.C. ignition engines, those which need a spark plug, and those that rely on compression of a fluid. Spark ignition engines take a mixture of fuel and air, compress it, and ignite it using a spark plug. The reciprocating motion of piston is converted in to rotary motion in the crank shaft by means of connecting rod.



Different process performed in IC Engine

Cycle of operation completed in four strokes of the piston or two revolution of the piston

(i) Suction stroke (suction valve open, exhaust valve closed)-charge consisting of fresh air mixed with the fuel is drawn into the cylinder due to the vacuum pressure created by the movement of the piston from TDC to BDC.

(ii) Compression stroke (both valves closed)-fresh charge is compressed into clearance volume by the return stroke of the piston and ignited by the spark for combustion. Hence pressure and temperature is increased due to the combustion of fuel.

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(iii) Expansion stroke (both valves closed)-high pressure of the burnt gases force the piston towards BDC and hence power is obtained at the crankshaft.

(iv) Exhaust stroke (exhaust valve open, suction valve closed) - burned gases expel out due to the movement of piston from BDC to TDC.

2.0 LITERATURE REVIEW

ChoongsikBae, JaeheunKim, (2017),This review paper covers potential alternative fuels for automotive engine application for both spark ignition (SI) and compression ignition (CI) engines. It also includes applications of alternative fuels in advanced combustion research applications. The representative alternative fuels for SI engines include compressed natural gas (CNG), hydrogen (H2) liquefied petroleum gas (LPG), and alcohol fuels (methanol and ethanol); while for CI engines, they include biodiesel, di-methyl ether (DME), and jet propellent-8 (JP-8). Naphtha is introduced as an alternative fuel for advanced combustion in premixed charge compression ignition. The production, storage, and the supply chain of each alternative fuel are briefly summarized, and are followed by discussions on the main research motivations for such alternative fuels. Literature surveys are presented that investigate the relative advantages and disadvantages of these alternative fuels for application to engine combustion. The contents of engine combustion basically consist of the combustion process from spray development, air–fuel mixing characteristics, to the final combustion product formation process, which is analysed for each alternative fuel. An overview is provided for alternative fuels together with summaries of engine combustion characteristics for each fuel, in addition to its current distribution status and future prospects.

M.Mahendran, D.Gowthamn, (2017), This review paper covers potential alternative fuels for automotive engine application for both the spark ignition (SI) and compression ignition (CI) engines. It also includes applications for the alternative fuels in advanced combustion research applications. There presentative alternative fuels in SI engines includes compressed natural gas (CNG), hydrogen (H2) liquefied petroleum gas (LPG), and alcohol fuels (methanol and ethanol); While for the CI engines includes biodiesel, Di-methyl ether (DME), and jet propellent-8 (JP-8). And the Present report summarizes current sources of the fuels, specifications and standards used in vehicle applications. From this start point a survey on published possible future alternative bio-based fuels is summarized and data on the fuels are presented in relation to parameters and properties described in current fuel standards. Gaps in fuel data and two proposed research areas in connection to fuel properties are presented.

N.V. Mahesh Babu Talupula, Dr. P. Srinivasa Rao (2017), The world is facing a huge problem of high fuel prices, air pollution and a lot of climatic changes. Alternate Fuels play an essential role in the present scenario in Internal Combustion Engines as the mineral fuels are depleting. This paper presents the maneuver and origin of the use of alternative fuels in internal combustion ignition engines. Analysing the literature, this article shows various alternative fuels utilized in India and all over the world. Furthermore, this article describes the research directions for alternative fuels usage in road transport powered by internal combustion engines.

Mayank Chandra Joshi, Mayank Joshi,(2016), As we all know that we all are living in the age of science and science had made our life so simpler and easier that we can't imagine a few decade ago. As in the earlier time we took a couple of days or more to travel from one place to another. But now we can travel or can do any work in a second or in hours. But with the development of science we all are losing are fossil fuels. Which is going to create a serious problem in the upcoming generation? Burning of petrol coal and other harmful fuel is causing a tremendous effect on our environment. The enthusiasm for using alcohols as alternate fuels in internal combustion engines (ICE) has been accelerating since the middle of 1970 and reached its peak by the middle of 1980. This was due to the serious effect of the

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exhaust emissions from automotive engines powered with oil-derived fuels coupled with a market rise in the cost of oil-derived fuels. This project leads to the idea of using alcohol in the internal combustion engine such that it reduces the demand of the petroleum products that is going to be extinct in near future. It includes about the emissions of harmful gases that can be reduced by the use of alcohol instead of petroleum products. Various fuels have been tested on IC engines for their suitability as alternate fuels. Expect few alcohols, CNG and LPG, not many fuels have been found to be matched with IC Engines requirements .Thus this project is an attempt for the use of an alternative resource such that it can prove to be useful for the peoples in near future.

3.0 Main Components of IC engine

Cylinder – the part of the engine block where the combustion takes place.

Piston – a plunger with rings that fit against the inside cylinder walls and prevent air from leaking past

Connecting rod – One end of the connecting rod is connected to piston through piston pin while the other is connected to crank through crank pin. It transmits the reciprocatory motion of piston to rotary crank.

Cylinder head-The top end of the engine cylinder is closed by means of removable cylinder head. It seal the cylinder block and not to permit entry and exit of gases on cover head valve engine.

Piston rings- To provide a good sealing fit and less friction resistance between the piston and cylinder, pistons are equipped with piston rings. And they are made up of cast iron of fine grain and high elastic material which is not affected by the working heat. Sometimes it is made by alloy spring steel.

Crankshaft- It converts the reciprocating motion of the piston into the rotary motion with the help of connecting rod.

Crank-It is a lever between connecting rod and crank shaft. It is a lever between connecting rod and

Crank case- It houses cylinder and crankshaft of the IC engine and also serves as sump for the lubricating oil.

Crank shaft- It is a lever between connecting rod and crank shaft.

Flywheel-A big wheel mounted on the crankshaft, whose function is to maintain its speed constant. It is done by storing excess energy during the power stroke, which is returned during other stroke.

4.0 Terminology used in IC engine:

1. Cylinder bore (D): The nominal inner diameter of the working cylinder.
2. Piston area (A): The area of circle of diameter equal to the cylinder bore.
3. Stroke (L): The nominal distance through which a working piston moves between two successive reversals of its direction of motion.
4. Dead centre: The position of the working piston and the moving parts which are mechanically connected to it at the moment when the direction of the piston motion is reversed (at either end point of the stroke). (a) Bottom dead centre (BDC): Dead centre when the piston is nearest to the crankshaft. (b) Top dead centre (TDC): Dead centre when the position is farthest from the crankshaft.
5. Displacement volume or swept volume (Vs): The nominal volume generated by the working piston when travelling from the one dead centre to next one and given as, $Vs=A \times L$
6. Clearance volume (Vc): the nominal volume of the space on the combustion side of the piston at the top dead centre.
7. Cylinder volume (V): Total volume of the cylinder.

$V= Vs + Vc$

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Advantages

- It is light and compact due to lower ratio of weight and bulk to output.
- Working pressure and temperature inside the engine cylinder is very much high; hence special alloys are used.
- Higher efficiency about 35-40%.
- Low initial cost with High power output per unit weight because of absence of auxiliary units like boiler, condenser and feed pump.
- Easy starting from cold conditions.

Disadvantages

- I C engines have reciprocating parts and hence balancing of them is problem and they are also susceptible to mechanical and they are also susceptible to mechanical vibrations.
- Fuel used is very costly like gasoline or diesel
- Engine emissions are generally high compared to external combustion engine
- Not suitable of large scale power generation
- IC engines cannot use solid fuels which are cheaper. Only liquid or gaseous fuel of given specifications can be efficiently used. These fuels are relatively expensive.

Definition of alternative fuels and their importance

The alternative fuels defined by the Energy Policy Act (EPAct) also cover a vast amount of non-conventional fuels, including alcohols, such as ethanol (including blends with gasoline over 85%); natural gas and liquefied fuels domestically derived from natural gas; liquefied petroleum gas (LPG); coal-derived liquid fuels (CTL); hydrogen (H2); biodiesel (B100); fuels, other than alcohol, derived from biological materials; and fuel that is substantially non-petroleum that yields substantial energy security and environmental benefits. Alternative fuels as those other than conventional gasoline and diesel fuels, covering a wide variety in terms of final forms and manufacturing sources. There are some of the requirements for gasoline fuels, as well as for alternative fuels for IC applications are Octane number,Flammability related to lean limit and combustion stability, Laminar burning velocity,TLHV (of air–fuel mixture), Volatility; boiling curve; vapour pressure.

5.0 Types of Alternative Fuels

Some alternative fuels include biodiesel, bioalcohol (methanol, E1510, butanol), refuse-derived fuel, chemically stored electricity (batteries and fuel cells), hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil, propane and other biomass sources. To reduce reliance on petroleum-based fuels, Alternate fuels are the best solution.

Biodiesel: It is a replacement diesel fuel that is made from renewable sources such as animal fats and vegetable oils. It is a liquid fuel that is typically mixed with conventional petroleum diesel fuel for use in diesel engines. A variety of vegetable oils such as those from soybean, rapeseed, sunflower, jatropha – carcass, palm, and cottonseed etc. have been widely investigated for production of biodiesel.

Ethanol(CH_3OH): Ethanol, a clear, colourless liquid, is an alcohol-based alternative fuel produced by fermenting and distilling starch crops that have been converted into simple sugars. l. Methanol is methane with one hydrogen molecule replaced by a hydroxyl radical (OH). The alternative fuel currently being used is M- *%. In the future, neat methanol or M-100 may also be used. Methanol is also made into ether, MTBE, which is blended with gasoline to enhance octane and to create oxygenated gasoline. Methanol confines no sulphur or complex organic species.

Hydrogen: Hydrogen gas (H_2) is the simplest and lightest fuel. It can be easily produced by reforming natural gas, partial oxidation of liquid fuels and gasification of coal or biomass. This gas may contain low levels of carbon monoxide and carbon dioxide, depending on the

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production source. Hydrogen is being explored for use in combustion engines and fuel cell electric vehicles.

Propane(C_3H8): Propane is produced as a by-product of natural gas processing and crude oil refining Propane or liquefied petroleum gas (LPG) produces fewer vehicle emissions than gasoline. It is a colourless paraffin gas that is compressible to a liquid for safe transport in inexpensive containers. LPG must consist of 90% propane, no more than 5% propylene, and 5% other components (primarily butane and butylene).

6.0 Analysis of alternative fuels

Engine performances and its emissions fuelled with biofuel due to different factors such as the different tested engines, the different operating conditions or driving cycles, the different used biodiesel or reference diesel, the different measurement techniques or instruments, etc. as s how in Fig.1.

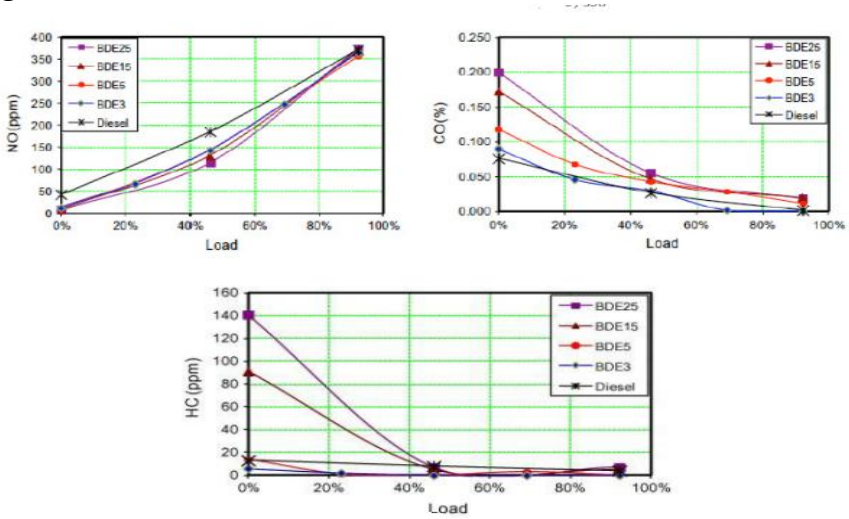

Fig. I: Effect of bio diesel-ethanol blends on NO, CO and HC.

Both the blend and diesel fuel showed almost similar NOx emission result and fuel consumption. However, biodiesel–ethanol–diesel fuel indicated lower PM and CO emissions compared to that of baseline petro-diesel fuel. The performance and emission of diesel-biodiesel-ethanol (D85/B10/E5 D80/B10/E10 and D70/B25/E5) blends in a diesel engine and compared to diesel fuel. The test result indicated that, at all operating condition HC and PM emissions decreased for blended fuel. The emission of CO decreased and CO_2 emissions increased at low engine loads due to a prolonged oxidation process including the exhaust.

	Case 1	Case 2	Case 3	Case 4	Case 5
Diesel price	$1.50	$1.50	$1.50	$1.50	$1.50
Cost difference	$0.15	$0.35	$0.55	$0.65	$0.75
CNG Price	$1.35	$1.15	$0.95	$0.85	$0.75

Estimation of Fuel prices for CNG and Diesel

Some documentation on natural gas vehicles indicates that longer oil change intervals can be adopted for CNG vehicles. As maintenance schedules and procedures vary from fleet to fleet, cost savings for longer oil change intervals will not be considered here, other than to note that it is possible to extend these maintenance intervals.

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Estimation of Fuel prices for Propane and Diesel

	Case 1	Case 2	Case 3	Case 4	Case 5
Diesel price	$1.50	$1.50	$1.50	$1.50	$1.50
Cost difference	$0.15	$0.25	$0.35	$0.45	$0.55
LPG Price	$1.35	$1.25	$1.15	$1.05	$0.95

The vehicles tend to be less expensive, the fuel price differentials between diesel and propane tend to be less than for natural gas as well (based on the Alternative Fuel Price Report). The range of fuel prices used in this analysis, estimated fuel economy numbers for propane and diesel buses used.

7.0 Conclusion:

Dependence on energy is key to our economy and approach of life. Economically, new and renewable types of fuels are to be utilized, as our supplies of many current fuels are very limited. Environmentally, burning fossil fuels has been greatly affecting and damaging our earth therefore to reduce emotions, also to seek benefits that alternative fuels can provide to engine efficiency improvement and emission reduction. Fuels that are most used at present are natural gas, liquefied petroleum gas (LPG) and biofuels, such as transesterified vegetable oils and alcohols (bioethanol). The increasing energy demand of petroleum-based liquid fuel and alternative fuels, plus the inequality of demand among various fuels would eventually yield friendly cooperation between the automotive and refinery industries.

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