

A REVIEW PAPER ON ALTERNATIVE FUELS IN IC ENGINES

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ABSTRACT

In this study, methyl radical and alkyl radical alcohols, hydrogen, biodiesel, boron, fossil fuel, liquefied fossil fuel gas, p-series, electricity, and solar fuels were concluded as alternative engine fuels. Those fuels are crucial because they replace petroleum fuels. there are numerous benefits the environment, economy and clients in using alternative fuels. alternative fuels for both spark ignition (SI) and compression ignition (CI) engines have become very crucial as a result of improved environmental protection issue, the need to reduce dependency on petroleum and even socio-economic aspects. A fuel cell is an energy conversion tool that produces electricity through electrochemically combining fuel (hydrogen) and oxidant (oxygen from the air) gases via electrodes and across an ion conducting electrolyte. The most important characteristic of a fuel cell is its potential to convert chemical energy without delay into electrical energy giving much better conversion efficiencies than any traditional thermo-mechanical device therefore extracting more electricity from the same amount of fuel, operate without combustion so they are virtually pollution free and have quieter operation since there are no moving components. Diesel consumption is in charge of severe pollution, which contains element oxides (NO_x), organic compound (HC), carbon monoxide gas (CO) emissions and many particulate matter (PM) discharged from the combustion chamber. within the past few decades, different fuels, like alcohol, biodiesel, natural gas, and Dialkyl Ether (DME), were used in diesel engines to reduce energy prices and environmental pollution.

Keywords- Alternative fuels,Alcohols fuel,Engine emissions,Spark ignition engine.

1. INTRODUCTION

Currently, combustion of conventional fuels such as gasoline and diesel account for more than half of the sector's primary energy consumption With the increasing cost of fossil oil and global warming continuing to be a dominant environmental concern, it appears that evidently the use of alternative fuels in the future is inevitable especially in light cars is not new however currently started to interest significant worldwide attention. Alcohols such as ethanol, butanol, methanol, and fusel oil and ethers (methyl tertiary butyl ether (MTBE) and Dimethyl Ether (DME)) are used as fuels in ICE. Government of India on 29th Nov 2001 has taken a decision to introduce petrol combined with 5% ethanol to be used in motor cars all over the country in a phased manner. In the first phase the 5% ethanol blended petrol will be introduced in the States of Andhra Pradesh,Gujarat, Haryana, Karnataka, Maharastra,Punjab, Tamil Nadu and Uttar Pradesh. Relaxation of the States/Union Territories will be taken up in the second phase.On the other hand India is also working to blend 10% ethanol in petrol. The pilot projects and R&D initiatives are also lined as much as look at the feasibility of 10% ethanol-gasoline blend. Amendment in BIS specification to house this 10% blend is being pursued. In the year 1992, BIS standard become amended to facilitate the use of methanol in gasoline. Central pollution control

board (CPCB) also commissioned a study to evaluate the emission performance of methanol-gasoline blends through Indian Institute of Petroleum (IIP). CPCB estimated that if all the petrol driven vehicles in Delhi use a methanol-gasoline blend of 3% methanol and 97% gasoline, it may be possible to have 11% reduction in hydrocarbons emissions, 7% CO decrease and 30% NO_x decrease compared to pure gasoline driven cars. Government of India has shown interest in supporting the developments of electrical vehicles. Several agencies which include Ministry of Non-conventional Energy Sources (MNES) have supported projects on specific types of fuel cell technologies with the involvement of national laboratories, universities and industries with an purpose to increase suitable materials, catalysts and components to strengthen production base for manufacturing of fuel cells in India. Small Phosphoric Acid Fuel Cells (PAFC) stacks have been developed and tested by Bharat Heavy Electrical Limited (BHEL). Researchers in India have developed a hydrogen-powered bike that its developers believe is prepared for commercialization. The technology based on a novel metallic hydrogen storage system, may also be modified to be used in cars. As a part of a R&D project, photo bioreactor for producing hydrogen from distillery wastes treatment was installed at Nellikuppam in Tamil Nadu. other projects have been also taken up for the production of hydrogen using solar power and water through photo electrochemical/photocatalytic methods. India too initiated to introduce CNG as automobile fuel recently large numbers of buses, autos and taxis in Delhi have been initially there have been problems of infrastructure and dispensing stations however slowly. Some manufacturers in India already received the technology for producing LPG version in their products particularly two wheelers however large demand of LPG for domestic cooking appears to deter its lunch in the vehicle sector in a large way. DME will be produced through Gas-to-Liquid (GTL) technology and for this gas will be sourced from the center East. Purpose of this project was to establish DME as a multi-purpose fuel for India but in the initial stages the project identified some southern Indian states to deliver DME as a feedstock for power plants. P-series fuels include at least 60% non-petroleum energy content material derived from MTHF and ethanol. Additives of this fuel can be derived from renewable domestic sources thereby making it a desire for energy security. Moreover it also gives emission benefits compared to conventional fuels. Solar and wind power systems are already in industrial use throughout the country today. India in fact has one of the world's largest solar photovoltaic industries. India has more than 350,000 sun photovoltaic systems installed in the country. Biodiesel in addition gives large reductions in particulates and carbon monoxide than conventional diesel fuel.[1]

Methanol

Methanol was used as vehicle fuel for the duration of the 1930s to replace gasoline components for high performance engine. Methanol (CH₃OH) is the chemically best alcohol, with single carbon atom per molecule. Methanol is poisonous, tasteless liquid, colorless, and normally known as "wood alcohol". It has many benefits that distinguish it as an appealing alternative fuel over oil fuels. The first is low cost and it can be produced from several ways which include synthesis fuel (mixture of hydrogen and carbon monoxide) that is produced by steam reforming of natural fuel, gasification of coal, in addition to a manufacturing of biomass, all of that are available in abundance or regeneration. The manufacturing cost of methanol is around 1/2 of the cost of petroleum fuels in Canada. Even though the price is in comparison with the equal power, it is quite low than

that of gasoline. the second is low exhaust emission. further, due to the lower boiling point of methanol, the fuel will evaporate faster and that is advantageous to engine combustion and thereby, hydrocarbon emissions will be reduced. furthermore, the high oxygen content of methanol and easy chemical structure can lead to lower emissions and higher engine combustion in spark ignition engines.

Methanol is an alternative, renewable, environmentally and economically attractive fuel; it is considered to be one of the most favourable fuels for conventional fossil-based totally fuels. Methanol is recently used as an alternative to petroleum fuels for internal combustion (IC) engines with a purpose to satisfy a few environmental and economical concerns. Methanol is one of the fine applicants for long-term, significant alternative of petroleum-based fuels. Among renewable alternative energy sources, there area lot of benefits to the development of alternative fuels such as alcohol fuels instead of the conventional non renewable oil resources, for instance, (1) it may mitigate national security and economic concerns over fuel supplies; (2) it may enhance the atmospheric emissions; and (3) it is able to maintain the sustainable development of the sources among gasoline and diesel alternative fuels, methanol (CH_3OH) fuel has been considered to be one of the most favourable fuels for IC engines. Methanol is taken into consideration to be one of the most favourable fuels for engines, for instance it can be used in a high compression ratio spark ignition (SI) engine that could replace diesels in certain vocational applications it can be used in an inlet port injection SI engine it can be used in a high compression direct-injection stratified rate SI engine it can be used in a direct-injection SI engine and it can be used in a turbocharged, port-fuel-injected, high compression ratio medium duty engine

Ethanol

Ethanol is a renewable and attentive gas commonly produced from organic material through fermentation processes. Ethanol was first submitted as an internal combustion engine fuel by the 1930s in the united states and became commonly used since 1970 moreover, in the 1930s, the government of Brazil stimulated gasoline blended with 5% bioethanol. due to the first oil crisis in 1973, Brazil decided to set up the national alcohol program (NAP) to reduce its reliance on fossil oil currently, ethanol is used as fuel, especially in Brazil, while in Canada, the united states, and India. Additionally, ethanol is used as a fuel additive to increase the octane rating and enhance engine combustion In 2014, the united states was the world's largest ethanol fuel producer, around 60% of ethanol global output, while approximately 23.47 billion liter were produced by Brazil which represents 25% of the global production. on the other hand, the European Union only produced 6% of the global production. due to the problems of gasoline price and emission regulations that are becoming more stringent, ethanol could be given more attention as a renewable fuel also to enhance the oxygen and octane cost. intensive study has been done to ensure high ignition temperatures, higher research octane number, lower freezing point, higher heat of vaporization, and low Reid evaporation pressure (REP) of ethanol in comparison with gasoline.

Butanol

Butanol is a four-carbon atom alcohol ($\text{C}_4\text{H}_9\text{OH}$) that may be used in non-modified spark ignition engines. It is miscible with most solvents and sparingly soluble in water Butanol is typically produced using fossil fuels, however can also be produced from biomass, in which case it is called bio-butanol. each bio-butanol and petro-butanol have the identical chemical properties. Butanol quit similar to gasoline because of the longer

hydrocarbon chain, lower oxygen content and better heating value of butanol compared to methanol and ethanol furthermore, butanol, as a promising fuel candidate, has attracted more attention recently.

Butanol has numerous benefits than methanol and ethanol and contains high tolerance to water contamination which permits the use of the existing distribution pipelines recently, the fusel oil attracts attention through a few researchers as blending gasoline in SI engine.

Dimethyl ether (DME)

Dimethyl ether (DME) as ether fuel does not have a long history as a blending fuel or additive with gasoline in SI engine, but blending DME with gasoline for SI engine appears a possible solution for enhancing the combustion and improving the engine thermal efficiency under normal operation conditions. Dimethyl ether CH_3OCH_3 (DME) can be produced from a variation of feedstock like crude oil, natural gas, coal, residual oil, biomass, and waste products. DME has quite a few suitable properties and is idea to be one of the best alternative fuels for IC engines in the future. in addition, many investigations have been carried out on DME to determine its suitability to be used as a fuel additive in spark-ignited ethanol engine As an general, dimethyl ether has been found to be a promising alternative additive fuel for spark ignition engines, as it has low combustion noise, high thermal efficiency, soot-free combustion, and low NO_x levels.[2,3]

Biodiesel

Biodiesel (fatty acid methyl esters) is efficient, clean, 100% natural energy alternative to petroleum fuels. among the many advantages of biodiesel fuels the following the safe for use in all conventional diesel engines provide the same performance the engine durability as petroleum diesel fuel non-flammable, non toxic, reduces tailpipe emissions visible smoke noxious fumes and odour. biodiesel is refined from various vegetable oils: palm, sunflower, rapeseed, cottonseed, peanut and soybean. it's been widely used in heavy-duty diesel vehicles and marine engines. Biodiesel may be obtained by reacting vegetable oils with alcohol, and the alkali catalysts like KOH and NaOH are added through the transesterification process The purpose of this process is to reduce the oxygen content and viscosity of the vegetable oil. Biodiesel includes organic matter with high molecular weight, such as ether, aldehyde, ketone, phenol and alcohol The density of biodiesel is lower than that of water, and it can be stored for a long period due to its stability Its Sulphur content is far below that of diesel, and there are no aromatic hydrocarbons included in biodiesel; thus, the emissions from biodiesel combustion are a ways less harmful to humans's health. furthermore, the cetane number of biodiesel is higher than that of diesel, improving its combustion performance.

Natural Gas

Natural fuel is another potential alternative to fossil fuels for use in the diesel-fueled vehicles it is the mixture of various hydrocarbon molecules such as methane, ethane, butane, propane and inert diluents like carbon dioxide and molecular nitrogen. but, its availability varies geographically and throughout the year. in addition, specific treatment is required during transportation and production. it can be blended very well with air to form the homogenous gas/air mixture for combustion in the cylinder and significantly reduces the emissions from the engine exhaust. among the alternative fuels, natural fuel is considered to be an essential power supply for internal combustion engines. compared with other alternative fuels, there are some distinct and desirable advantages of natural gas including relatively decreased capital costs and low green-house gas emissions.

natural fuel may be used in diesel engines with a high compression ratio, due to its high octane number. In recent years, power shortage and environmental pollution have drawn increasing attention from governments worldwide towards natural gas because the alternative fuel for heavy-duty diesel engines, as well as stationary engines. It is due to the fact that the natural gas is induced into the intake manifold or the cylinder directly and blended with clean air to form a homogeneous mixture, which is then ignited by pilot diesel fuel or the spark plug therefore, efficient combustion is done and emissions from the exhaust gas are substantially reduced. Moreover, natural gas can be implemented on the in-use vehicles without significant modifications, offering important economic and environmental benefits. Natural gas as a fuel for SI engines is widely used in the United States and Western Europe, in particular Germany, where there are many gas filling stations. In Poland it is not broadly used; LPG has priority. In comparison with diesel fuel, a CI engine fuelled with NG has much lower emissions of NO_x, PM, HC and also CO. In a comparison between NG and LPG fuelled engines has been performed.[4,5,6]

Fuel cell and Hydrogen

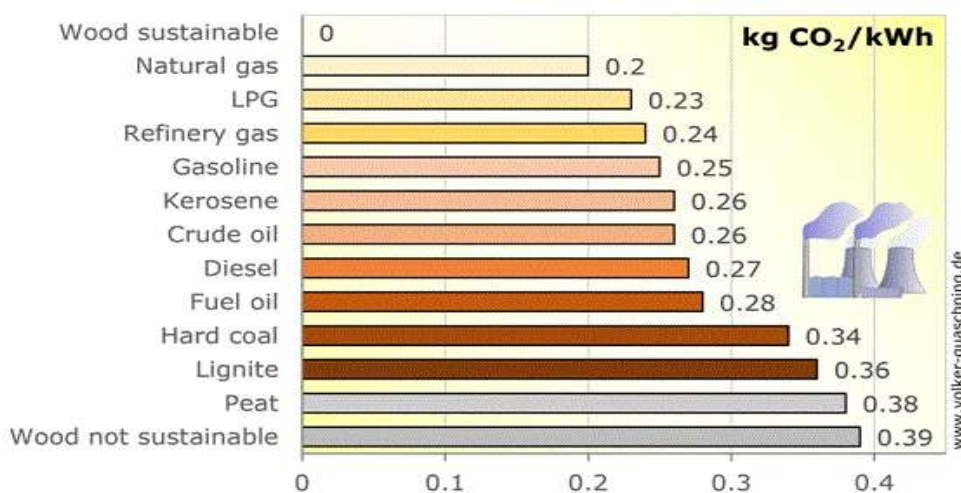
A fuel cell is an energy conversion tool that generates electricity and heat by electrochemically combining a gaseous fuel (hydrogen) and an oxidant gas (oxygen from the air) through electrodes and across an ion conducting electrolyte. During this process, water is formed on the exhaust. The fuel cell does not run down or require any recharging, not like a battery it's going to produce power as long as fuel is provided. The principle feature of a fuel cell is its potential to transform chemical energy directly to electrical energy giving much better conversion efficiencies than any traditional thermo-mechanical system thus extracting more electricity from the same amount of fuel, to operate without combustion so they are actually pollution free and have quieter operation since there are no transferring components.[6] Hydrogen (H₂) will play an important role in developing sustainable because in the future it may be produced in virtually unlimited quantities using renewable resources. Hydrogen has been used correctly in some of internal combustion engine vehicles as pure hydrogen combined with natural gas, and in a growing wide variety of demonstration fuel cell vehicles. Hydrogen isn't always a primary fuel and benefits consist of cleaner air, cleaner water, and better fitness. Hydrogen is also a renewable resource. Hydrogen can be used as a motor fuel, while neither nuclear nor solar energy may be used directly. Hydrogen has excellent properties as a fuel for internal combustion engines in automobiles. Hydrogen can be used as a fuel directly in an internal combustion engine not much distinctive from the engines used with fuel. Laboratory assessments carried out on internal combustion engines burning hydrogen show appropriate performance. Hydrogen can be used as a fuel without delay in an internal combustion engine not a lot unique from the engines used with fuel. The trouble is that at the same time as hydrogen elements 3 times the energy per pound of fuel it has only one tenth the density when the hydrogen is in a liquid form and very a lot much less when it is saved as a compressed fuel. Because of this hydrogen fuel tanks must be large. Significant use of hydrogen as an energy supply should enhance worldwide climate change, power efficiency, and air quality. Fuel cells are an crucial enabling era for the hydrogen future and have the potential to revolutionize the way we energy our nation, providing cleaner, more-efficient alternatives to the combustion of fuel and other fossil fuels.

P-Series Fuel

P-series fuel is a completely unique mixture of natural gas liquids, ethanol, hydrocarbons methyltetrahydrofuran (MeTHF). MeTHF and a biomass-derived co-solvent. P-series is made basically from renewable sources and gives significant emissions benefits over reformulated gas. P-series fuel may be combined with gasoline in any proportion and used in flexible fuel vehicles. P-series is at the least 60% non-petroleum. It also has many environmental benefits. due to the fact a majority of the components that make up p-series fuels come from domestically produced renewable sources, this alternative fuel promotes both energy security and environmental quality. P-series will be 96% derived from domestic sources. P-series fuels should reduce fossil power use by 49% to 57% and petroleum use by 80% relative to gasoline. Greenhouse gas emissions of the p-series fuels are 45% to 50% below those of reformulated gas.

Solar Energy

Solar energy technology use sunlight to produce heat and power. electricity produced by solar energy through photovoltaic technology can be used in traditional electric vehicles. Using sun energy directly to power vehicles has been investigated primarily for competition and demonstration vehicles. solar fuel is light from the solar transformed into energy. It is 100% renewable and emits no emissions.[8] Fuel is not same to gasoline at least if we consider carbon dioxide emissions. Burning of lignite emits almost 100 % more carbon dioxide with respect to the energy content than burning of natural gas. Even natural fuels which includes wood or peat have high specific emissions if they are not used sustainable. As a result deforestation has a high impact on climate change. Then again if we only use as much wood as can grow again it is carbon dioxide neutral because it binds as lots carbon dioxide during growing as it is emits during burning.If fuels are used for electricity generation carbon dioxide emissions increase with the reciprocal of the power plant performance. For example if a electricity station with an efficiency of 34 % burns coal, it emits 1.0 kg carbon dioxide for



Specific Carbon Dioxide Emissions of Various Fuels

Fuel	Emissions in kg CO ₂ / kWh	Emissions in kg CO ₂ / GJ
Wood *	0.39	109.6
Peat	0.38	106.0
Lignite	0.36	101.2
Lusatia	0.41	113.0
Central Germany	0.37	104.0

Rhineland	0.41	114.0
Hard coal	0.34	94.6
Fuel oil	0.28	77.4
Diesel	0.27	74.1
Crude oil	0.26	73.3
Kerosene	0.26	71.5
Gasoline	0.25	69.3
Refinery gas	0.24	66.7
Liquid petroleum gas	0.23	63.1
Natural gas	0.20	56.1

*not sustainable used without reforestation

generating one kilowatt hour of electricity. changing to less carbon dioxide extensive fuels reduces the emissions and contributes to climate protection in the short-time period. For a long-term climate safety the only alternative are zero-carbon electricity resources which includes sustainable-used biomass and different renewable types of energy.[9]

2. CONCLUSIONS

- Presently much attention is focused on utilization of alcohols, hydrogen, biodiesel, boron, natural gas, liquefied petroleum fuel, p-series, energy, and solar fuels as alternative engine fuels. alternative engine fuels are aggressive fuels to petroleum. those fuels are essential because they update petroleum fuels. there are numerous benefits the environment, financial system and clients in the usage of alternative fuels.
- The most famous of alternative fuels are gases. natural gas (used in the united states and Germany) and liquefied petroleum fuel (used in Holland and middle Europe) which are mainly applied to SI engines. Methyl esters of vegetable oils (rapeseed methyl ester used in Europe) bioethanol (used the united states) and other vegetable oil ester and crude oils (used especially in South Asia) may be used as neat fuels for CI engines (now used in demonstration cars).
- In the near future, technology will open up new opportunities and fuel cell based power systems will be best distributed power-generation systems: reliable, clean, quiet, environmentally friendly, and fuel conserving.
- There is a significant reduction of normal gasoline and PM emissions by the use of an alcohol/diesel dual fuel. but, unregulated emissions consisting of methanol, ethanol, acetaldehyde, formaldehyde and ketone are improved as compared to diesel fuel.
- Alcohol and ether have positive chemical and physical characteristics that effect engine performance, emissions, and combustion process without delay including octane number, heating value, oxygen content, carbon content, boiling point and latent heat of evaporation. alcohol and ether have a significant effect at the surroundings and greenhouse gases (GHG) and human health in preferred.

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