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A Review Paper on Alternative Fuels in IC Engines

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ABSTRACT
This study concluded that alternative engine fuels include methyl and alkyl radical alcohols, hydrogen, biodiesel, boron, fossil fuel, liquefied fossil fuel gas, p-series, electricity, and solar fuels. Because they take the place of petroleum fuels, such fuels are essential. Using alternative fuels has several advantages for the economy, environment, and customers. Due to increased environmental protection concerns, the need to lessen reliance on petroleum, and even socioeconomic considerations, alternative fuels for both compression ignition (CI) and spark ignition (SI) engines have become extremely important. A fuel cell is an energy conversion device that uses electrodes and an ion-conducting electrolyte to electrochemically combine fuel (hydrogen) and oxidant (airborne oxygen) gasses to create electricity. The most crucial feature of a fuel cell is its ability to instantly transform chemical energy into electrical energy, which enables it to extract more electricity from the same amount of fuel than any conventional thermo-mechanical device. Additionally, because fuel cells don't burn, they are essentially pollution-free and operate more quietly because they don't have any moving parts. Diesel use is responsible for significant pollution, including emissions of carbon monoxide gas (CO), organic compounds (HC), element oxides (NOx), and numerous particulate matter (PM) from the combustion chamber. Different fuels, such as alcohol, biodiesel, natural gas, and dialkyl ether (DME), have been employed in diesel engines in recent decades in an effort to lower energy costs and pollution levels.

KEYWORDS
Spark ignition engine, Alternative fuels, Alcohols fuel, Engine emissions.

INTRODUCTION
Currently, over half of the sector's primary energy consumption comes from burning conventional fuels like gasoline and diesel. Although the use of alternative fuels, particularly in light cars, is not new, it has recently begun to garner major international attention due to the rising expense of fossil fuels and the ongoing dominance of global warming as an environmental concern. Alcohols like ethanol, butanol, methanol, fuel oil, and ethers (methyl tertiary butyl ether, or MTBE) are used as fuels in ICE. On November 29, 2001, the Indian government decided to gradually introduce gasoline with 5% ethanol for use in automobiles across the nation. The first stage will see the introduction of 5% ethanol blended gasoline in the states of Andhra

Pradesh, Gujarat, Haryana, and Karnataka. However, India is also attempting to add 10% ethanol to gasoline. The possibility of a 10% ethanol-gasoline blend is also examined in the pilot projects and R&D activities. The goal is to amend the BIS specification to include this 10% blend. The BIS standard was changed in 1992 to allow for the use of methanol in gasoline. Through the Indian Institute of Petroleum (IIP), the Central Pollution Control Board (CPCB) also commissioned a research to assess the emission performance of methanol-gasoline blends. According to CPCB estimates, if all Delhi's gasoline-powered vehicles were powered by a methanol-gasoline blend consisting of 3% methanol and 97% gasoline, hydrocarbon emissions may be reduced by 11%, CO by 7%, and NOx by 30% as compared to pure gasoline driven cars. The Indian government has expressed interest in promoting the advancement of electric vehicles. In order to increase the number of appropriate materials, catalysts, and components to strengthen the production base for fuel cell manufacturing in India, a number of agencies, including the Ministry of Non-conventional Energy Sources (MNES), have funded projects on particular types of fuel cell technologies with the participation of national laboratories, universities, and industries. Bharat Heavy Electrical Limited (BHEL) has designed and tested small phosphoric acid fuel cell (PAFC) stacks. An Indian team of researchers has created a hydrogen-powered bicycle that its creators think is ready for market release. The device, which is based on a new metallic hydrogen storage mechanism, might potentially be adapted for use in automobiles. A photo bioreactor for hydrogen production from distillery waste treatment was developed as part of an R&D effort. Additional projects have been undertaken to produce hydrogen utilizing solar energy and water using photo catalysis and photo electrochemical processes. Although there have been initial issues with infrastructure and distribution stations, India has also lately started to adopt CNG as an automobile fuel. This has affected a significant number of buses, cars, and taxis in Delhi. Some Indian manufacturers already have the technology to produce LPG versions of their products, especially two-wheelers, but the high demand for LPG for home cooking seems to be a major deterrent for the car industry. Across the nation, solar and wind power systems are already being used in industry. In actuality, India boasts one of the biggest solar photovoltaic industries in the world. Over 350,000 solar photovoltaic systems have been deployed in India. Additionally, compared to traditional diesel fuel, biodiesel significantly lowers carbon monoxide and particles.

PERFORMANCE ANALYSIS OF ALTERNATIVE FUELS

Methanol

During the 1930s, methanol was employed as automobile fuel in place of gasoline for high-performance engines. With only one carbon atom per molecule, methanol (CH3OH) is the finest alcohol in terms of chemistry. Methanol, sometimes referred to as "wood alcohol," is a colorless, tasteless, and toxic liquid. Compared to oil fuels, it is a more desirable alternative fuel due to its numerous advantages. The first is inexpensive and can be made in a number of ways, such as by

producing synthesis fuel, which is a mixture of hydrogen and carbon monoxide made by steam reforming natural fuel, gasifying coal, or manufacturing biomass, all of which are abundantly available or regenerable. The cost of producing methanol is approximately half that of producing petroleum fuels in Canada. Even though the prices 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 a fuel that is renewable, alternative, attractive from an environmental and economic standpoint, and is thought to be one of the best alternatives to traditional fossil fuels. In order to address some financial and environmental issues, methanol is now utilized in internal combustion (IC) engines instead of petroleum fuels.

Ethanol

Fermentation techniques are often used to make ethanol, a gas that is clean and renewable when produced from organic material. In the United States, ethanol was originally introduced as an internal combustion engine fuel in the 1930s, and it has been widely utilized since 1970. Additionally, the Brazilian government promoted gasoline mixed with 5% bioethanol in the 1930s. Brazil established the National Alcohol Program (NAP) in 1973 in response to the first oil crisis, which made the country less dependent on fossil fuels. Today, ethanol is mostly used as fuel in Brazil, Canada, the United States, and India.

Butanol

The four-carbon alcohols (C_4H_9OH) can be used in unmodified spark ignition engines. It is miscible with most solvents and only faintly soluble in water. Butanol is often produced from fossil fuels, but it can also be produced from biomass; this is known as bio-butanol. Petro-butanol and bio-butanol share the same chemical properties. Butanol is similar to gasoline in that it has a longer hydrocarbon chain, a lower oxygen content, and a higher heating value than methanol and ethanol. Furthermore, butanol has recently attracted more attention as a possible fuel alternative. Butanol is superior to methanol and ethanol in several ways. Because of its exceptional resistance to water contamination.

Dimethyl ether (DME)

Though it hasn't been used much in the past as an additive or ether fuel for SI engines, dimethyl ether (DME) and gasoline blends seem like a viable way to improve combustion and increase engine thermal efficiency in typical operating situations. A variety of feed stocks, including crude oil, natural gas, coal, residual oil, biomass, and waste products, can be used to create

dimethyl ether CH3OCH3 (DME). DME is anticipated to rank among the top alternative fuels for internal combustion engines in the future due to its many advantageous qualities.

Biodiesel

Fatty acid methyl esters, or biodiesel, is a 100% natural, efficient, and clean energy substitute for fossil fuels. Among the many benefits of biodiesel fuels are the following: they are non-flammable, non-toxic, produce less visible smoke, noxious fumes, and odor, and are safe to use in all conventional diesel engines. They also offer the same engine durability as petroleum diesel fuel. Vegetable oils such as palm, sunflower, rapeseed, cottonseed, peanut, and soybean are processed to create biodiesel. It is extensively utilized in marine engines and heavy-duty diesel cars. Vegetable oils and alcohol can react to produce biodiesel; during the transesterification process, alkali catalysts like KOH and NaOH are added.

Natural Gas

Natural fuel is another potential replacement for fossil fuels in diesel-powered vehicles. It is a mixture of several hydrocarbon molecules, including methane, ethane, butane, and propane, with inert diluents, such as carbon dioxide and molecular nitrogen. Its accessibility varies by area and throughout the year, though. Furthermore, particular handling is needed both in manufacture and during shipment. It greatly lowers engine exhaust emissions when combined with air to generate a homogeneous gas/air mixture for combustion in the cylinder. Natural gas has several clear and advantageous advantages over other alternative fuels, such as lower capital expenditures and lower greenhouse gas emissions. Because natural fuel has a high octane number, it can be utilized in diesel engines with high compression ratios. Governments throughout the world have been paying more attention to natural gas as an alternative fuel for heavy-duty diesel engines and stationary engines in recent years due to power shortages and environmental pollution. It is because natural gas is directly injected into the cylinder or intake manifold and mixed with clean air to create a homogenous mixture. This mixture is then ignited by a spark plug or pilot diesel fuel, resulting in effective combustion and significantly lower exhausts gas emissions.

Fuel cell and Hydrogen

By electrochemically mixing a gaseous fuel (hydrogen) and an oxidant gas (airborne oxygen) through electrodes and across an ion conducting electrolyte, a fuel cell is a device for converting energy into heat and power. On the exhaust, water forms during this process. The main characteristic of a fuel cell is its ability to convert chemical energy directly into electrical energy, providing significantly higher conversion efficiencies than any conventional thermo-mechanical system and allowing for the extraction of more electricity from the same amount of fuel. Additionally, because fuel cells don't require combustion to function, they are actually pollution-free and operate more quietly than other fuel cells. 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. Tests conducted in laboratories on hydrogen-burning internal combustion engines demonstrate acceptable performance. Without much delay, hydrogen can be utilized as fuel in internal combustion engines, which are not all that different from fuel-powered engines. The problem lies in the fact that while hydrogen has three times the energy per pound of fuel, it only has a tenth of the density in liquid form and much less in compressed form when stored. Large hydrogen fuel tanks are required as a result. Significant hydrogen energy utilization should improve power efficiency, air quality, and global climate change. Fuel cells are a critical component of the hydrogen future and have the power to completely transform the way our country is powered, offering cleaner, more-efficient alternatives to the combustion of fuel and other fossil fuels.

P-Series Fuel

P-series gasoline is an entirely distinct blend of ethanol, hydrocarbons, and natural gas liquids called methyl tetra hydrofuran (MeTHF). MeTHF and a co-solvent generated from biomass. P-series offers notable emissions advantages over reformulated gas and is primarily composed of renewable resources. P-series fuel can be utilized in flexible fuel cars at any ratio with gasoline. At least 60% of the P-series is petroleum-free. It is also very beneficial to the environment. Energy security and environmental quality are both supported by p-series fuels because most of its constituent parts are derived from renewable sources that are produced locally. 96% of the P-series will come from domestic sources. In comparison to gasoline, P-series fuels should save 49% to 57% of fossil power and 80% of petroleum in comparison to gasoline. The p-series fuels have 45% to 50% fewer greenhouse gas emissions than reformulated gas.

Solar Energy

Solar energy technology generates power and heat from sunshine. Conventional electric vehicles can run on electricity generated by photovoltaic technology using sun energy. Direct solar energy conversion to power has mostly been studied for demonstration and competition vehicles. Solar fuel is solar light that has been converted to energy. It produces no emissions and is entirely renewable. Fuel is not the same as gasoline, at least when carbon dioxide emissions are taken into account. Compared to natural gas, burning lignite releases over 100% more carbon dioxide per unit of energy. If not used sustainably, even natural fuels like wood or peat have high specific emissions. Deforestation therefore has a significant effect on climate change. Because wood absorbs as much carbon dioxide during growth as it does during burning, we can achieve carbon dioxide neutrality by using only the amount of wood that can be grown again. When fuels are utilized to generate electricity, carbon dioxide emissions rise in direct proportion to power plant efficiency.

CONCLUSIONS

1. Alternative fuels for engines are more aggressive than petroleum. Because they modernize petroleum fuels, such fuels are indispensable. The use of alternative fuels has several advantages for the environment, the financial system, and customers.
2. Gases are the most well-known alternative fuel. SI engines mostly use liquefied petroleum fuel (used in Holland and middle Europe) and natural gas (used in the US and Germany). Bio ethanol (used in the United States), methyl esters of vegetable oils (such as rapeseed methyl ester in Europe), and other vegetable oil ester and crude oils (particularly in South Asia) can be utilized as neat fuels for CI engines.
3. Fuel cell-based power systems will be the finest distributed power-generation systems in the near future because to their dependability, cleanliness, quietness, environmental friendliness, and fuel efficiency.
4. By using an alcohol/diesel dual fuel, regular gasoline and PM emissions are significantly reduced. However, compared to diesel fuel, unregulated emissions of methanol, ethanol, acetaldehyde, formaldehyde, and ketone are improved.
5. The positive chemical and physical properties of alcohol and ether, such as their octane number, heating value, oxygen and carbon contents, boiling point, and latent heat of evaporation, have an immediate impact on engine performance, emissions, and the combustion process. Ether and alcohol have a major impact on greenhouse gas emissions, the environment, and human health.

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