International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 09 | Sep 2018 www.irjet.net p-ISSN: 2395-0072

Engines and Alternative Fuels

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Abstract - ***Alternative fuels for compression ignition (CI) and spark ignition (SI) engines have become extremely critical thanks to the increased concerns on environment protection, the need to decrease over-dependence on petroleum and numerous other socioeconomic aspects. The paper assesses the current status of alternative fuels for combustion engines, including their sources, physiochemical properties, and the recent data on the application of R&D and technological aspects. Natural gas, biofuels and liquefied petroleum gas (LPG) are the most commonly used fuels. Some fuels species cannot be applied directly as pure fuels but used as additives, including oxygenates, alcohols and dimethyl ether. These are reviewed to provide profound insights as far as alternative fuels are concerned.***

Keywords*:* Alternative fuels, engines, alternative fuel vehicles, diesel, and Otto principle

I. INTRODUCTION

Substantial interest in the alternative source of energy for vehicles, evident presently, is a consequence of the growing concern for the significant environmental effect of the greenhouses gases and other toxic components from the transport sector due to consumption of the already limited fossil fuel .

The limits of emission are increasingly becoming stringent, and the fuel industry is compelled to align its operations with the changing conditions. The 'alternative fuel' is a term used commonly to identify the non-petroleum-based energy sources.

This class of energy has significantly high heating value and result in lower emission relative to petroleum fuels . Another benefit of the fuel class is the diversity of sources. In the domain of alternative fuel, research work has been ongoing, and some fuels types are already in the market (CNG and LPG, the leading alternative fuel in the transport sector).

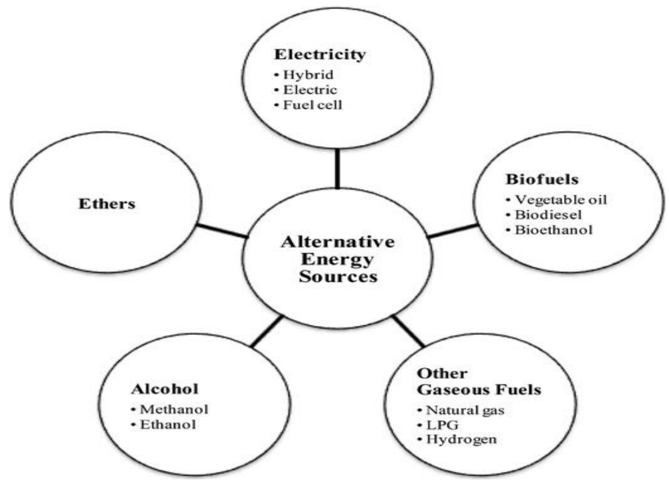

Figure 1: Alternative Fuel Sources

II. TECHNOLOGICAL OPTIONS

Globally, the most common automobile technologies are internal combustion engines by Diesel and Otto. As a result, the commonly used fuels are gasoline and diesel refined from mineral oil. As a result, alternative fuels are not gasoline and diesel based fuel generated from mineral oils. However, alternative propulsion technologies are all technologies apart from Diesel and Otto . The applications of alternative fuel have necessitated the development of new automobiles or modification of existing models. Compatible models are referred to as alternative fuel vehicles (AFV). They are categories of automobiles with the capacity to operate on AL. Except for electric cars, which are non-hybrid and hybrid cars, AFVs are designed and dedicated to run only on one fuel.

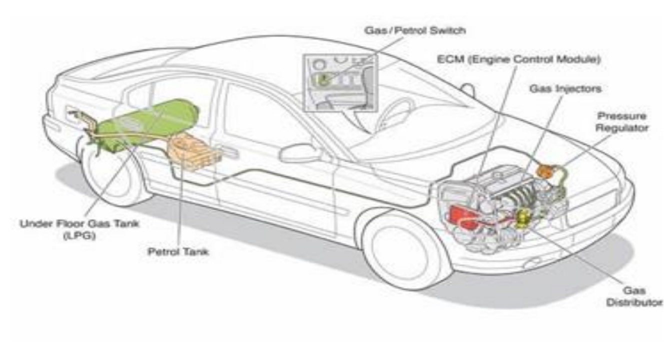

Figure 2: Bi-Fuel System LPG

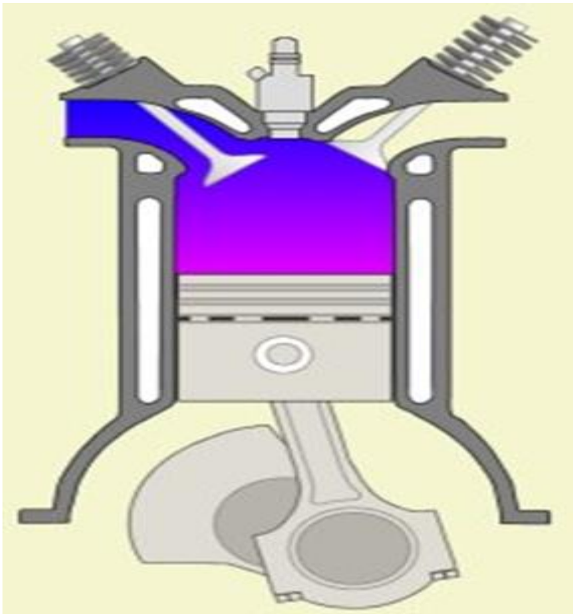

Figure 3: Otto Engine

The non-dedicated vehicles, which are bio-fuelled operated on either conventional fuel or alternative fuel although not concurrently. Flexible AFVs have engines that work with both fuel alternatives, with dual AFVs having the capacity to burn both fuels simultaneously but separately. Currently, the use of AFs is mostly restricted locally because some issues still need to be addressed, including generation, distribution and use, as well as onboard storage, cost-effectiveness, safe use and distribution infrastructure . The general acceptance of AFs by users is critical since their purpose is linked to specific problems, including refueling operations, a hazard in storage, and corrosiveness and toxicity.

A. Alternative Fuels

There is a wide range of alternative fuel, and their use and acceptance is still a concern. Natural gas is 90% methane and a blend of other gases, such as carbon dioxide, propane, ethane, and hydrogen. Natural gas, as a fuel, has an extended range of availability and emits less carbon dioxide, unlike petroleum products. Compressor Natural Gas (CNG) is a form of natural gas compressed at 200 bar pressure . Filling stations are supplied with natural gas from supply grids and pump them to cars installed with storage tanks. For use as a fuel, natural gas burn in engines based on Otto principle. Thus, Otto engines are necessary for automobiles to run on natural gas.

On the other hand, CNG has relatively lower energy content than diesel and gasoline. Conversely, traditional gasoline tanks are still present in bivalent cars as monovalent can slowly being phased out from the market. LPG is not explicitly meant for cars but a great form of natural gas that is easy to move around. The gas is stored at a temperature of –165° C with pressure just above the atmospheric. In the liquefied form, the gas is effectively transported, and at its destination, it can be changed into a gaseous state. Other types of alternative fuel are bio-fuel, sourced from plants, and hydrogen, which is abundant globally in a chemical form . Energy is critical in the isolation of the gas from its original form primarily found in hydrocarbons, coal, and water. Research on gas-to-liquid fuels (GTL) is at present still at its infancy

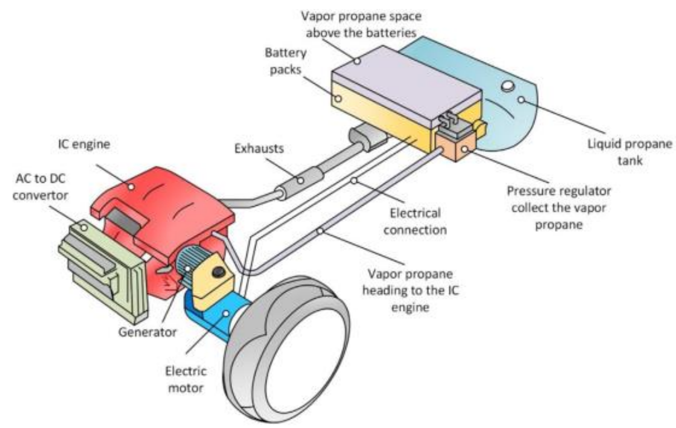

Figure 4: Propane Engine

In the past, electric cars were viewed as a suitable alternative to automobiles powered by fossil fuels. The primary drawback of the electric vehicle is the inability to store sufficient power to power the automobile for a long time. The capacity of the battery to save energy in an electric car is significantly low compared to conventional fuels common in modern vehicles. The performance, operation, and efficiency of motor powered electric vehicles are relatively higher compared to the engine driven care notwithstanding being environmentally friendly. Despite such strengths, electric cars are falling behind in the industry because of the limited capacity for power storage. The paper is premised on the idea of charging the batteries of electric vehicles while in motion. The above can be achieved through the use of wind energy resulting from the relative movement of the car. Wind turbines are mounted on the vehicle's body structure to generate electric power. The paper presents an elaborate analysis of aerodynamics along with the wind turbine and flow pattern. Techniques to lower drag associated by the introduction of the turbine are also examined. On prime concerns are the optimum values of the various design parameters and the vehicle's rated velocity.

B. Alternative Propulsion Technologies

There is a range of propulsion technologies apart from combustion engines that operate as per Diesel and Otto principles . Fuel cell technology is expected to shape the future of propulsion technologies. Presently, no cars powered by fuel cars have been commercially introduced in the market with most manufacturers focusing on modifying existing model standard .

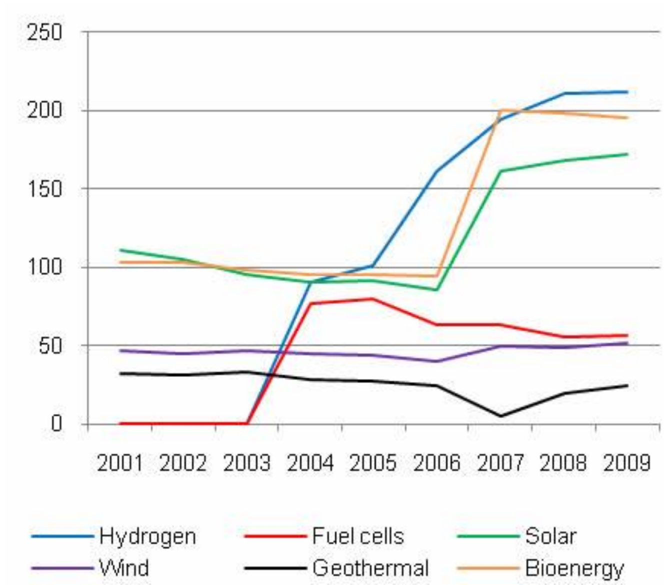

Figure 5: R&D Investment on AF

For purposes of lowering R&D costs, strategic partnerships have become norms among manufacturers in the industry. Estimates show that in 2002, about 4000 fuels cells both medium and large scales were in operation globally. Fifty percent of these systems were located in Canada and the US with UTC and Ballard being the primary market leaders . The remaining is shared among companies in Europe and Japan. Proton Exchange Membrane Fuel Cell (PEMFC) is presently the most promising concept for integration into vehicles. Direct Methanol Fuel Cell (DMFC) is perceived to have the potential for introduction into vehicle propulsion although it is presently considered as technologically advanced in comparison to PEMFC .

Wind also present alternative source of energy to propel automobile engines. When an automobile is in motion, it experiences wind resistance in the form of form drag and frictional drag. The former arises as a result of air viscosity whereas the latter is associated with the changes in air pressure in the rear and front side of the vehicle. Turbulence develops when a car is moving through the wind, and when stationary turbines are position at the roadside, they can harness power from the wind streams created from the moving vehicles. The energy used to overcome the aerodynamic drag of the automobile can be extracted from the wind streams. However, when the wind energy is used in the generation of power in ways that do not result in thrust or force working in the opposite direction of the vehicle's propulsion, then the gained energy can potentially be used in the production of electricity for charging the electric vehicle's batteries [1]. Similarly, the aerodynamic drag can be reduced by encouraging the movement of air to the rear side. Vortex shedding prevents the air streams from entering the back side of the car as they slide over its body. When streams of air flow to the area, the drag will be reduced significantly, and extra electricity can be generated based on the kinetic energy from the wind. Some studies have been conducted, but not substantial findings have materialized.

During World War II, submarines had inbuilt wind turbines to charge batteries when they were static or afloat in the water. Presently, such turbines are common in caravans, vehicles, and ships when they are static. However, extraction of power from a mobile car is complicated because the turbine acts as the load. Conventional designs have turbines positioned at the roof of the vehicle without taking into consideration the additional weight. A prototype by Maxx Bricklin and Rory Handel demonstrated that it has four strategically placed air intakes to channel the flow of air over the body of the car to the turbine . The study attempts to address such frailties by presenting a novel approach.

III. CONCLUSION

The new technologies with the enormous potential to transform energy economy are solar voltaic and hydrogen fuel. Solar voltaic generates electricity from widely distributed and abundant energy. Hydrogen fuel cells offer clean and high-performance energy from a range of fuels. Fuel cells require fueling infrastructure whereas photovoltaics need a new type of energy storage with a related decrease in cost. An important question for the above technologies is the issue of the most capable of overcoming the current technological and technical hurdles. They are expected to provide sufficient power to meet the existing needs while reducing environmental concerns to encourage widespread implementation. Choices of energy source are indeed social choices and the attitude of the public and government toward self-sufficiency or energy security affect the application of novel technologies across regions. Similarly, they are the driving forces in the supply of renewable energy among the government. Personal priority is also another critical parameter and involves values, lifestyles, and the environment. When there is a desire for change, it solely depends on the fuels and technologies available. Timing and research will make the difference between revolutionary and evolutionary solutions to concerns, such as climate change.

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