International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 01 | Jan 2021 www.irjet.net p-ISSN: 2395-0072

Alternative Fuel

Ananta Kr. Nath, M.E. (Mech)

Lecturer (SS), Mechanical (Automobile) Engineering, Bongaigaon Polytechnic, Bongaigaon, Assam.

Abstract: *The World at present is faced with the crisis of energy and environment degradation. One of the factors is the growing rate of automobile industry based on fossil fuel. The present situation of energy crises due to continuous depletion of frighten ancient fuels has resulted in rise of global prices of crude petroleum products which is bound to affect adversely on the overall economy of many countries like India. In India, availability of edible oils is partially dependent on import; it would not be possible to use edible oil in C.I engines. As such we should prepare for some alternative of this conventional diesel or petrol fuel. Alternative energy solutions may shift energy consumption to less carbon, less pollutions and provide more energy diversity.*

The World petroleum of the past several years has focused attention on the needs of research and development of fuel alternatives. Now a days it has been inclusively realized that the I. C engine form an indispensable part of the growth of the modern civilization. The growing of green plants as a renewable source of fuel and chemical feedstock is attracting increasing interest. Chemical analysis of a number of plants species, in order to access their suitability as renewable sources of hydrocarbon-like photosynthetic products have made by several researchers.

Alternative fuels also known as non-conventional fuels, are any materials or substances that can be used as a fuel, other than conventional fuels. Some well-known alternative fuels include vegetable oil, biodiesel fuel, CNG, electric car etc.

Keywords: **Alternative fuels, Mesua Ferrea, Biodiesel fuel, CNG, Electric car.**

I. Introduction and Overview

As the price of oil increases, the demand of alternate fuels also increases. A combination of available alternative fuels will evolve with the most likely choices affected by a number of technical, economical and marketing issues. In order to allow a wider application of alternative fuels, a number of obstacles have to be overcome. These include economic, technological, and infrastructural issues. Conventional fuels are Fossil fuels (petroleum), coal, and nuclear materials such as uranium. Alternate fuels are also known as non-conventional fuels. That are highly oxidized, sulphur free, environmental friendly fuel and any materials or substances that can be used as fuels, other than conventional fuels. Example: Vegetable oil, Biodiesel, Natural gas etc.

Now, alternative fuel has needed because

(a) Conventional fuels are going to run out (b) To reduce pollution (c) To protect against global warming (d) To save money (e) Biodegradable and non-toxic (f) Easy to handle and store (f) To develop rural areas.

The presentations includes their production, utilization, environment effect, running performance, fuel property, market share, running and investigate cost and production barriers, etc.

II. Objectives of the Present Study

1. To introduce different kinds of alternative energy for vehicles, such as vegetable oil, biodiesel, compressed natural gas, and electricity.
2. To compare the properties of the alternative fuels and discuss the advantages and drawbacks of different types of fuel energies.
3. To evaluate and compare conventional fuel vehicles and several massive produced alternative fuel vehicles.

III. Nahor (Mesua Ferrea) Oil

The study has been carried out with the following steps:

(a) Extraction of Oil from Seeds:

Crushing the seeds and extracting oil from it by applying mechanical pressing,

(b) Steam Distillation of the Crude Oil obtained from Mesua Ferrea Seeds:

Mesua ferrea seeds contain viscous oil which is non-edible. The steam distillation of the crude oil was carried out with an A. S. apparatus (American Standard Apparatus). The initial boiling point was found out to be 80^0 C. The colour of the distillate fraction for different boiling ranges differs from faintly green to dark green. The major distillate fraction in the range 250 to 300^0C was considered for properties investigation which is similar to the boiling range of diesel. The fraction so obtained was found to be acidic in nature. The excess of acid present in the major oil fraction was neutralized by

adding the required quantity of solid sodium carbonate and then the oil was distilled. The initial boiling point and the final boiling point of the distillate fraction were recorded. Density, viscosity and specific gravity of the distillate fraction from the range 250 to 300^{0}C were measured. Density was measured using Pycnometer.

Viscosity was measured using Ostwald's viscometer. The properties measured were comparable with those of the diesel fuel. Thus the distillate fraction obtained in the range of 250 to 300^{0}C may be used as a fuel in compression ignition engine.

(c) The Test Rig and Test Engine

Experimental investigation was performed on a 4-Stroke, 10 – 15 H.P, and 1500 r. p.m. vertical single cylinder water cool diesel engine coupled to hydraulic dynamometer/ mechanical brake. The compression ratio is around 16:1 and to facilitate end crank starting, decompression valve is provided. For the starting purpose of the engine the decompression lever is used, the crankshaft of the engine is moved up to a sufficient speed by using end crank lever and then suddenly the decompression lever is closed. Due to the closing of decompression lever the air inside the cylinder is compressed and temperature of the air is increased. After that the injection sprays fuel in the cylinder chamber. The temperature inside the cylinder is increased to such a point that it ignites the sprayed fuel and combustion takes place. As the combustion starts, the burnt gases expand and move the piston from T. D. C. to B. D. C. and the engine starts running.

The cooling water is used to keep the engine temperature in between 50 to 60^{0}C. A governor is fitted with the engine because the engine runs under varying load condition. When the load increases the governor allows more fuel to be consumed to increase the power and to make the running speed of the engine constant. A hydraulic dynamometer is used to give the engine load. The hydraulic dynamometer is constructed with some blades and runners arrangements. The shaft of the runner is coupled to the engine shaft. So when the engine starts running, the runner runs with the blades. So water comes to provide force against the blades. A valve is used to control the quantity of water flow. The force with which the water strikes the blades is measured by using a dial spring balance which gives the measure of force up to 100 kg.

The 4-stroke diesel engine is used for determining-

- Specific fuel consumption
- Air fuel ratio
- B.H.P.
- Mechanical efficiency
- Brake thermal efficiency

For determining the above property the arrangements provided with engine are-

- Hydraulic water brake dynamometer
- Water manometer and fuel gauge

IV. Biodiesel Fuel

Biodiesel refers to a non- petroleum based diesel fuel consisting of short chain alkyl (methyl or ethyl) esters, made by trans esterification of vegetable oil, which can be used (alone, or blended with conventional petro diesel) in unmodified diesel-engine vehicles. Biodiesel is distinguished from the straight vegetable oil (SVO), sometimes referred to as "waste vegetable oil" (WVO), "used vegetable oil" (UVO), pure plant oil (PPO) used alone or blended as fuels in some converted diesel vehicles.

Biodiesel is produced by mechanically extracting natural vegetable oils from seeds, such as rape, and reacting the oil with methanol in the presence of a sodium or potassium hydroxide catalyst. Valuable by-products are produced during the production including straw (which can be used as a fuel), oilseed cake (a protein rich animal feed) and glycerol used in the production of soap and as a pharmaceutical medium. The production of biodiesel, such as rape methyl ester, is still done on a small scale and does not presently enjoy the economies of scale available to the production and distribution of diesel.

(a) Production

Biodiesel is the name of a fuel alternative of the conventional, petroleum based diesel engine fuel, which is manufactured from vegetable oils or animal fats by catalytically reacting these with a short-chain aliphatic alcohol(methanol or ethanol), typically using a process called trans esterification or alcoholics. The application of this process is what is meant by biodiesel production.

(b) Advantages of Biodiesel:

1. As it contains no sulphur content thus produced no sulphur and considerably less amount of CO & HC.
2. Since it grows well on the waste lands thus the economic value can be extracted from the waste land.
3. This price does not affected by reduction in the production of petroleum based fuel.
4. Its prices comparatively low then the conventional petro diesel.

(c) Disadvantages of Biodiesel:

1. If the blending of biodiesel with petro diesel is exceeds more than 20% then certain modification is to be made in the engine.
2. Another effect of biodiesel is that it emits more NO_X than the petro diesel that affect the ozone layer.

(d) Blending:

These demerits can be eliminated by making suitable proportion of blending of biodiesel with petro-diesel

Proportion of mixing(%) of biodiesel	Emission of particulate material (%)	Emission of CO (%)	Emission of HC (%)	Emission of NO_x (%)
Blending of biodiesel with petro diesel up to 40%	Less than 17.77	Less than 28.13	Less than 40.28	More than 14.89
Blending of biodiesel with petro diesel up to 20%	Less than 11.17	Less than 12.58	Less than 22.22	More than 5.44

(e) Applications

Biodiesel can be used in pure form (B100) or may be blended with petroleum diesel at any concentration in most modern diesel engines. Biodiesel has different solvent properties than petro diesel, and will degrade natural rubber gaskets and hoses in vehicles (before 1992) although these tend to wear out naturally and most likely will have already been replaced with FKM, which is nonreactive to biodiesel.

In 2005, Daimler Chrysler released Jeep Liberty CRD diesels from the factory into the American market with 5% biodiesel blends, indicating at least partial acceptance of biodiesel as an acceptable diesel fuel additive. In 2007, Daimler Chrysler indicated intention to increase warranty coverage to 20% biodiesel blends if biofuel quantity in the United States can be standardized.

The British businessman Richard Branson's Virgin Voyager train, number 220007 Thames Voyager, billed as the world's first "biodiesel train" was converted to run on 80% petro diesel and only 20% biodiesel, and it is claimed it will save 14% on direct emissions.

Similarly, a train in Eastern Washington will be running on a 25% biodiesel 75% petro diesel blend during summer, purchasing fuel from a biodiesel producer seated along the railroad tracks.

The World's first biofuel-powered commercial aircraft took off from London's Heathrow Airport on February 24, 2008 and touched down in Amsterdam on a demonstration flight hail as a first step towards "cleaner" flying. The "Bio Jet" fuel for this flight was produced by Seattle Imperium Renewables, Inc.

V. Compressed Natural Gas:

The term CNG (Compressed Natural Gas) stands for natural gas which is compressed at a pressure of 200-220 bars. The filling stations use natural gas from the supply grid, compress it and pump it into the pressure tanks in the car. The use of natural gas as a fuel requires engines which work according to the Otto principle. Therefore, for cars running on natural gas, Otto engines are used, which are optimised for the use of natural gas.

CNG has lower energy content per litre than gasoline or diesel. This initially can be seen through the lower range of CNG vehicles compared to gasoline or diesel fuelled vehicles. However, conventional gasoline tanks still exist in bivalent vehicles (in contrary to monovalent vehicles). Thus, the range of the bivalent vehicles is clearly increased.

Compressed Natural Gas (CNG) is a substitute for gasoline (petrol), diesel or propane fuel. It is considered to be a more environmentally "clean" alternative to those fuels and it is much safer than other motor fuels in the event of a fuel spill: natural gas is lighter than air, so it disperses quickly when leaked or spilled.

CNG is a mixture of hydrocarbons consisting of approximately 80-90% methane in gaseous form. Due to its low energy density, it is compressed to a pressure of 200-250 kg/ cm^2 and hence the named compressed natural gas.

Natural gas is colourless, odourless, non-toxic but inflammable and lighter than air. It is not a liquid fuel and not the same as LPG. CNG is lead free and its use

substantially reduces harmful engine emissions and helps keep the environment clean.

(a) Composition of CNG (%Volume):

Methane	93.20
Ethane	4.27
Propane	1.38
I- Butane	0.18
N- Butane	0.20
I- Pentane	0.04
N- Pentane	0.03
Carbon dioxide	0.27
Nitrogen	0.43
Moister content	2ppm

(b) Advantage of using CNG fuels:

1. Green fuel – Commonly referred to as the green fuel because of its lead and sulphur free character, CNG reduces harmful emissions. Being non- corrosive, it enhances the longevity of spark plugs. Due to the absence of any lead or benzene content in CNG, the lead fouling of spark plugs and lead or benzene pollution are eliminated.

2. Increased life of oils – Another practical advantage observed is the increased life of lubricating oils, as CNG does not contaminate and dilute the crankcase oil.

3. Mixes evenly in air – Being a gaseous fuel CNG mixes in the air easily and evenly.

4. Using CNG Fuels is safe –

- CNG has a higher ignition temperature (7000^{0}C) as compared to Petrol or Diesel.
- CNG therefore has a lesser chance of catching fire in case of accidental leakages.
- CNG is lighter than air. Thus, in the event of accidental leakage, CNG easily goes up in the atmosphere and reduces the possibility of fire.

5. 'CNG' the Environment Friendly Fuels –

Petrol and Diesel vehicles pollute environment by releasing harmful gases like Hydro carbon, Carbon monoxide, Carbon Dioxide and Nitrous Oxide etc. These gases are responsible for thousands of premature deaths around the World and affect other living things. Majority of people convert their cars to CNG for financial reasons and also contribution towards working for a clean & green environment.

(c) Disadvantage of using CNG fuel:

Compressed natural gas vehicles require a greater amount of space for fuel storage than conventional gasoline power vehicles. Since it is a compressed gas, rather than a liquid like gasoline, CNG takes up more space for each GGE (Gallon of Gas Equivalent). Therefore, the tanks used for store the CNG usually take up additional space in the trunk of a car or bed of a pickup truck which runs on CNG.

VI. Electric Vehicle (Electric car):

An electric car is a type of alternative fuel car that utilizes electric motors and motor controllers instead of an internal combustion engine (ICE). The electric power is usually derived from battery packs in the vehicle. In general terms an electric car is a rechargeable battery electric vehicle.

An electric vehicle (EV) is a vehicle that uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels or an electric generator to convert fuel to electricity. EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft.

EVs first came into existence in the mid of 19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. Modern internal combustion engines have been the dominant propulsion method for motor vehicles for almost 100 years, but electric power has remained commonplace in other vehicle types, such as trains and smaller vehicles of all types.

Commonly, the term EV is used to refer to an electric car. In the 21st century, EVs saw resurgence due to technological developments, and an increased focus on renewable energy. A great deal of demand for electric vehicles developed and a small core of do-it-yourself (DIY) engineers began sharing technical details for doing electric vehicle conversions.

Electric vehicles are expected to increase from 2% of global share in 2016 to 22% in 2030.

(a) Electric Car Components and Functions:

Electric car or vehicle components and functions depend on the car type. There are at least four types of electric cars currently sold commercially and operates in the world. This article will discuss various common main electric car components or parts or elements and their function such as traction batteries, inverters (DC-DC converters), traction motors, on-board chargers and controllers. The different types of components of electric car determine how the car works.

(b) Electric Vehicle Components

The basic elements of electric cars installed in almost all types of electric cars are as follows:

1. Traction Battery Packs
2. Power Inverter
3. Controller
4. Electric Traction Motor
5. Other Electric Car Components
6. Charger
7. Transmission.

(c) Comparison with Gas Cars:

1. The cost of electric cars is lesser than gas vehicles.
2. Electric cars have zero tailpipe emissions as compare to gas cars.
3. The recharge can also be done at home.
4. Electric cars are the future of transportation.
5. EVs also undergo the same rigorous safety testing and meet the same safety standards as conventional vehicles.
6. Electric vehicles generally require less maintenance than ICE vehicles.
7. Electric car has a quiet, economical engine.
8. EVs also are highly efficient with benefits like regenerative braking and many have smart features such as connectivity.
9. Recent electric car models are making huge gains in range performance.
10. The government will be provided significant rebate or tax credit simply for purchasing an electric car.
11. Nearly 80% of all EV charging occurs at home so electric utility will help for payment.
12. Driving an electric car feels like a game but not in other cars.

VII. Conclusions

The conventional fossil fuels have been used for vehicles for long time, but unfortunate reality we face is that fossil fuels are limited. That is research has led to the development of alternative energy extraction systems. Alternative fuels provide ways to shift energy consumption to less carbon, low pollution and more energy diversity. Compared with transitional fuel, alternative fuels have superiority in environment impact, sustainability and energy efficiency. Some of them have been used in reality and shown the potential for future fuel.

Biodiesel is another potential fuel for future vehicle in short-term and mid-term. In order to produce biodiesel more environmentally, however, current production methods need to be more advanced.

Compressed natural gas has been used for a long time due to rise of gasoline prices and by the need to reduce air pollution emissions. The technology of them is mature and reliable. Good emission performance and relatively low operating costs decide these kinds of fuels have high possibilities to be used for substitution energy in short term period.

Electric vehicles are not creating emissions like other vehicles. So EV's are steadily gaining in popularity, perhaps due to the major technological strikes that have been made recently that have made them cheap and easier to charge. It is a promising pathway to substitute gasoline vehicle where electricity generated from renewable source in mid-term period.

VIII. References

[1] Heywood John B. "Internal Combustion Engine Fundamentals", Tata McGraw – Hill, Singapore, 1998.

[2] Ganesan V. "Internal Combustion Engine", Tata McGraw – Hill Publishing Company Ltd., New Delhi, 1994.

[3] Konwar D. & Baruah K., "Chem. Ind. (London) 1984.

[4] Dr. Das L.M. & Prof. Bansal N. K, I. I.T. Delhi "Alternative Fuel & Low Emission Engines", May 24 – 29, 1999.

[5] Agarwal A. K "Biofuels (Alcohols and Biodiesel) applications as fuels for Internal Combustion Engines", Progress in Energy and Combustion Science 2007; 33:233- 271.

[6]https://www.slideshare.net/rakeshamanta/alternate-fuels-ppt

[7]https://www.omazaki.co.id/en/electric-vehicle-components.

BIOGRAPHY

Mr. Ananta Kumar Nath received his B.E. degree in Mechanical Engineering from Jorhat Engineering College, Jorhat, under Dibrugarh University, Assam in India in 2002 and did his M. E. degree in Mechanical Engineering (Specialization of Production and Industrial Engineering) from Jorhat Engineering College, Jorhat, under Dibrugarh University, Assam in India in the year of 2015. He is a member of Institution of Engineers. He has also 28 years teaching experience in different Institutes. He is a Lecturer (SS) in Mechanical (Automobile) Engineering Department at Bongaigaon Polytechnic, Bongaigaon, Assam, India under Dept. of Higher Education (Technical), and Govt. of Assam in India. His research interests include Alternative fuels, Automobile Engineering, Industrial Engineering and Productivity analysis & improvement of Tea Industry.