Need of Alternative Fuel Sources in Current Scenario

[1]Dr. M.B. Chougule, [2]Miss. Vaishnavi M. Chougule

[1]Associate Professor and H.O.D., [2]Research Scholar
Civil Engineering Department
Textile and Engineering Institute, Ichalkaranji, Maharashtra, India

***Abstract*: The world is getting modernized and industrialized day by day. As a result, vehicles and engines are increasing. But energy sources used in these engines are limited and decreasing gradually. This situation leads to seek an alternative fuel. As civilization is growing, transport becomes essential part of life. The biggest problem is the growing population & depletion of fossil fuel. About 100 years ago, the major source of energy shifted from recent solar to fossil fuel (hydrocarbons). Technology has generally led to a greater use of hydrocarbon fuels, making civilization vulnerable to decrease in supply. This necessitates the search for alternative of oil as energy source. All around the world, air pollution is a part of everyday life. This type of pollution is usually invisible and the effects tend to occur over a long period, thus it is easy to forget how present this issue is in all of our lives. Air pollution is an enormous worldwide issue and, thus an important topic to be well informed about. Air pollution is both an environmental concern and a health issue. When pollutants are pumped into the air, they do not affect just the atmosphere but also can make their way into ground water and soil. Thus, air pollution can be harmful even to the most unlikely organisms such as plants, birds, fish and mammals. Humans too are no exception to these effects. Recently, the United States, along with other nations, have begun to research and utilize different forms of fuel to reduce the amount of pollution produced by burning fossil fuels. These newly developed fuels include ethanol, biodiesel, natural gas, propane, and hydrogen. Each of these fuels have advantages and drawbacks, but all of them burn cleaner than fossil fuels. If the world can begin to depend less upon fossil fuels and more upon alternative energy sources, better health and air quality could be just around the corner**.

***Index Terms*: Methanol, Propane, Ethanol, Methane, Electricity, Hybrid Electricity, Biodiesel and Hydrogen Fuel**

I. INTRODUCTION

It is necessary to identify what emissions are and where they come from. Exhaust gas or flue gas is emitted as a result of the combustion of fuels such as natural gas, gasoline, petrol, biodiesel blends, diesel fuel, fuel oil, or coal. According to the type of engine, it is discharged into the atmosphere through an exhaust pipe, flue gas stack, or propelling nozzle. Another important objective is to recognize the importance of alternative fuel sources. One day, our sources for traditional fuels including petroleum would be depleted. Owing to the fact that these fuels are typically not renewable, a lot of people are worried that a day would come when the demand for these fuels would be more than the supply, triggering a considerable world crisis.

Alternative fuels, known as non-conventional and advanced fuels , are any materials or substances that can be used as fuels, other than conventional fuels like; fossil fuels, as well as nuclear materials such as uranium and thorium, as well as artificial radioisotope fuels that are made in nuclear reactors. Some well-known alternative fuels include biodiesel, bioalcohol, refuse-derived fuel, chemically stored electricity, hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil, propane and other biomass sources. It is necessary to investigate the advantages and disadvantages of using alternative fuel sources. Alternative fuels such as methanol, ethanol and biodiesel have numerous advantages and disadvantages regarding environmental and societal impacts. In developing countries, the expansion of the alternative fuel industry could increase deforestation, decreasing the removal of CO_2 from the atmosphere through photosynthesis. The view that vehicles contribute the most to air pollution and climate change in the metropolis because they emit carbon dioxide heavily has made the government put top priority to four alternative fuels with potential use in the transport sector. These are compressed natural gas (CNG), liquefied petroleum gas (LPG), biodiesel and Alco gas. Biodiesel produced from Jatropha plant, a promising substitute as an alternative fuel has gained significant attention due to the predicted shortness of conventional fuels and environmental concern. The utilization of liquid fuels such as biodiesel produced from Jatropha oil by transesterification process represents one of the most promising options for the use of conventional fossil fuels.

II. IMPORTANCE OF USING ALTERNATIVE FUELS

The main purpose of fuel is to store energy, which should be in a stable form and can be easily transported to the place of use. Almost all fuels are chemical fuels. The user employs this fuel to generate heat or perform mechanical work, such as powering an engine. It may also be used to generate electricity, which is then used for heating, lighting, or other purpose. All fossil fuels are nonrenewable, and as such they will eventually be depleted. As they are based on finite resources and their distributions are heavily localized in certain areas of the world, they will become expensive. Further, energy generation from fossil fuels require combustion, thus damaging the environment with pollutants and greenhouse gas emission. In order to sustain the future of the world with a clean environment and no depletive energy resources, alternative fuel sources is the obvious choice.

Today's transportation sector is served by a very large, efficient, and reliable petroleum-based liquid fuel infrastructure. A range of fuel and vehicle technology combinations have been proposed and assessed as alternatives to the current system that would provide sustainable, non-petroleum, low-carbon mobility. Many of these alternatives would require new or modified fuel infrastructure. The results of numerous past studies have focused on a wide range of topics to improve the understanding of the relative merits of these technologies, including vehicle designs, fuel production and delivery processes, techno-economic policy modeling, and consumer behavior patterns.

Energy has always been the foremost resource that humans have relied on for survival and productive activities. Industrialization and technological advancement of modern society have also been possible through the effective use of energy. There is a strong correlation between the index for quality of life and energy consumption. Heightened economic strength of a country, technological prosperity of a society, higher production output of an industry, improved finances of a household, and increased activities of an individual are also realized by effective utilization of energy. It is necessary to focus on use of alternative fuels for the sake of following reasons-

1. Conventional fuels are going to run out: Determining a new method or solution with respect to finding different countries to create new fuels would reduce the unrest and conflict resulting from the world's dependence on fuel supply.

2. To reduce pollution: The use of alternative fuels considerably decreases harmful exhaust emissions (such as carbon dioxide, carbon monoxide, particulate matter and sulfur dioxide) as well as ozone-producing emissions.

3. To protect against global warming: According to a commonly accepted scientific theory, burning fossil fuels was causing temperatures to rise in the earth's atmosphere (global warming). Though global warming continues to be just a theory, a lot of people across the globe are of the belief that discovering sources of cleaner burning fuel is an essential step towards enhancing the quality of our environment.

4. To save money: Alternative fuels can be less expensive to use not just in terms of the fuel itself but also in terms of a longer service life. This in turn means savings for the long term.

5. Can reuse waste: Biofuels, bioproducts, and biopower provide modern and fresh relevance to the old belief that trash for one person is a treasure for another. That's good news considering that Americans produce in excess of 236 million tons of waste each year.

6. More choices: People are different. Each person has his own requirements, opinions, and preferences. One great thing about alternative fuels and the corresponding vehicles that run on them is that there is something to suit any lifestyle.

7. Help to the farmers: The use of biofuels that depend on crops produced and processed locally help to support farmers for their dedicated and hard labor. Biodiesel and ethanol cooperatives are a result of the great outmoded farmer cooperatives that assist with returning power to the hands of the people.

8. Can frequently be produced domestically: Often, alternative fuels can be developed domestically, utilizing a country's resources and thereby strengthening the economy.

9. Fuel economy: Vehicles driven on hydrogen fuel cells and diesel are more economical with respect to fuel compared to an equivalent gasoline vehicle.

10. More convenience: Wireless charging is one of the factors that make alternative fuels more convenient.

III. MAJOR ALTERNATIVE FUELS

1. **Methanol:** Methanol, or wood alcohol, is a colorless, odorless, toxic liquid. Methanol is the simplest alcohol (CH_3OH), produced by replacing one hydrogen atom of methane with a hydroxyl radical (OH). Methanol can be produced from natural gas, coal, residual oil, or biomass.

Fig 1: Methanol and Ethanol as fuel sources

2. Propane: Propane is an energy-rich fossil fuel often called liquefied petroleum gas (LPG). It is colorless and odorless; an odorant called mercaptan is added to serve as a warning agent. Propane is a by-product of petroleum refining and natural gas processing. And, like all fossil fuels, it is nonrenewable. The chemical formula for propane is C_3H_8.

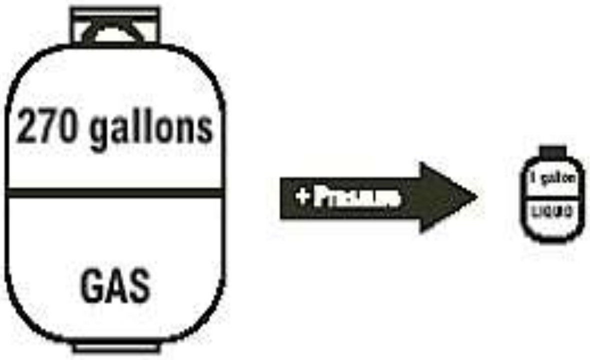

Fig 2: Gas and Liquid proportion

Propane has been used as a transportation fuel for more than half a century and is the most widely used and most accessible alternative fuel. Today about three percent of total propane consumption is used to fuel 270,000 vehicles, mostly in fleets. For vehicles, the cost of using propane is 5 to 30 percent less than for gasoline.

3. Ethanol: Ethanol is a clear, colorless alcohol fuel made by fermenting the sugars found in grains such as corn and wheat as well as potato wastes, cheese whey, corn fiber, rice straw, urban wastes, and yard clippings. There are several processes that can produce alcohol (ethanol) from biomass. The most commonly used processes today use yeast to ferment the sugars and starch in the feedstock to produce ethanol. A new process uses enzymes to break down the cellulose in woody fibers, making it possible to produce ethanol from trees, grasses, and crop residues.

4. Methane: Methane, the natural gas we use for heating, cooking, clothes drying, and water heating, can also be a clean burning transportation fuel when compressed (CNG) or liquefied (LNG). Compressed natural gas (CNG) vehicles emit 85-90 percent less carbon monoxide, 10-20 percent less carbon dioxide, and 90 percent fewer reactive non-methane hydrocarbons than gasoline-powered vehicles.

4. Electricity: William Morrison, developed the first electric car. By the turn of the century, dedicated electric vehicles (EVs) outnumbered their gasoline-powered counterparts by two-to-one. Today there are about 10,500 dedicated EVs in use in the United States, mostly in the West and South. Researchers are still working on the same problem that plagued those early dedicated EVs: the need for an efficient battery.

5. Hybrid Electricity: Hybrid Electric Vehicles (HEVs) may be the best alternative vehicle for the near future, especially for the individual consumer. HEVs offer many of the energy and environmental advantages of the dedicated electric vehicle without the drawbacks. Hybrids are powered by two energy sources: an energy conversion unit (such as a combustion engine or fuel cell) and an energy storage device (such as battery, flywheel, or ultra-capacitor). The energy conversion unit can be powered by gasoline, methanol, compressed natural gas, hydrogen, or other alternative fuels.

6. Biodiesel: Biodiesel is a fuel made by chemically reacting alcohol with vegetable oils, fats, or greases, such as recycled restaurant greases. It is most often used in blends of two percent or 20 percent (B20) biodiesel. It can also be used as neat biodiesel (B100). Biodiesel fuels are compatible with and can be used in unmodified diesel engines with the existing fueling infrastructure. It is the fastest growing alternative transportation fuel.

7. Hydrogen Fuel Cell: In the future, hydrogen may provide a significant contribution to the alternative fuel mix. The space shuttles use hydrogen for fuel. Fuel cells use hydrogen and oxygen to produce electricity without harmful emissions; water is the main by-product. Hydrogen is a gas at normal temperatures and pressures, which presents greater transportation and storage hurdles than liquid fuels

IV. Biodiesel from Jatropha oil as an alternative

Biodiesel is an alternative fuel for diesel engine. The esters of vegetables oil animal fats are known as Biodiesel. This paper investigates the prospect of making of biodiesel from jatropha oil. Jatropha curcas is a renewable non-edible plant. Jatropha is a wildly growing hardy plant in arid and semi-arid regions of the country on degraded soils having low fertility and moisture. The seeds of Jatropha contain 50-60% oil. In this study the oil has been converted to biodiesel by the well-known transesterification process and used it to diesel engine for performance evaluation.

V. Analysis

The use of biodiesel is an effective way of substituting diesel fuel in the long run. One important conclusion that can be drawn from the work done earlier is that the vegetables oils can't be used directly in the diesel engine. Several problems crop up if unmodified fuel is used and viscosity is the major factor. It has been found that transesterification is the most effective way to reduce the viscosity of vegetable oils and to make them fit for their use in the present diesel engines without any modification.

Transesterification is the process by which biodiesel is produced. In this process an ester reacts with an alcohol to form another ester and another alcohol. The catalyst for this reaction is KOH or NaOH. Three mol methanols react with one mol triglyceride which produces mixture of fatty esters and glycerin. The industrial-scale processes for transesterification of vegetable oils were initially developed in the early 1940s to improve the separation of glycerin during soap production.

The primary input is assumed to be oil that has previously been extracted from jatropha oil seed. To accomplish the transesterification reaction described above, the oil, methanol, and catalyst are mixed together in a stirred reactor. 55 °-60 ° C temperatures will cause the reaction to reach equilibrium more rapidly; in most cases the temperature is kept below the normal boiling point of the methanol (65ºC) so the reactor does not need to be pressurized.

As shown in the reaction equation below, three moles of methanol react with one mole of triglyceride. In practice, most producers will use at least 100% excess methanol (6:1 molar ratio) to force the reaction equilibrium towards a complete conversion of the oil to biodiesel. The reaction is slowed by mass transfer limitations since at the start of the reaction the methanol is only slightly soluble in the oil and later on, the glycerin is not soluble in the methyl esters.

Since the catalyst tends to concentrate in the glycerin, it can become unavailable for the reaction without agitation. A common approach to overcome this issue is to conduct the transesterification in two stages. First, the oil is combined with 75% to 90% of the methanol and catalyst and this mixture is allowed to react to equilibrium. Then, the glycerin that has formed is separated by gravity separation and the remaining 10% to 25% of the methanol and catalyst is added for a second reaction period. At the conclusion of this second reaction period, the remaining glycerin is separated and the biodiesel is ready for further processing. The glycerin separation steps are usually accomplished by gravity settling or with a centrifuge

After the biodiesel is separated from the glycerol, it contains 3% to 6% methanol and usually some soap. If the soap level is low enough (300 to 500 ppm), the methanol can be removed by vaporization and this methanol will usually be dry enough to directly recycle back to the reaction. Methanol tends to act as a co-solvent for soap in the biodiesel, so at higher soap levels the soap will precipitate as a viscous sludge when the methanol is removed.

The reaction is given below:

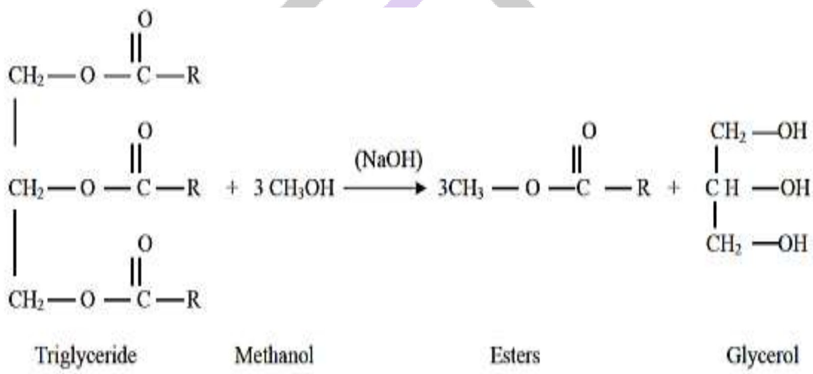

Fig 3: Hydrocarbon chains

Where R is long hydrocarbon chains, sometimes called fatty acid chains.

After the methanol has been removed, the biodiesel needs to be washed to remove residual free glycerin, methanol, soaps, and catalyst. This is most frequently done using liquid-liquid extraction by mixing water with the biodiesel and gently agitating them to promote the transfer of the contaminants to the water without creating an emulsion that might be difficult to break. The washing process is usually done multiple times until the wash water no longer picks up soap. Although the gray water from later washes can be used as the supply water for the earlier wash steps, the total amount of water will typically be one to two times the volume flow rate of the biodiesel. Sometimes, to reduce the amount of water required, producers will add acid to the wash water. Weaker organic acids, such as citric acid, will neutralize the catalyst and produce a soluble salt.

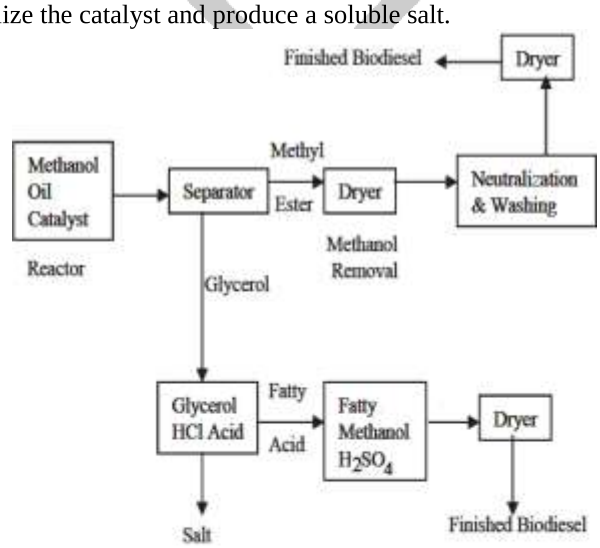

Fig 4: Biodiesel

Stronger inorganic acids, such as hydrochloric, sulfuric, or phosphoric, can be used to split the soap and this reduces the water requirement to 5% to 10% of the biodiesel flow because the salts are easier to remove than the soap. After washing, the biodiesel is frequently cloudy due to small water droplets suspended in the fuel. While these droplets will eventually settle out, it is much faster to use a flash evaporator to remove the residual water from the fuel.

The glycerin that is separated from the biodiesel will contain a substantial amount of methanol, most of the catalyst, soaps that have been formed during the reaction and many of the polar contaminants that were originally present in the oil. These contaminants contribute to a dark brown or black color for the glycerin in spite of it being clear when present asa pure compound. The raw glycerin has very little value and must be upgrade to raise its purity before it can be sold. The usual practice is to add strong hydrochloric acid to the glycerin to neutralize the catalyst and split the soap.

The reactions are given below:

Soap + Hydrochloric Acid = Fatty acid + Salt

Fatty acid + NaOH = Soap + Water

The soaps split into free fatty acids (FFAs) and salt, as shown in the equation. The FFAs are not soluble in the glycerin and can be separated with a centrifuge. The methanol can be removed by vaporization leaving a crude glycerol that is 80% to 90% pure. Most of the impurities will be salts. Only a few of the biodiesel producers in the U.S. have invested in the equipment to refine this crude glycerin to the 99.5% purity required for pharmaceutical and cosmetic applications. The fatty acids are not soluble in the glycerin and can be separated with a centrifuge. These high free fatty acid oils present special challenges when used for biodiesel production. When an alkali catalyst is added to these feed stocks, the free fatty acid reacts with the catalyst to form soap and water as shown in the above reaction. This reaction makes the catalyst unavailable for catalyzing the reaction and if enough soap is produced it can inhibit the separation of the methyl esters and glycerin.

When oils and fats with high free fatty acids are to be used for biodiesel production, an acid catalyst such as sulfuric acid can be used to esterify the free fatty acids to methylesters as shown in the following reaction.

Sulphuric Acid

Fatty acid + Methanol= Methyl ester + Water

Then, the Methanol with the FFAs converted to methyl esters, a conventional alkali-catalyzed process can be used to transesterify the triglycerides in the feedstock. While acids can be used to catalyze the transesterification reaction, the reaction is very slow at the 50° to 60°C reaction temperature the two-step approach of acid-catalyzed esterification followed by base-catalyzed transesterification gives a complete reaction at moderate temperatures. A problem with this approach is that the water produced by the esterification reaction should be removed before the base-catalyzed process begins so that soap formation is not excessive. This can be done by settling or centrifuging the methanol-water-acid layer that separates after the esterification has reached equilibrium. The additional equipment required for the acid-catalyzed pretreatment raises the processing cost, but this approach allows the use of feed stocks containing up to 100% FFA. Finally after drying the found methyl ester is converted to the required biodiesel. Hence, it is seen that 900ml biodiesel is produced from 1 liter of Jatropha oil.

VII. OBSERVATIONS

1. The final product of biodiesel from Jatropha oil is used as an alternative fuel to operate diesel engine. The engine has been run using biodiesel and required data is collected to calculate the engine performance parameters. It has been found that the performance of biodiesel, mixture of 50% biodiesel & 50% diesel and compared with diesel and found that the brake power, brake thermal efficiency is greater than diesel and mass of air, fuel consumption, mass of fuel of biodiesel and air fuel ratio is less than diesel. It is also found that brake power, brake thermal efficiency, mass of fuel of biodiesel is greater than 50% biodiesel & 50% diesel and mass of air and air fuel ratio of biodiesel is less than mixture of 50% biodiesel & 50% diesel.
2. From the analysis of exhaust gas it is observed that %of CO_2 gas of biodiesel is very lower than the diesel and also from the mixture of 50% biodiesel & 50% diesel. The % of O_2 of biodiesel is very higher than the diesel and nearly with mixture of 50% biodiesel & 50% diesel. And the % of CO is zero for biodiesel & one for other two compositions.
3. As far as the utilization of the seed cake is concerned, niche formation processes are hardly present. The seedcake pressed into briquettes, which can be used as fuel in wood stoves or ovens. Using seedcake as fertilizer could be more promising because of its favorable nutritional qualities. Potential actors in this domain are farmers who want to use the cake as fertilizer, and the oil pressing facilities, which generate Jatropha cake as a by-product. It would appear to be highly important for this niche to develop, because Jatropha cultivation itself stands to benefit from it.
4. The by-products of Transesterification process; glycerin and soap can also be the source of income. By supplying the processed glycerin in the market money can be made. And small-scale Jatropha soap contributes on the economics.
5. Because, the soap, itself is a good product with strong antiseptic qualities. It commands a high price compared to ordinary soaps, so only a minority of people can afford it. The expectation is that this market will not expand much beyond its current size.
6. From the above discussion it is clear that biodiesel from Jatropha oil is very necessary to us. It reduces greenhouse effect on our environment by reducing CO_2 gas emission. It is very friendly with environment because it increases percentage of O_2 in exhaust gas than the ordinary diesel. The economics of biodiesel fuels compared to traditional petroleum resources are marginal; public policy needs to be revised to encourage development.

VIII. METHODOLOGY

The use of biodiesel is an effective way of substituting diesel fuel in the long run. Transesterification is the process by which biodiesel is produced. In this process an ester reacts with an alcohol to form another ester and another alcohol. The catalyst for this

reaction is KOH or NaOH. Three mol methanols react with one mol triglyceride which produces mixture of fatty esters and glycerin. The industrial-scale processes for transesterification of vegetable oils were initially developed in the early to improve the separation of glycerin during soap production.
The primary input is assumed to be oil that has previously been extracted from jatropha oil seed. To accomplish the transesterification reaction described above, the oil, methanol, and catalyst are mixed together in a stirred reactor. 55º-60º C temperatures will cause the reaction to reach equilibrium more rapidly; in most cases the temperature is kept below the normal boiling point of the methanol (65º C) so the reactor does not need to be pressurized.

Fig 5: Jatropha plant

Fig 6: Jatropha seeds

Fig 7: Jatropha oil

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VI. CONCLUSIONS

I. The different sources of fuels such as coal, petroleum are used increasingly being used day by day. These different sources are getting reduced. So the use of these non-renewable must be controlled or reduced otherwise a day will come when there will be shortage of these types of sources of energy without which we cannot think about a good life.

II. The government should take measure steps to restrict the use of these non-renewable and increase the use of the renewable sources and take efforts to discover alternative fuels and motivate the common people to use these fuels. This will help our country to increase the economy and will result in the better lifestyle. Thus everyone should prefer alternative fuels and renewable sources of energies over the non-renewable sources of energy.

III. Biodiesel is a viable substitute for petroleum-based diesel fuel. Its advantages are improved lubricity, higher cetane number, cleaner emissions (except for NOx), reduced global warming, and enhanced rural development. Jatropha oil has potential as an alternative energy source. However, this oil alone will not solve our dependence on foreign oil

IV. Within any practical time frame. Use of this and other alternative energy sources could contribute to a more stable supply of energy. Major production centers on the level of modern petroleum refineries have not been developed.

V. The economics of biodiesel fuels compared to traditional petroleum resources are marginal; public policy needs to be revised to encourage development. Increased Jatropha oil production would require a significant commitment of resources. Land for production would need to be contracted, crushing and biodiesel production plants need to be built, distribution and storage facilities constructed, and monitoring of users for detection of problems in large-scale use are all needed to encourage development of the industry.

VI. To meet the challenges of excessive import, we have to strengthen our oilseed sector and lay special emphasis on harnessing the existing and augmenting future potential source of green fuel. The organized plantation and systematic collection of Jatropha oil, being potential bio-diesel substitutes will reduce the import burden of crude petroleum substantially. The emphasis should be made to invest in agriculture sector for exploitation of existing potential by establishing model seed procurement centers, installing preprocessing and processing facilities, oil extraction unit, trans-esterification units etc.

VII. There is also need to augment the future potential by investing largely on compact organized plantation of Jatropha on the available wastelands of the country. This will enable our country to become independent in the fuel sector by promoting and adopting bio-fuel as an alternative to petroleum fuels. It is evidenced that there are new work opportunities in Jatropha cultivation and biodiesel production related sectors, and the industry can be grown in a manner that favors many prosperous independent farmers and farming communities.

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AUTHOR

Dr. M.B. Chougule received the B.E. and M.E. degrees in Civil Engineering from Shivaji University, Kolhapur. He is recipient of Gold medal in Civil Engineering. Completed his Ph.D. from Solapur University (M.S.). He is working as Associate Professor in Civil Engineering and Head of Civil Engineering Department at Textile and Engineering Institute, Ichalkaranji. He is member of various technical bodies and recipient of many prestigious awards.