CHAPTER 1

INTRODUCTION

The diminishing reserves of fossil fuels coupled with spiraling prices and higher environmental degradation has led to the interest in development of environment friendly alternate fuel and alternate sources of energy. One of the sources is straight vegetable oil. The idea of using straight vegetable oil as alternate fuel is as old as 1912. Mr Rudolph Diesel in his 1912 patent mentioned that “use of vegetable oil for engine fuel may seem insignificant today but such oil may become as important as petroleum in the course of time” [1]. The search of alternate energy sources become more important for the countries whose energy demand is met by foreign sources. The global concern about environmental pollution resulting from exhaust of internal combustion engines also attracted the attention of researchers to work in this area. The replacement of petroleum diesel by vegetable oil is one important potential initiative.

1.1 Prospects of Alternate Energy Sources

The world is confronted with the twin crises of fossil fuel depletion and environmental degradation. The indiscriminate extraction and consumption of fossil fuels have led to reduction in petroleum reserves. Alternative fuels, energy conservation and management, energy efficiency and environmental protection have become important in recent years. The increasing import bill has necessitated the search for liquid fuels as an alternative to diesel, which is being used in large quantities in transport, agriculture, industrial, commercial and domestic sectors.

There are so many sources of vegetable oil e.g. forest, vegetable oil crop and oil bearing biomass material. An important concern about it is that many of the
straight vegetable oils are edible oils, if these oils are used for this purpose then the cost of edible oil and its direct effect on human food materials will be very adverse and not acceptable. Thus there is need to focus research and development on utilizing non-edible seeds from oil bearing trees. Some of the sources of non-edible straight vegetable oils are Linseed oil, Mahua, Rice bran oil, Jatropha oil, Karanja oil etc. The research work carried out at various research institutions over the last decade have resulted in standardization of production technologies for production of bio-diesel from oil seeds from Jatropha, Karanja etc. The research in the area of using straight vegetable oil directly in the IC engine is also a prominent field of research. The properties of straight vegetable oil carry an important role for engine performance and emission characteristics.

In present scenario the straight vegetable oil is processed to produce biodiesel and then it is used in engines. There are different methods of generating the biodiesel a replacement of petro diesel by chemical processes at industry. Once the Straight vegetable oil is processed at the industry level for making biodiesels, it will be sold in the market at commercial prices. The farmers, who are the potential target in this study are using the IDI engine for their agricultural applications, power generations, pumping the water etc. will have to depend upon market once again and pay the cost of biodiesel fixed by industries. Apart from the cost and affordability, the accessibility is another problem especially for remotely established places. The utilization of straight vegetable oils has not been found favorable due to various technical limitations imposed primarily because of its high viscosity. However, straight vegetable oils could be advantageous in certain specific application areas such as remote village electrification and energizing pump-set for rural irrigation needs due to lower cost and simpler production technology.

In present era, the global objectives are to develop in the areas of resources, technology, automation and social values. These objectives can be fulfilled by ensuring energy availability not only from the available petroleum reserves but
also by considering new sources of alternative fuels. These new sources of energy will give us liberty to use them as per the need of development for long term.

1.2 Energy requirement in remote areas and agriculture

As the economy of the countries are growing at rapid pace and also the technological developments have taken place very rapidly during near past, the energy requirements of human beings not only in cities but also in rural areas have hiked. In rural areas the energy requirements to meet the livelihood and agricultural needs have become more critical.

One needs to differentiate between the energy security of rural and urban areas because energy dynamics of both the areas are quite different. Energy security perhaps is more important for the rural people because they are very vulnerable, marginalized and lack access to most of the basic resources. Majority of rural households in developing countries like India depend on traditional fuels like firewood to meet most of their energy requirements, supplemented by small amounts of kerosene, coal and electricity for lighting.

As per the statistics available in literatures:

I. About 70% of the Indians live in rural areas and use animal dung, agricultural waste and firewood as fuel for cooking,

II. Particulate matter in the Indian rural households is 2000 µg/ m³ which is much higher than the permissible 150 µg/ m³,

III. Use of traditional fuel is estimated to cause around 400,000 premature annual deaths due to various respiratory problems.

IV. 75% of rural households depend on firewood for cooking, 9% each on dung-cake and on LPG as against 22% of urban households using firewood for cooking, another 10% on kerosene and about 57% on LPG.
V. 44% of rural households depend on kerosene and another 55% on electricity, while in urban areas dependency is 89% on electricity and 10% on Kerosene for domestic lighting.

‘Rural’ is usually equated with agriculture and rural energy with cooking and lighting; which certainly misses out the energy requirements of various other rural facets like rural schools and rural enterprises etc. Most neglected policy dimension has been energy for manufacturing in rural areas. Some of the statistical data about rural areas are listed below. These data explains the energy requirements in rural areas for rural development.

a. About 87% of the schools in the country are located in the rural areas.

b. About 25.81 million or (61.3%) of the enterprises in India are located in the rural areas (Economic Census 2005).

c. Among Micro, Small and Medium Enterprises (MSME) alone, around 44.52% of the registered units and around 54.68% unregistered units are in rural areas.

d. Besides, there are thousands of rural artisans who operate as Own Account Enterprises (OAEs) e.g. weavers whose productivity could be enhanced by supply of clean energy on a regular basis.

‘Agriculture’ is always considered to be synonymous with ‘rural’, especially in countries like India. Agriculture consumes power both in the animate and non-animate forms. During the first five year plan power consumption in Indian agriculture was 316 GWh (3.97% of total power consumption in India). In 2005 total power consumption in agriculture stood at 88,555 GWh, which is approximately 22.93% of total energy consumption in India. Gujarat (46%), Andhra Pradesh (43%) and Haryana (45%) are the leading states regarding electricity power consumption in Agriculture (TERI energy data directory & yearbook, 2005, P: 240).
Biomass based energy generation has a good potential for our country because of the rich biodiversity and a huge population. The potential sources of biomass energy are:

- a. Non-edible oil producing plants/trees-biofuel/bioenergy
- b. Wood biomass-lignocellulosic
- c. Forest litter biomass
- d. Bamboo energy
- e. Household/domestic waste
- f. Daily/weekly market waste
- g. Wastes from rural based industries
- h. Algal Energy

1.3 Vegetable oil as a potential substitute for diesel

Considering the above aspect, an initiative is taken through this study to make the farmers self dependent. If the petro diesel is replaced by vegetable oil directly which farmers can cultivate in their field. The Straight vegetable oil as alternative fuel is not enough but machines which can use those alternative fuels with optimum efficiency and economy are also required.

The replacement of petro diesel by vegetable oil will depend upon various parameters. The major parameters which make the straight vegetable oil as substitute are combustion quality, emission characteristics, and its physical availability, impact on engine parts i.e. short t and long term effects.

If the entire world production of 115 billion liters of vegetable oil had been used for fuel in 2007, neglecting the conversion losses as well as the debate on the use of food materials for fuel, this would satisfy about 75% of US diesel demand. The use of locally grown non edible plant oil as fuel in slow speed diesel engine has potential to provide a low cost sustainable energy solution.

1.4 Use of Straight vegetable oil in Diesel Engine
There are many applications of diesel engine in the rural areas such as electricity
generation, running the machines like flour mills, oil expellers, rice mills, tube wells, pumping water etc. The farmers depend on petro-diesel available in the market at high prices. Sometimes, the farmers travel long distances for procuring the commercial diesel to meet the agricultural and domestic needs at typically established remote areas.

Exploring the possibilities of utilizing the vegetable oil as alternate fuel will make the farmers self-dependent. They can cultivate energy crops in their fields which may improve the socio-economic conditions. The literatures available in these areas suggest that the already available IDI engines with farmers or manufactures are not compatible with straight vegetable oil. Therefore, there is need to modify the existing engines which can perform efficiently with SVO.