CHAPTER - 1

INTRODUCTION

India is importing 100 million tones of crude oil and other petroleum products and spending huge amount of foreign exchange. It is estimated that the world wide reserves of petroleum are 100 billion barrels and the estimated period of consumption of these fuels is around 40 years. The diesel fuel consumption is usually five times more than petrol consumption. The estimated diesel fuel consumption is around 67 million tones during 2011-2012. Such huge imports of petroleum products will have large impact on Indian economy especially when the crude oil prices in the international market shoots up. Recently the crude oil barrel price have gone up from 70-100 $ and it may touch 130$ shortly. Keeping this in view the Indian government is encouraging the use of non-edible vegetable oils, bio-diesels and ethanol as they are renewable and by implementation of use of these oils the rural economy, rural employment, energy self-sufficiency, environmental concerns can be addressed effectively.

In India about 100 million hectares of waste degraded land is available along the sea coasts, hilly areas and along the railway tracks. We can effectively use this land for plantation of jatropha, karanja, neem, mahua and other suitable oil bearing trees and also for producing vegetable oils which can be directly used as engine fuels or in bio-diesel preparation (134). This helps in reduction of oil import bills and by doing so we can generate employment to rural people thus preventing migration of rural youth towards the nearby towns and cities. India has good
resources for production of sugar cane so we can produce sugar and ethanol too. Government of India has already implemented 5% ethanol blending with petrol from January 2003 and there were minor problems like the softening of rubber components and gaskets in the carburetor and fuel supply lines which were rectified subsequently. Vegetable oils are renewable, non toxic, biodegradable, and have low emission profiles. However some drawbacks related to the use of straight vegetable oils in diesel engines primarily due to their high viscosity, lower volatility and lower heat content. The high viscosity causes some problems in atomization of injector systems and combustion in cylinders of diesel engines. During long term operations, high viscosity of vegetables oils may lead to ring sticking, formation of injector deposits, development of gumming, as well as incompatibility with lubricating oils. Different techniques have been developed to solve their high viscosity and low volatility problems of vegetable oils, such as preheating oils, blending or dilution with other fuels, by change of fuel injection pressure, fuel injection advance and also by adding additives, transesterification and thermal cracking or pyrolysis. Transesterification appears to be the most promising technique which is a chemical process of converting vegetable oil to bio-diesel fuel. Bio-diesel can be used as a blend in diesel engines without any engine modification. Bio-diesel contains 10-12% of oxygen in weight basis which lowers the energy content. The lower energy content causes reductions in engine torque and power. As the bio-diesel contains excess oxygen compared to normal diesel which reduces exhaust emissions such as HC, smoke and CO mainly due to the effect of combustion. Not only the above mentioned quality but also bio-diesel
contains little or no sulphur compared to the diesel fuel, we can find no sulphur dioxide or a significant reduction in sulphur dioxide emission. But NOx and particulate emissions will be higher due to higher temperatures of combustion chamber using bio-diesel. This is also evident from higher exhaust gas temperatures from bio-diesel fuelled engines. Some studies revealed lower NOx emissions. This is because of higher cetane numbers of bio-diesel which shortens the ignition delay and the amount of premixed fuel and peak burning temperatures are reduced, leading to the reductions in NOx emissions.

In India the price of edible vegetable oils are higher than that of the diesel fuel, and if we start using them as fuel as in the case of Western countries, the common man has to starve for the cooking oil. To avoid this kind of unacceptable proposal by the majority of the people in India, it is proposed to use non–edible vegetable oils which are considered as potential alternative fuels. In India to meet Euro - IV fuel specifications for reducing the sulphur content, all the existing 18 refineries in the country needs a total investment of Rs.55000-60000 crores to modernize these refineries. If we can divert some of the amount for plantation of high yielding and high oil bearing trees in the above said waste lands we can generate sulphur free vegetable oils and we can cut down the oil import bills.

The majority of the research across the Globe is focused on this issue and most of the research is being carried out in the preparation of bio-diesel and its testing, long time storage and its effects. Some of the researchers experimented with straight or neat vegetable oils. Because of the above mentioned problems they stopped and preferred or confined
their experiments to bio-diesel. In India, because of the Government policies the products like ethyle alcohol and methyle alcohols comes under the central excise policy and they are not easily available for the common man and even for researchers. At this juncture the agriculturist who possesses the non-edible oil from his farms/ near by forest/ or his own back yard cannot process the available oil to prepare bio-diesel to run their farm equipment like tractors, power tillers, diesel pump sets, diesel generators etc. More over the small farmers have to travel all the way to reach towns/cities to fetch the diesel to run the above equipment by wasting their valuable time and money. Especially this kind of situation for the people who live in hilly areas and remote villages with no road or transport connectivity is painful and the transport costs are really taxing. If the farmers can spend some time to pick the oil bearing seeds from the above said places and extract oil from the seeds using the local available manual or machine operated expellers and filter the oil by using simple industrial filter cloth or fine wire mesh filters to make the oil suitable to use directly in to their farm equipment. More over the oil cake obtained contains high nutrine value and can be used as manure for their fields.

Some times the farmers come across a peculiar situation when they get two or three varieties of oil seeds. They will be left with small quantities of these oils and they don’t know how to use them effectively. They use them for other purposes like lighting the lamps, greasing the cart wheels etc. To over come this typical situation one can blend these oils to increase the quantity and the richness of oil by adding higher calorific value oil to lower calorific value oil by adopting simple blending techniques. The main hurdle by using the non-edible vegetable oils is its
viscosity. To reduce the viscosity many costly techniques like transesterification, thermal cracking etc, are employed. For the first time garlic treatment was given to the non – edible oil to improve the fuel quality in a more natural and cost effective way. Before using this locally extracted and filtered non edible oil, two or three non edible oil mixtures called blends and garlic treated non- edible oils as fuel during emergency and short term application by the farmers, the farmers should be given the following basic information and training.

1) These oils can be used as fuel and for better and effective usage the fuel injection pressure and fuel injection advance has to be adjusted as defined by the researchers or manufacturer depending on the fuel variety.

2) It is always recommended to have two fuel tanks. One for the base line diesel and the other for the extracted fuel. Initially the engine should be started on base line diesel and after warm up one can switch over to the extracted fuel. Before stopping the engine the engine should be switched over to base line diesel and run for sufficient time to see that the fuel lines are filled with diesel. This will solve the cold starting problems especially during winter seasons and also fuel injector needle sticking problems in the long run.

3) Depending on the extracted fuel type the optimized fuel injection pressure and fuel injection advance values derived from experimental results by researchers are to be made available to the farmers and sufficient practical training should be provided to the
them to change these values on the engine for effective usage of these oils.

In the present experimental investigation on a C.I. Engine, using tobacco seed oil, pongamia oil and mahua oil as test fuels to determine the optimum fuel injection pressure and fuel injection timing for the above oils based on the performance, emission and combustion parameters. The above oils were mixed with each other in equal quantities and prepared blends for testing in the engine to observe the effect of blending on the performance, emission and combustion parameters and compared with the individual best performance setting values of the above three oils. The three test fuels were given garlic treatment and the effectiveness of garlic treatment on the oils were tested and compared with the individual best performance setting values of the above three oils.

1.1 ORGANIZATION OF THESIS

The research work that has been carried out so far is presented in the following format.

Chapter – 1

The Indian fuel scenario and the necessary steps to improve rural background for self sufficiency of non edible oil production to cut down the oil import bills are presented.

Chapter – 2

In this chapter the research and development on vegetable oils as I.C. Engine fuel by various researchers has been compiled and summarized.

Chapter – 3

This chapter explains the objectives and methodology of the present research work.
Chapter – 4

The test fuels procurement, preparation of blends and fuel treatment and determination of their fuel properties as per ASTM specifications are presented in this chapter.

Chapter – 5

This chapter explains the experimental engine setup with necessary instrumentation and their specifications and also the sequence of experimental procedure adopted.

Chapter – 6

In this chapter the results pertaining to straight vegetable oils operation are presented and discussed.

Chapter – 7

The results and discussions derived out of the experimental data with straight vegetable oil blends are presented in this chapter.

Chapter – 8

This chapter explains the treated vegetable oils results and discussions.

Chapter – 9

An over all comparison of all the test fuels is presented in this chapter.

Chapter – 10

The conclusions derived out of the present work and the scope for future work has been presented in this chapter.