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Experimental Exploration on The Utilisation of Low Viscous Cooked Waste Palm Oil into Biofuel Influenced by Additives in A Diesel Engine

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I. INTRODUCTION

IMPORTANCE OF ENERGY

Energy drives all the living and non-living things in the world. The energy needs and demands are not balanced and so, we are using up the future energy reserves. This will lead to the depletion of fossil fuels in the near future. As a consequence of population growth, change in life style, industrialization and urbanization, there has been an exponential increase in the energy requirements. Petroleum reserves are depleting day by day whereas energy consumption is increasing at 6.5 percent per year. India's crude oil consumption amount increased to 3.1% whereas the production is 1% of the total global crude oil production. A number of Government organizations and private companies are involved in the production and distribution of biofuel in India. The leaders in biofuel processing in India are Reliance Industries Ltd, D1 Oil Plc, Emmi Group, Godrej Agrovet, Atiya Biofuels Pvt Ltd., Gujarat Oleo Chem Limited (GOCL), Jatropha Oil Extractions Private Limited etc., Nova Biofuels Pvt.Ltd., Jain Irrigation System Ltd., Sagar (Swain 2014). According to a survey made by the International Energy Agency (IEA), oil demand at global level will rise about 1.6% for the year 2000 by 75 mb/d and it will increase in the year 2030 by 120 mb/d. Energy sources are broadly classified into two categories renewable energy sources and nonrenewable energy sources.

Non-renewable energy source cannot be replaced by natural processes once it is consumed, it will take longer time to get accumulate e.g., Natural gas, coal, crude oil and nuclear energy. Renewable energy fuels are generated from natural materials or renewable energy materials which are inexhaustible e.g., geo-thermal energy, solar energy, biofuels, hydro-power, wind energy, and biomass etc.

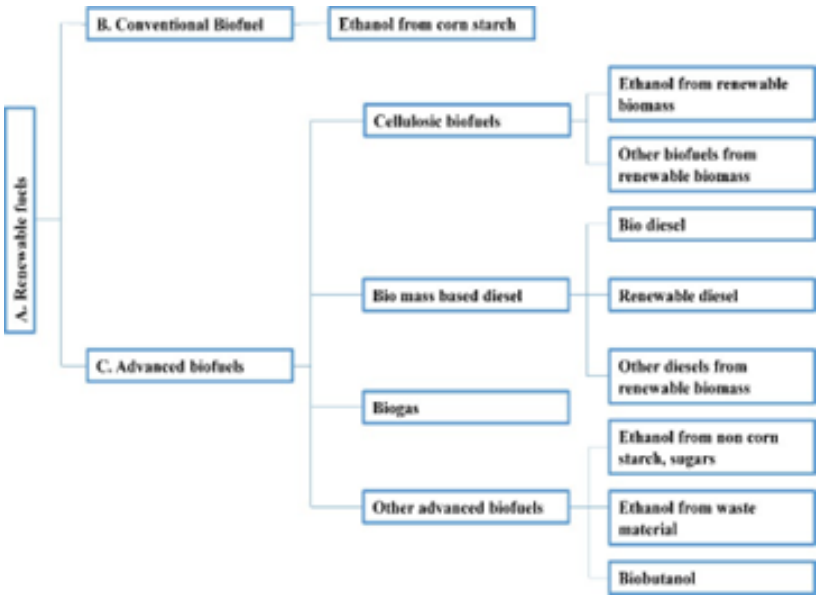

Fig 1.1 Sources and types of Renewable biofuels

Due to the rising greenhouse gas levels and depletion of oil supply, there is an increase in the energy demand which resulted in the search for an alternative clean and sustainable fuel in order to balance the energy demand supply chain. Currently, fossil fuels such as coal, crude oil and natural gas contribute majorly towards the power generation in the nonrenewable sector. Figure 1.1 shows that biofuels such as bioethanol, bio- butanol biodiesel, biohydrogen and biomethane are the major renewable bioenergy's which are reducing the usage of petroleum-based fuels. Bioenergy is the largest source of renewable energy today derived from biomass as it supplies energy in the form of fuel, heat and electricity for transport, industry and domestic usage. Bioenergy is compensating 10% for electricity production and 3% for transportation. The lack of large-scale production to meet the requirements and supply chain, which is dependent on number of economic sectors is the obstacle today. Moreover, these projects require relatively more sustainable and reliable technology to overcome the economic issues in the usage of biofuels impractical application.
private cars and busses are the major consumersof diesel fuel.

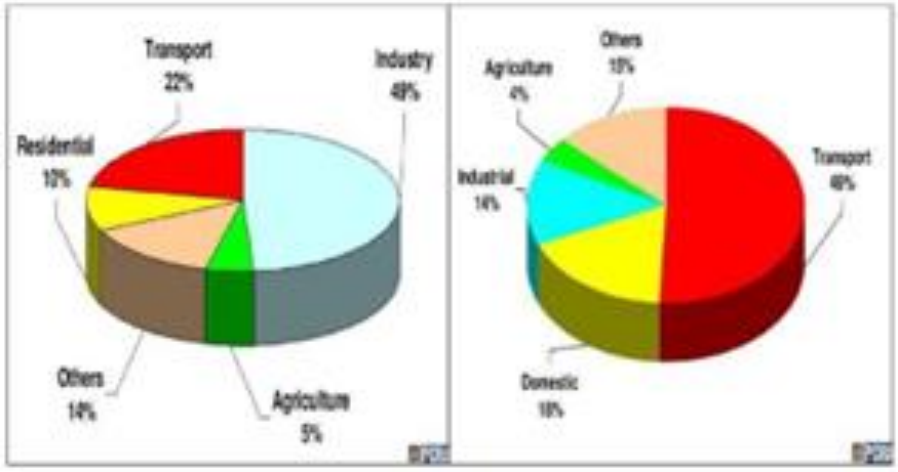

Fig 1.2 Petroleum fuel consumption by various sectors in India

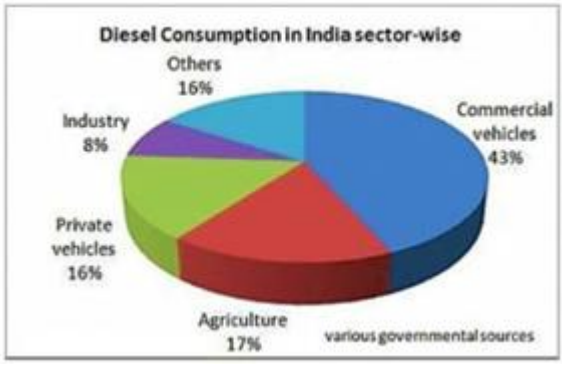

Fig 1.3 Consumption of diesel in various sectors

INDIA ENERGY SUPPLY BY VARIOUS ENERGY SOURCES

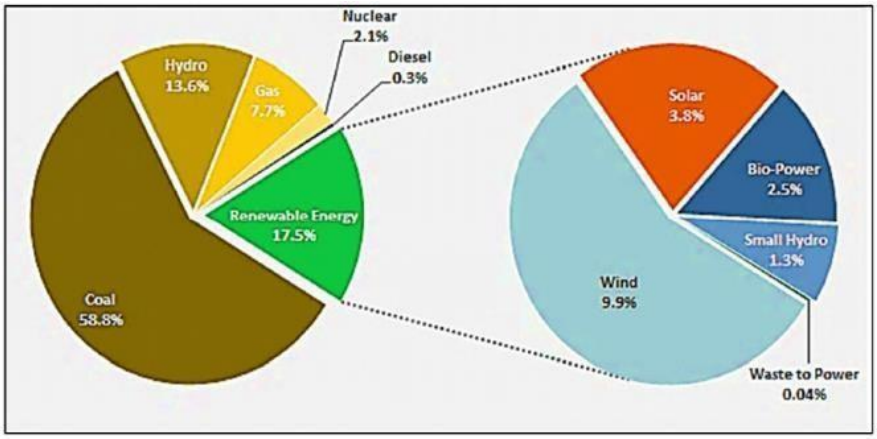

Fig 1.4 Energy supply from various sources of renewable and nonrenewable Resources

Figure 1.4 shows that the worlds energy requirement was mainly depending on coal, in which diesel stands for 0.3% and renewable energy sources accounts for 16.1%. In the renewable energy generation sector, biopower contributes about 2.6%. However, waste to energy accounts only about 0.04%, which is a very minimal contribution in the nation of large amount of waste production. It is due to the lack of waste to energy conversion technologies.

BIOFUEL TYPES

There are no strict guidelines for the classification. Generation of biofuel is mainly classified based on the feedstock and conversion method used for raw material to biofuel production. Biofuels are derived from biomass feedstock such as plant materials, algae, microorganism and animal waste materials, which could completely replace or blended with petroleum fuels to power the engines.

EXISTING FAT AND OIL EXTRACTION METHODS

In the oil refining process, extraction is the first step. Fats and oils are extracted from their source such as seeds, fruits or other oil-bearing raw materials using a variety of extraction methods. For example, virgin olive oil is

extracted directly from seeds and fruits by means of a mechanical press and used for commercial applications without any further processing. This process is called as cold pressing. For most of oil extraction methods the cold pressing method is more complex. In the conventional oil extraction mills combination of cooking, pressing and solvent extraction has been following to extract the oil from samples. This process is followed from the origin of country.

Dried biomass sample was grinded well to make smaller particle size. As shown in figure 1.6, Extraction process was carried out for 6 h at 70°C with suitable solvent mostly mixture of solvents (n- hexane: methanol, n-hexane: chloroform) were used to get the complete extraction of fat oil. After the extraction, the residual solvents were distilled and removed from the oil.

ULTRASOUND-ASSISTED EXTRACTION

The beaker containing seed was mixed with n- hexane. The setup and its contents were immersed into the ice-bath. The probe was immersed into the beaker and treated with ultrasound for 30 mi. During extraction, the system temperature was maintained at 30°C.. After extraction, the mixture was filtered and residual solvent in the oil was evaporated.

PHYSICAL METHOD

Expeller pressed oils are mechanically pressed from the raw material at high pressure to obtain maximum oil yield. In expeller pressed oils high- pressure extraction can raise the temperatures above 120 degrees. In cold pressed the temperature is monitored and kept under 120degrees, otherwise it is called expeller pressed. By this method 85-90% of oil can be extracted from the biomass.

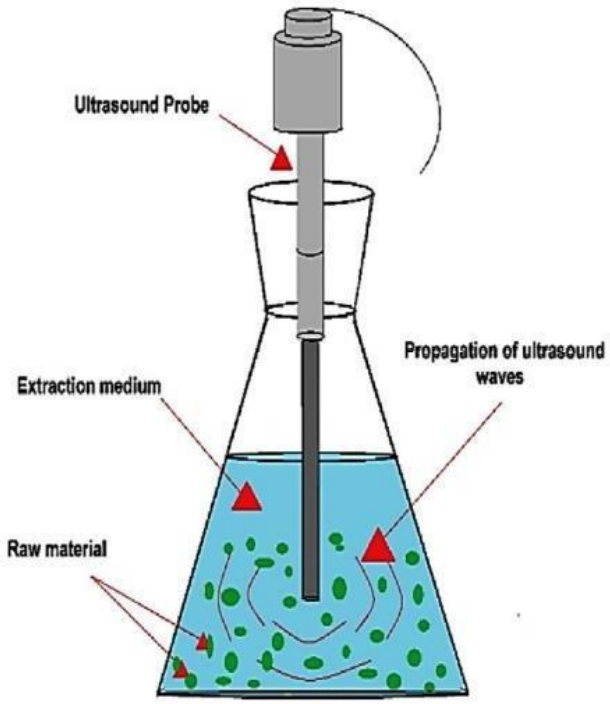

Fig 1.7 Ultrasound assisted oil extraction

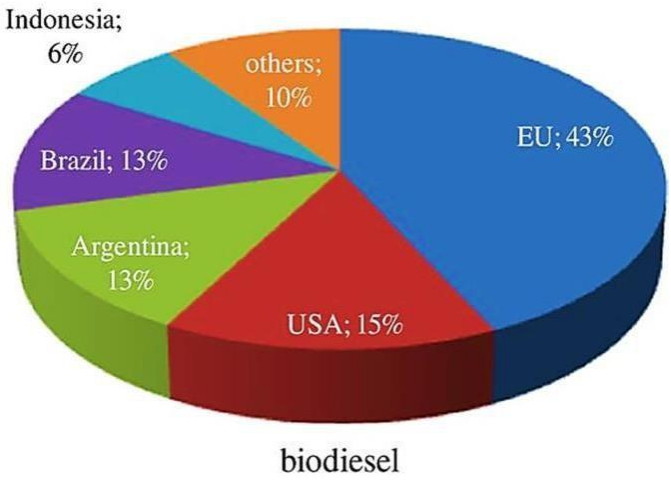

Fig 1.8 Regional production of biodiesel

High FFA in fat necessitates a two-step transesterification process. Due to the cleanemission profile of biodiesel, its usage is increasing faster. Low grade glycerol is produced at the end of transesterification process. Converting this glycerol into bioethanol by solventogenesis process will give valuable end product. Ethanol produced by this process is used for biodiesel production and it will reduce thebiodiesel production cost. Also, Ethanol is mixed with petroleum fuel and used to power the engines.

NEED OF BIODIESEL PRODUCTIONFROM WASTEMATERIALS

In India, Biodiesel production from jatropha seeds were well-established, but the raw material production has not been consistent. Farmers were encouraged to produce jatropha seeds, but the production was not in the expected levels. This will increase the raw material cost and biodiesel

CONCENTRATED SULPHURY ACID

Sulfuric acid (American spelling and the preferred IUPAC name) or sulphury acid (Commonwealthspelling), known in antiquity as oil of vitriol, isa mineral acid composed of the elements sulfur, oxygen and hydrogen, with the molecular formula H_2SO_4. It is a colorless, odorless and viscous liquid that is miscible withwater.

Fig 1.10 96% sulfuric acid

Disposal of WCO and fats has become a serious environmental problem around the world. Proper utilization and management office can effectively solve this problem. Physical and chemical properties and fatty acid composition of WCO are given in Tables. Besides, use office significantly reduces total biodiesel processing cost as the cost of WCO is 2 to 3 times less than that of vegetable oil. Comparison of average price of WCO with another biofuel is showed.

Fig3.1 Different waste cooking oil

Though source of cooking oil differs across the globe, plant-based lipids such as sunflower oil, corn oil, coconut oil, palm oil, olive oil, soybean oil, canola oil, rapeseed oil margarine etc. are the main feedstock. Animal based lipids such as fish oil, ghee, buttered. used for cooking and frying

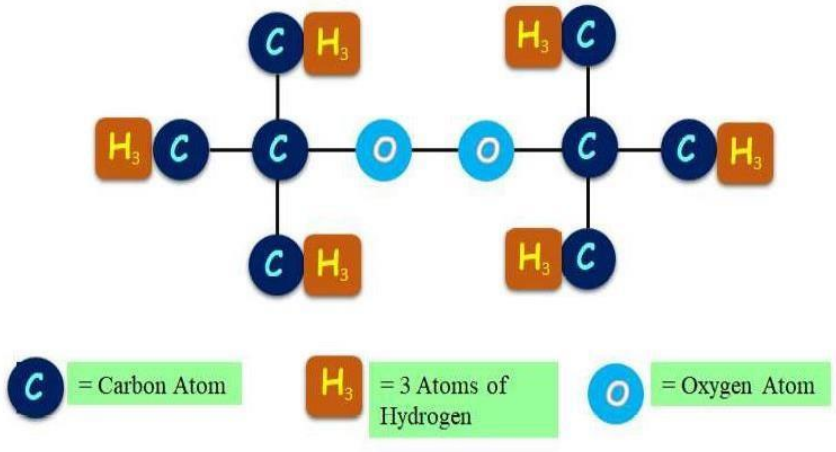

Fig 3.3 Molecular Structure of Di tertiary butyl peroxide

Table 3.3 Properties of Di tertiary butylperoxide

PREPARATION OF CATALYST FOR TRANSESTERIFICATION PROCESS

In the correct quantity, combine sodium hydroxide and methanol. Keep the combined particle on the magnetic stirrer at room temperature for 3 to 4 hours. Finish the operation until the two chemicals are transparently dissolved. In the transesterification process, this end chemical is used as a catalyst.

Fig 4.1 Preparation of catalyst

ESTERIFICATION PROCESS

Filter the one-liter waste cooking oil purchased at home or at motels. To begin the procedure, add a small amount of con.H2SO4 to the oil and let it sit for 30 minutes. Add the con.H2SO4 to the oil and heat it for 2 hours at 600 degrees Celsius. Theoil and sulfuric acid are heated in the heating mantle. Existing triglycerides are transformed to petroleum esters in this method.

TRANSESTERIFICATION PROCESS

In a beaker, slowly pour the catalyst into the petroleum esters. We acquire glycerol, water, sodium sulphate, and biofuel methyl ester as a byproduct.

Fig 4.3 Transesterification process

BLENDING THE SOLVENT

DMF has chosen the solvent DMF as an additive to combine with the biofuel. It's a first in biofuel research. Low carbon emissions, low fuel usage, and a high volatile temperature are the reasons for using a solvent to mix. At the blending procedure, the bio fuel and solvent were blended in a 100:1 ratio.

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