PROCESS ANALYSIS AND FEASIBILITY STUDY ON USING BIODIESEL FOR ELECTRICITY GENERATION

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ABSTRACT

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The University has on-campus unutilized nearly twenty eight gallons of waste cooking oil that could be used more efficiently as biofuel. The waste cooking oil could turn into something that is economically efficient helping University power their generators and also be used as an educational asset to the University. If efficiently used, the waste cooking oil could become multifaceted in that it will benefit the University.

The primary focus is to design a system in which the waste vegetables can be converted into Biodiesel .It is intended that this Biodiesel produced may ultimately be a fuel source for the power generation from the generators.

The procedure includes survey of electricity and diesel cost, preparation of biodiesel from fresh and waste vegetable oil, analysis of biodiesel , comparison of cost and energy efficiency by running generators.

I dedicate this thesis to my parents, siblings, husband, friends, and those visionary teachers who taught me to be inventive, vigilant, to courageously lead and nobly serve the humanity at large.

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Introduction

1.1 Motivations and Objectives

During the last century, the consumption of energy has increased a lot due to the change in the life style and the significant growth of population. This increase of energy demand has been supplied by the use of fossil fuels such as oil, coal and gas .As fossil fuels are limited sources of energy and the increasing demand for energy has led to a search for alternative sources of energy that would be economically efficient, socially equitable, and environmentally sound. Two of the main contributors of this increase of energy demand have been the transportation and the basic industry sectors, being the largest energy consumers. The transport sector is utilizing petroleum fuels such as diesel, gasoline, liquefied petroleum gas(LPG) and compressed natural gas (CNG)'on large scale[1]. Demand for transport fuels has risen significantly during the past few decades [2]. The demand for transport fuel has been increasing and expectations are that this trend will stay unchanged for the coming decades. In fact, with a worldwide increasing number of vehicles and a rising demand of emerging economies, demand will probably rise even harder. Transport fuel demand is traditionally satisfied by fossil fuel demand. However, resources of these fuels are running out, prices of fossil fuels are expected to rise and the combustion of fossil fuels has detrimental effects on the climate.

Hydrogen is an excellent choice for powering an engine by two processes: combustion, and fuel cell conversion. In combustion water vapors are produced by direct burning of hydrogen. The fuel cell cars convert hydrogen into electricity through fuel cell, and power is produced in the engine. The flaw of combustion is that it uses hydrogen very rapidly and water vapors produce pollution. Fuel cell conversion is extremely effective but there are some drawbacks associated with this method like low density of hydrogen and high construction cost.

The increase in the demand and prices of petroleum products as well as the environmental concerns resulting from the burning of fossil fuels in electricity production has resulted in focusing on the use of environmental friendly renewable alternative energy resources, like solar,

hydro, tidal, wind, geothermal and biomass energy[3]&[4].However there are some drawbacks of these renewable energies. The total power generated by wind and tidal energy is confined and equipments to convert solar, wind and tide energy are expensive. Wind and tidal power plants can be constructed only in locations where appropriate conditions of tide and wind withstand. The plant for producing energy from sun light and wind require large space for installation. The solar power vacillates from zero to maximum every day due to dependence on availability of sunlight. Use of hydro power is already known change the pattern of sedimentation in rivers. Geothermal energy produces heat along with poisonous gases. Biofuels has less disadvantages as compared to other renewable energy resources. The only drawback associated with bio energy is that some waste materials are not available all year round. Thus biofuels appear to be a best solution to substitute fossil fuels.

Resources for bioenergy will not run out, they are becoming cost wise competitive with fossil fuels, they appear to be more environmental friendly and they are rather accessible to distribute and use as applicable infrastructure and technologies exists and are readily available. Bio energy constitutes 15% of the world's energy consumption. Solid biomasses that can be used in fuel production are animal debris, crops husks, wood and bagasse. Liquid biomasses like bioalcohols; straight and waste vegetable oils and biodiesel; oil and gases can be used as fuel. There are gaseous biomasses for fuel yield such as wood gas, hydrogen carbon monoxide and bio-methane. Forecasts are that transport on a global scale will increase demand for conventional fuels with up to a maximum annual growth of 1.3% up to 2030. This would result in a daily demand of around 18.4 billion liters (up from around 13.4 billion liters per day in 2005) [5].

.Nowadays, among biomass energy sources, biodiesel has gained much importance as a flipside fuel for diesel engines due to number of environmental characteristics such as low greenhouse emissions and pollution [6]. Biodiesel is primarily made of mono-alkyl esters of long chain fatty acids. Various types of raw materials are available for the biodiesel production, such as virgin oils, waste vegetable oils and animal fats. Main advantage of this fuel is that the raw materials are natural, renewable, biodegradable and nontoxic [7]. Mostly, the used frying oils contain large quantities of free fatty acids. The transesterification of these fatty acids produce ester and glycerin layers which become difficult to separate due to the production of soap [8, 9]. So, usually a two-step process is followed for conversion of high free fatty acids to biodiesel.

The process consists of the acid catalyzed esterification followed by the alkali catalyzed transesterification [10, 11].But this also includes complicated removal of acid catalyst and water formed during pre-esterification [12].Alternatively use of a cosolvent to carry out the esterification and transesterification simultaneously has also been reported [13].However, the use of relatively high alcohol ratio can also increase the yield of biodiesel from used frying oil [14].

Characteristics of the biodiesel may change with the oil source and the type of alcohol used for its production [15]. Biodiesel is reported to have good lubricating properties which improves engine life and reduces engine component wear [16, 17].The flash point, cloud point, pour point and cetane number of biodiesel are higher as compared to those of fossil diesel but its heating value and cetane number calorific value are relatively lower [18, 19, 20].

That is why it is necessary to study the potential of biodiesel, as well as to study its feasibility, if it will be used as a viable alternative fuel in the future.