PREPOTENCE OF BIOWRAP MODEL FOR MICRO GREEN ENRGY: A CASE FOR BIODIESEL FOR RURAL COMMUNITIES

Nazim Baluch, Shahimi Mohtar, and Ahmad Shabudin Ariffin
School of Technology Management and Logistics
COB Universiti Utara Malaysia

Abstract

Dwindling fossil resources, such as petroleum oils and coal, and the over dependence on imported fuels has prompted countries to look for internal resources to meet escalating energy demands. Micro energy from biofuels is one of the viable renewable energy options new technologies provide that can transform the remote rural communities. This paper outlines Bio-WRAP model developed by the author and illustrates that the oil obtained from amenity plantings and riparian buffers, including coconut and oil palm, can be a sustainable alternative to diesel fuel. The paper concludes that biofuels are sustainable alternative to fossil fuels and biodiesel is a green energy source for agriculture, transport and power generation at micro level use in rural communities.

Keywords: *Biodiesel, Biofuels, Green Energy, Transesterification*

BACKGROUND

Dwindling fossil resources, such as petroleum oils and coal, and the over dependence on imported fuels has prompted countries to look for internal resources to meet escalating energy demands. Micro energy from biofuels is one of the viable renewable energy options new technologies provide that can transform the remote rural communities, otherwise deprived of basic needs including food security. Community based renewable energy technology has proven to be an appropriate energy solution for remote rural villages which are not connected to the main electricity grid. And where the conventional petroleum products are either not available or the prices are enormously high.

Due to the gradual depletion of world petroleum reserves and the impact of environmental pollution of increasing exhaust emissions, there is an urgent need for suitable alternative fuels for use in diesel engines. In view of this, vegetable oil is a promising alternative as it has several advantages; it is renewable, environmentally friendly and produced easily in rural areas, where there is an acute need for modern form of energy (Sorate *et al.,* 2011). People residing in rural areas heavily depend on agriculture and climate change has significant negative impacts on the agricultural production globally (Alam *et al.,* 2011). Greenhouse gas emissions, earth warming, and increasing sea levels are the reasons of climatic change that have resulted in lowering the farm production thereby increasing poverty and ultimately increasing food insecurity (Azhar, 2013). Rudolf Diesel, in 1912, predicted: "The use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in the course of time as important as the petroleum and coal tar products of the present time" (Knothe, 2001). Conceivably, the time has come. The volatile world market prices for fossil fuels in the past years have significantly increased interest in the development of alternative indigenous sources of energy all over the world. As part of their resources governance strategy, many countries are looking into the use of local biomass resources to replace traditionally imported fuels such as petrol and diesel with biofuels. The behaviour of crude oil prices in world markets affects input costs in all phases of modern agricultural production and distribution.

Bio-WRAP MODEL

The name is a derivative of "Biofuel from Water & Roadways Amenity Plantings"; **Bio-WRAP.** The acronym WRAP is a metaphor delineating the biofuel acquiring activity wrapped around intermodal transportation. Author is inspired by: *Barefoot Economics; Human Scale Development; Small is Beautiful;* and genuine *Green Technology* working on micro scale to substitute fossil fuels and

subsequently leading to sustainable development and alleviating poverty. There are varied 'Feed stock' choices available for tropics, including *Millettia Pinnata*, *Oil Palm* and *Jatropha*. However, for amenity planting in tropics, oil palm has the most, per hectare, biofuel potential. There is a tremendous amount of savings in the initial set up cost and operation & maintenance cost for feed stock availability.

Amenity plantings are a way to blend the stark utility of road and waterways with their surroundings by improving the aesthetic and environmental qualities of the roadside and river & stream banks; amenity plantings are also an effective way to improve community relations through extended amenity plantings on marginal lands and boundary markings. The advantage of using trees and shrubs for amenity plantings is their long lives and large size; they can make a positive visual impact for a long time. Additionally, the long-term maintenance requirements for trees and shrubs are much lower than for herbaceous ornamental plantings: Plant selection and handling, site preparation, and maintenance combine to maximize your investment in roadside plantings (Kuhns *et al*., 2005).

Roadside and waterway banks' plantings are part of shelterbelts; an agro forestry practice. They contain linear plantings of trees and shrubs. Benefits that shelterbelts provide include protecting soil, improving air and water quality, enhancing wildlife habitat, and beautifying the landscape (Shelterbelts, 2010). Bio-WRAP model augments the efficacy of amenity plantings (roadside plantings & riparian buffers) by turning them into a source of feedstock for biofuel production: Biofuel so produced would power the village community diesel powered machines including agricultural equipment and transportation modes cruising the same road and waterways. Biofuel would also be used in power generation where other energy sources are either non-existent or enormously expensive. Feed stock type and quantity can be calculated according to the needs of the community and resources available at their disposal. The phrase "Think globally, act locally" urges people to consider the health of the entire planet and to take action in their own communities and cities. In fact it is small villages and towns that are driving the move toward 100 percent renewable energy policy in Germany; German villages compete with each other for the title of who produces more renewable energy per capita. Winners are even feted with an annual award. The incentive to use 100% renewable energy, for electricity, transport, or even total primary energy supply globally, has been motivated by global warming and other ecological as well as economic concerns. Renewable energy use has grown much faster than anyone anticipated (Gipe, 2013).

MICRO BIODIESEL PRODUCTION

First, it's important to understand that even though diesel is part of its name, pure biodiesel does not contain petroleum diesel or fossil fuel of any kind. Biodiesel is a biofuel: a subcategory of biomass that includes three energy-crop-derived liquid fuels; ethanol (referred to as grain alcohol), methanol (referred to as wood alcohol), and biodiesel. Technically, a fatty acid alkyl ester, biodiesel can be easily made through a simple chemical process from virtually any vegetable oil including; Soy, Palm, Corn, Canola, Coconut, Jatropha, Millettia Pinnata, Cotton seed, Peanut, Sunflower and many more. Biodiesel can also be made from recycled cooking oil or animal fats from rendering plants. There have been some promising experiments with the use of algae as a biodiesel feed stock. Biodiesel is most commonly produced through a process called transesterification (Figure 1) which involves taking naturally occurring carbon chain molecules, known as triglycerides, found in such feed stocks as seed oils and animal fats, and converting them into methyl esters, which is the chemical term for biodiesel.

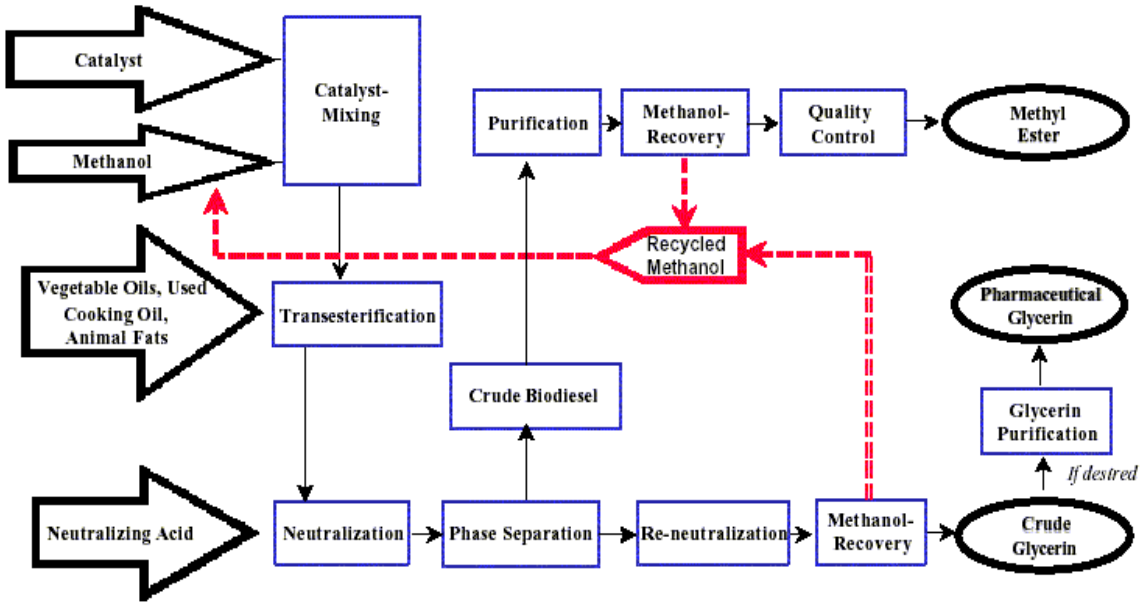

Figure: 1 - Biodiesel Production Flow Chart (Source: ESRU, 2013)

Almost all biodiesel is produced using base catalyzed transesterification as it is the most economical process requiring only low temperatures and pressures and producing a 98% conversion yield. The Transesterification process is the reaction of a triglyceride (fat/oil) with an alcohol to form esters and glycerol. A triglyceride has a glycerine molecule as its base with three long chain fatty acids attached. The characteristics of the fat are determined by the nature of the fatty acids attached to the glycerine. The nature of the fatty acids can in turn affect the characteristics of the biodiesel. During the esterification process, the triglyceride reacts with alcohol in the presence of a catalyst, usually a strong alkaline like sodium hydroxide. The alcohol reacts with the fatty acids to form the mono-alkyl ester, or biodiesel and crude glycerol. In most production methanol or ethanol is the alcohol used (methanol produces methyl esters, ethanol produces ethyl esters) and is base catalysed by either potassium or sodium hydroxide. Potassium hydroxide has been found to be more suitable for the ethyl ester biodiesel production; either base can be used for the methyl ester. The reaction between the fat or oil and the alcohol is a reversible reaction and so the alcohol must be added in excess to drive the reaction towards the right propensity and ensure complete conversion (ESRU, 2013). Once separated from the glycerine, the biodiesel goes through a purification process, removing all remaining alcohol and catalyst. It is then dried and stored. To guarantee the biodiesel is without colour, odour and sulphur, an additional distillation process may be implemented.

Soybean oil is the most common feedstock used in U.S. production, while rape seed and palm oil is used in Europe and Asia. An important factor in considering which feedstock to use is the stock's free fatty acid (FFA) content. Biodiesel is a low-emissions diesel substitute fuel made from renewable resources and waste lipid. Biodiesel is safe, biodegradable, and produces less air pollutants than petro diesel; it can be used in its pure form (B100) or blended with petroleum diesel. Common blends include B2 (2% biodiesel), B5, B10, and B20. Most vehicle manufacturers approve blends up to B5, and some approve blends up to B20. In considering a new biodiesel facility or an upgrade of existing biodiesel plant, it is imperative that ultrasonic mixing technology be considered; it is efficient and ideal for micro scale biodiesel processing. Biodiesel must be segregated and handled separately because of its unique physical properties. Biodiesel can be corrosive to rubber materials and liner materials and cannot be stored in concrete lined tanks (Leung *et al*., 2010; Biodiesel, 2013).

Biodiesel Quality - Today, making biodiesel is not just about making a renewable fuel; for biodiesel producers this is the challenge of producing high-quality biodiesel with consistent characteristics, regardless of feedstock at times. Using traditional ASTM (American Society for Testing and Materials) methods is time consuming and challenging. It involves sample preparation, the use of

reagents, and time; usually at least 40 minutes per sample. Quality Trait Analysis (QTA) offers an Infra-red based, on line, quality testing system for biodiesel producers. Besides its potent user-interface, QTA offers gamut of options; from measuring the feed stocks & raw materials, in process fuel, and glycerine purity to finished B100 per ASTM D6751 & EN14214 specs (Shah, 2009).

CONCLUSION

Biodiesel, a form of biofuel, is a green fuel; diesel fuel manufactured from vegetable oils, animal fats, or recycled restaurant greases. It is safe, biodegradable, and produces less air pollutants than petroleum-based diesel. It is part of the solution to make the energy supply more renewable and will pave the way for a cleaner environment and creation of jobs. Ultrasonic reactor technology is highly cost effective way to micro produce biodiesel. The impact of growing biofuels markets has the potential to provide new jobs and incomes throughout the supply chain from rural communities and farmers to biotechnology and engineering companies, and fuel producers and distributors across the world. Renewable energy has crucial economic and social benefits for the poorest countries in the world; home grown renewable sources can help developing countries to fuel their economic development and to insulate themselves against rising world energy prices. Biofuels are part of the solution to make the energy supply more renewable and will pave the way for a cleaner environment, creation of jobs and a more resilient economy (Cloin *et al*., 2007).

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