Jatropha oil plant for biodiesel production with a biorefinery processing perspective

Magali C. Vivas C.* and Emerson A. Collado D.*

*Facultad de Ingenieria Química y Textil, Universidad Nacional de Ingenieria
Av. Tupac Amaru 210, Lima 25, Perú, mvivas@uni.edu.pe, ecollado@uni.edu.pe

ABSTRACT

Biodiesel production from Jatropa Curcas in Peru is interest in the regional government of Tarapoto and other regions of Peru. The advantages of the easy cultivation of this species make it possible to maintain a supply of raw material for the production of biodiesel from Jatropha Curcas with a biorefinery processing perspective.

Biodiesel can be produced at small and medium scale, having the potential to be an option for energy supply in isolated rural areas, especially in the Amazon rainforest. With the local production of biodiesel, the standard of living in rural communities can be improved, reducing migrations and fixing the rural population in the countryside. Transesterification reaction defined the production of biodiesel

Keywords: biodiesel, Jatropha oil, production, biorefinery, transesterification.

1 INTRODUCTION

The study was aimed to support for biodiesel production of Jatropha oil. Fatty acid methyl ester (biodiesel) has been identified as alternative fuel obtained from renewable sources.

Biodiesel production from Jatropa Curcas in Peru has in recent years (2010 to present). It's interest in the regional government of Tarapoto and other regions of Peru, so it is necessary to review the technology applied in the present biodiesel production. The advantages of the easy cultivation of this species make it possible to maintain a supply of raw material for the production of biodiesel from Jatropha Curcas.

2 BASIC TRANSESTERIFICATION

Basic transesterification is the most recommended technology. The literature records several studies related to obtaining biodiesel from vegetable oils, including Jatropa curcas (Ramachandran et al., 2013, Marchetti, 2012, Maltsoglou I., & Tatsuji E., 2013, Rainer J. & Dominik. D., 2011). In these studies the processing that occurs in different equipment such as: reactor, filtration, centrifuge and adsorption tank.

The main factors that affect transesterification are:

- Molar ratio of glycerides to alcohol
- catalysts and reaction temperature
- content of water and free fatty acids in oils and fats.

2.1 Jatropha oil

The Jatropha oil is stored inside the seed, in the kernel (which represents about 65% of the total mass of the seed). The Jatropha curcas begins to produce after 6 months of sowing and it's reaches optimum level of production between 4 and 6 years. The plant of *Jatropha curcas* is toxic because the seed contains curcin and alkaloids known as phorbol esters, which cause a purgative effect. Due to the toxicity of the seeds, *Jatropha curcas* oil is not edible and it is traditionally used for medicinal applications and for the manufacture of soap, insecticides and lubricants.

2.2 Reaction Basic

Reaction of transesterification has several parameters, such as temperature, ratio alcohol/oil, amount of etoxido of sodium that must be fixed by the kinetics of the reaction

The most common molar ratio of alcohol to glycerides is 6: 1. Basic catalysts are more effective than acid catalysts and enzymes. The amount of base usually to be used is between 0.1 to 1% w / w of oils and fats. High temperatures accelerate the reaction and the reaction time is short. The base-catalysed transesterification ends in about one hour. The oils or grease used in the transesterification must be substantially anhydrous (> 0.06% w / w) and free of fatty acids (> 0.5% w / w).

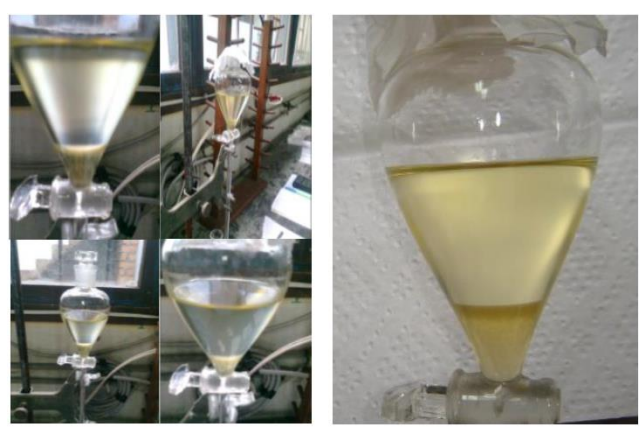

Figure 1: Separation of biodiesel.

In the experimental tests made in the laboratory (see figure 1) to start the transesterification reaction, the mixture of sodium methoxide is prepared in a vessel by adding the

volume of methanol and the mass of NaOH found with constant agitation. Once the sodium methoxide mixture is obtained, the oil volume to be transesterified is added to the beaker, this oil should be at a temperature of 60ºC and with agitation that should be maintained after adding the sodium methoxide. the reaction time should be 40min.

After completing the transesterification reaction, the mixture is passed to a decanting pear where it must remain for 1 day. subsequently the glycerin is decanted, leaving the main product Biodiesel in the pear.

3 BIOREFINERY PROCESSING

Actually, concept of biorefinery in important for new plants of biodiesel. Where all waste (pulp of fruit, shell and cake) is used. The figure 2 show the use of all waste.

The pulp of the fruit, the shell of the seed and the cake resulting from the extraction of the oil (which contains 56% of proteins), can be used for organic fertilization or for the production of more energy. The husks of the seeds (see figure 3) can be burned and, together with the pulp of the fruit, can be used as fuel for use in boilers and in processes that use heat as the same production of biodiesel. The cake and pulp of the fruit can be used for the production of biogas by anaerobic fermentation. Because it is toxic, the cake can not be used in animal feed. From the stem of the Jatropha curcas the latex is extracted, and from its leaves and barks other different substances for medicinal applications, uses as an insecticide, etc.

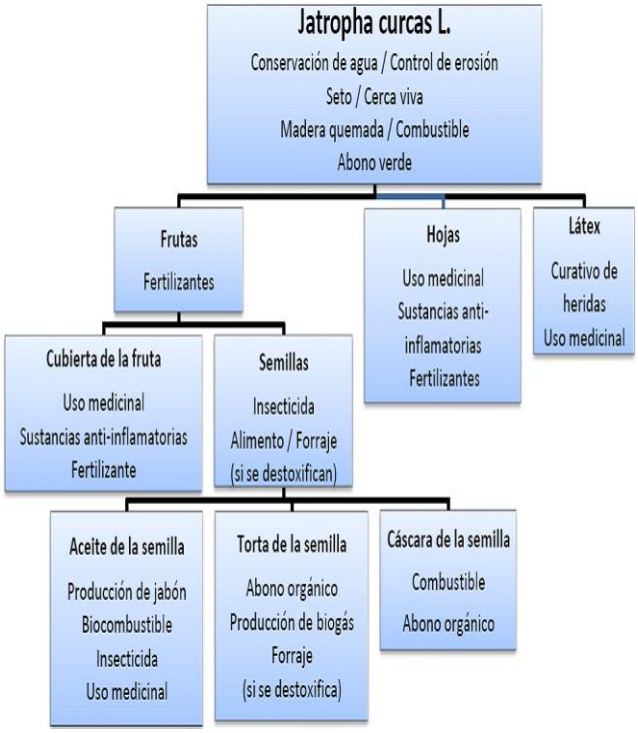

Figure 2: Explotation of components of *Jatropha curcas*.

4 PILOT PLANT OF BIODIESEL OF JATROPHA OIL

From biorefinery processing perspective, waste (cake, shell) will be used to give them added value.

The mathematical model of the transesterification of Jatropha Curcas oil allows the design of a transesterification reactor (see figure 4) of the oil in biodiesel in function of the process variables (temperature, catalyst concentration, catalyst / oil ratio).

Figure 3: Seeds of *Jatropha curcas*.

Figure 4: Transesterification reactor.

In faculty of Chemical Engineering was built an pilot plant. See figure 5.

5 CONCLUSIONS

The potential of Jatropha curcas for biorefinery processing is important of alternative in Perú.

The biodiesel of Jatropha oil occurs at 60°C in 40 minutes. The production of biodiesel from the inedible oil of Jatropha Curcas is an option to replace other raw materials to produce biodiesel from inedible oils.

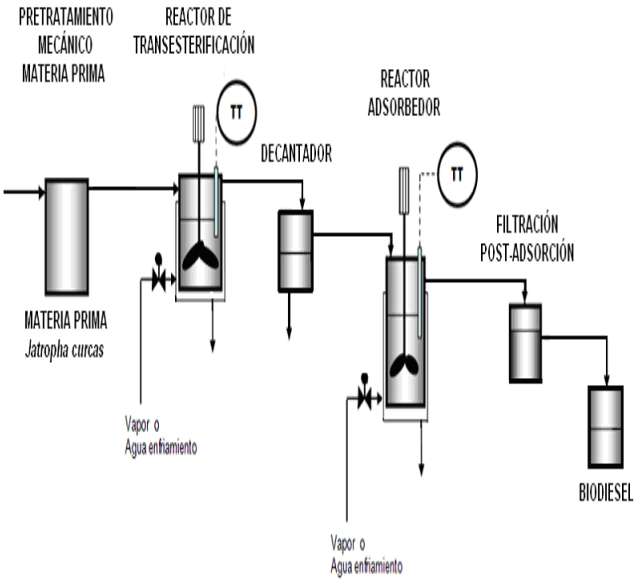

Figure 5: Plant piloto of Biodiesel of Jatropha oil.

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