Extraction of Bio - diesel from Jatropha Oil by Transesterification Process

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***Abstract*: Biodiesel is an alternative source of fuel; it has an energy content of about 12% less than petroleum-based diesel fuel on a mass basis. Various methods are currently employed in the manufacture of Biodiesel. The adopted process utilizes Jatropa oil and methanol as its principal raw materials and uses NaOH as its catalyst. The advantage this catalyst holds is that it yields Biodiesel product. Considering the fact that the consumption and demand for the petroleum products are increasing every year due to increase in population, standard of living and urbanization.The increase in crude oil import affects the country's economy and its development. Today's diesel engines require a clean burning, stable fuel that performs well under the variety of operating conditions. Biodiesel is the only alternative fuel that can be used directly in any existing unmodified diesel engine. Because it has similar properties to diesel fuel, biodiesel can be blended at any ratio with diesel fuel.**

INTRODUCTION

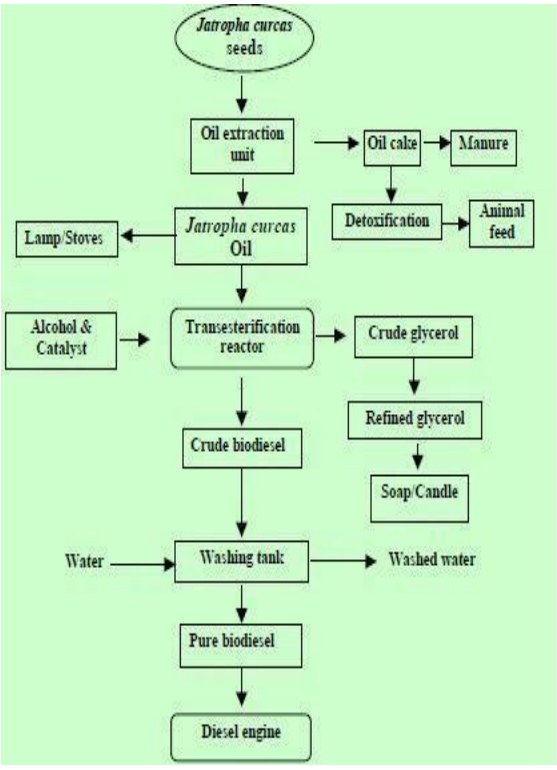
The prices of fuel are going up day after day in the world. So, ways and means have been sought for many years to be able to produce oil-substitute fuel. Biodiesel extracted from vegetable oil is one such renewable alternative under consideration. The production of biodiesel would be cheap as it could be extracted from nonedible oil sources. *Jatropha curcas* (Linaeus), a non-edible oil-bearing and drought-hardy shrub with ecological advantages, belonging to the *Euphorbiaceae* family, was found to be the most appropriate renewable alternative source of biodiesel. The extracted oil could not be used directly in diesel engines because of its high viscosity. High viscosity of pure vegetable oils would reduce the fuel atomization and increase fuel spray penetration, which would be responsible for high engine deposits and thickening of lubricating oil. The use of chemically

altered or transesterified vegetable oil called biodiesel does not require modification in engine or injection system or fuel lines and is directly possible in any diesel engine. Pure biodiesel (B100) can be used in any petroleum diesel engine, though it is more commonly used in lower concentrations. Since biodiesel is more often used in a blend with petroleum diesel, there are fewer formal studies about the effects on pure biodiesel in unmodified engines and vehicles in day-to-day use. Fuel which meets the standards and engine parts that can withstand the greater solvent properties of biodiesel are expected to and in reported cases does run without any additional problems than the use of compared to petroleum diesel.

METHODOLOGY.

In this process, jatropha oil is blended with alcohol and catalyst mixture in transesterification equipment. The equipmentis kept at reaction temperature for specific duration with vigorous agitation. After reaction, the biodiesel and glycerol mixture is sent to the glycerol settling tank.

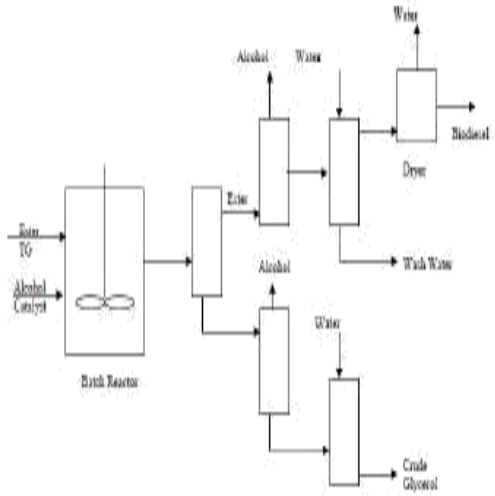
The crude biodiesel is collected and washed to get pure biodiesel. Depending upon the need, the size of the unit can be scaled up to get higher production capacity



BIODIESEL PRODUCTION PROCESS OPTIONS

BATCH PROCESSING. The simplest method for producing alcohol esters is to use a batch, stirred tank

reactor. Alcohol to triglyceride ratios from 4:1 to 20:1 (mole:mole) have been reported, with a 6:1 ratio most common. The reactor may be sealed or equipped with a reflux condenser.

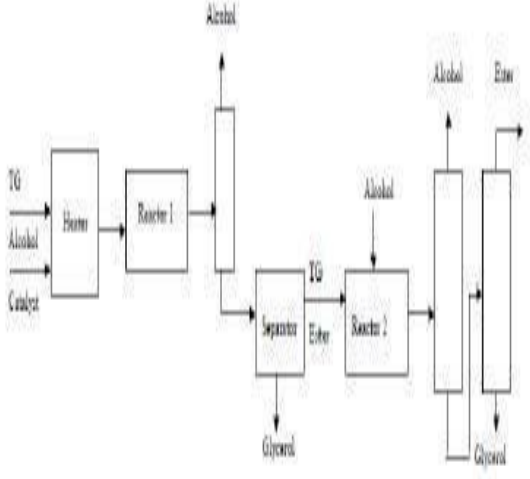


Fig; Batch Reaction Process

The operating temperature is usually about 65°C, although temperatures from 25°C to 85°C have been reported. The most commonly used catalyst is sodium hydroxide, with potassium hydroxide also used. Typical catalyst loadings range from 0.3 % to about 1.5%. Thorough mixing is necessary at the beginning of the reaction to bring the oil, catalyst and alcohol into intimate contact. Towards the end of the reaction, less mixing can help increase the extent of reaction by allowing the inhibitory product, glycerol, to phase separate from the ester – oil phase. Completions of 85% to 94 % are reported.[8]. Some groups use a two-step reaction, with glycerol removal between steps, to increase the final reaction extent to 95+ percent. Higher temperatures and higher alcohol:oil ratios also can enhance the percent completion. Typical reaction times range from 20 minutes to more than one hour. The oil is first charged to the system, followed by the catalyst and methanol. The system is agitated during the reaction time. Then agitation is stopped.In some processes, the reaction mixture is allowed to settle in the reactor to give an initial separation of the esters and glycerol. In other processes the reaction mixture is pumped into a settling vessel, or is separated using a centrifuge. The alcohol is removed from both the glycerol and ester stream using an evaporator or a flash unit. The esters are neutralized, washed gently using warm, slightly acid water to remove residual methanol and salts, and then dried.[9]. The finished biodiesel is then transferred to storage. The glycerol stream is neutralized and washed with soft water. The glycerol is than sent to the glycerol refining section.

2) CONTINUOUS PROCESS SYSTEMS:

A popular variation of the batch process is the use of continuous stirred tank reactors (CSTRs) in series. The CSTRs can be varied in volume to allow for a longer residence time in CSTR 1 to achieve a greater extent of reaction. After the initial product glycerol is decanted, the reaction in CSTR 2 is rather rapid, with 98+ completions not uncommon. An essential element in the design of a CSTR is sufficient mixing input to ensure that the composition throughout the reactor is essentially constant. This has the effect of increasing the dispersion of the glycerol product in the ester phase. The result is that the time required for phase separation is extended.

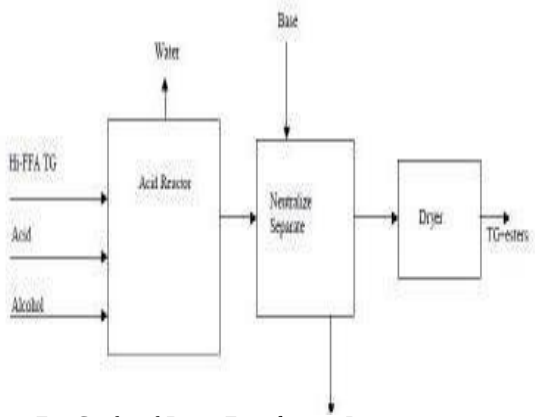


Fig; Plug Flow Reactor Systems

There are several processes that use intense mixing, either from pumps motionless mixers, to initiate the esterification reaction. Instead of allowing time for the reaction in an agitated tank, the reactor is tubular. The reaction mixture moves through this type of reactor in a continuous plug, with little mixing in the axial direction. This type of reactor, called a plug-flow reactor (PFR), behaves as if it were a series of small CSTRs chained together. The result is a continuous system that requires rather short residence times, as low as 6 to 10 minutes, for near completion of the reaction. The PFRs can be staged, as shown, to allow decanting of glycerol. Often this type of reactor is operated at an elevated temperature and pressure to increase reaction rate.

3)HIGH FREE FATHY ACID;

High free fathy acid feedstocks will react with the catalyst and form soaps if they are fed to a base catalyzed system. The maximum amount of free fatty acids cceptable in a base catalyzed system is lessthan 2 percent, and preferably less than 1percent. Some approaches to using high freefatty acid feedstocks use this concept to “refine” the free fatty acids out of the feed for disposal or separate treatment in an acid esterification unit.



Fig; Catalyzed Direct Esterification Process

The caustic is added to the feedstock and the resulting soaps are stripped out using a centrifuge. This is called caustic stripping. Some triglycerides are lost with the soaps during caustic stripping. The soap mixture can be acidulated to recover the fatty acids and lost oils in a separate reaction tank. The refined oils are dried and sent to the transesterification unit for further processing. Rather than waste the free fatty acids removed in this manner, they can be transformed into methyl esters using an acid esterification process. Less expensive feedstock, such as tallow or yellow grease, are characteristically high in free fatty acids

(FFA). The standard for tallow and yellow

grease is ≤ 15 percent FFA. Some lots may

exceed this standard.

Direct acid esterification of a high free fatty acid feed requires water removal during the reaction, or the reaction will be quenched prematurely. Also, a high alcohol to FFA ratio required, usually between 20:1 and 40:1. Direct esterification may also require rather large amounts of the acid catalyst depending on the process used. The esterification reaction of FFAs with methanol produces byproduct water that must be removed, but the resulting mixture of esters and triglyceride, can be used directly in a conventional base catalyzed system. The water can be removed by vaporization, settling, or centrifugation as a methanol-water mixture. Counter-current continuous-flow systems will wash out the water with the exiting stream of acidic methanol

Biodiesel Production

Aim: Production of of 90 litres for every 100 litres of oil.

biodiesel fuel from jatropha oil.

Assumptions

One production year is equivalent to 280 working days

- One working day is equivalent to 24hrs
- Methanol used is 99.7% pure
- Methanol used is 100% excess of required
- Triglyceride oil used is 100% pure after purification as indicated in the process of flow diagram
- The accumulation of reactant and products in pipes and vessel is negligible

Biodiesel product is made up of

Methyl esters 98%

Glycerol 0.5% maximum

Water 0.3% maximum

Unreacted stock Balance 1.2% .

Determination of the Average Molecular Weight of Fatty Acid

Average Molecular Weight of Fatty Acid fatty acid	Molar Mass (Kg/Kmol)	% mass	Mass in Feed
myristic acid	228.36	0.38	86.7768
palmitic acid	256.4241	16	4102.7856
palmitoleic acid	254.408	2	508.8160
stearic acid	284.477	6.5	1849.1005
oleic acid	282.46	40.75	11510.2450

CONCLUSION

We have extracted the bio diesel from jatropha oil. From this work we have concluded that the bio diesel extracted gives the annual yield of 90 litres for every 100 litres of oil.

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