

Biofuels an Initiative for Improved Life Methodologies and Applications

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Abstract - This paper elucidates about generations of Biofuels based on substrate and its applications, also the economics, policies and other factors affecting Biofuel generation. In Biofuel the organic materials generated from renewable biomass replaces the fossil fuels for energy purposes. It is a renewable resource. Its utilization has received great attention due to environmental consideration and increasing demand for energy worldwide. Since the energy crisis in the 1970s, many countries have targeted to utilize Biofuel as the source of energy. The development of Biofuel initiatives has reduced the environmental and ecological impact of energy production all over the world. Bioenergy accounts for almost 35% of primary energy consumption in developing countries. The most important Biofuel energy sources are feedstocks, agricultural waste byproducts, animal waste and algae. For generation of Biofuel several issues require careful analysis- (1) Availability of feedstock (THE FOOD MATERIAL CANNOT BE USED FOR FUEL PRODUCTION DUE TO ETHICAL REASONS) (2) The chemical composition of feedstock (3) Availability of land (4) Resources (5) emission of greenhouse gases (6) Transportation of feedstocks (7) Storage of Biofuel (8) Economic value of feedstock taking into account (9) Injection of pesticides (10) Soil quality. Processes like transesterification which converts animal and vegetable oils into usable 2 fuel forms are reported.

I. INTRODUCTION

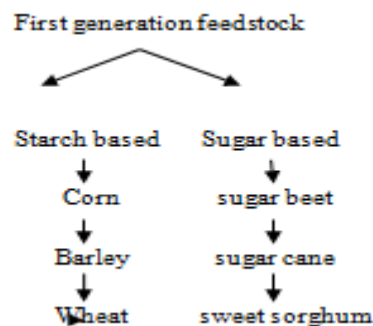
The power demand across the globe is increasing day by day and the demand for power is running much ahead of the supply or the yield. Power or energy is a necessity for the economic growth and the sustainable development in both developed and the developing countries. The conventional sources of energy like fossil fuels (coal ,petroleum) may not be either sufficient or suitable to keep pace with the ever increasing demand for power. Also, the increasing cost of these fuels has led to the search of the more effective fuel for the energy as well as environment protection. The scarcity of fossil fuels and the increasing demand has led the increase in the oil prices all over the world. In addition, the environmental and climate changes is another reason incitementing for other non-polluting energy sources. The one such alternative is the Biomass or Biofuel .Biofuel is manufactured using a wide range of resources like feedstocks and biomass. The variety has grown notably in the recent years. Production has risen from around 25 million gallons in the early 2000s to about 1.7 billion gallons advanced biofuels in 2014. With the projected feedstock availability the industry aims for manufacturing about 10% of the diesel transportation market by 2022. Biofuels can be processed from numerous types of biomass. First generation biofuels are processed from the sugars and vegetable oils formed in arable crops , in comparison advanced or second generation biofuels are made from woody crops and agricultural wastes , which makes it tougher to extract the requisite fuels. Algae represent significant group which produces the large amount of energy. However , it is important to note that the technology

has so far not been sufficiently developed to allow these biofuels to be produced commercially. Biofuel is the only source that can replace fossil fuels directly for our present and future energy constraints.

GENERATIONS OF BIOFUELS AND METHODS OF GENERATION: According to the availability of feedstock and resources , the generation of biofuel can be divided into three categories:

1. First generation biofuels
2. Second generation biofuels
3. Third generation biofuels

A) First generation biofuels: First generation biofuels refers to the fuels that have been derived from feedstocks that can be consumed as human food. Depending on this there are two types of crops:



Whether it is sugar , starch , or vegetable oil , all of them are food products . Conventional biofuels are those that can be easily extracted using conventional techniques . The most common First Generation Biofuels are:-

A) Biodiesel , B) Ethanol, C) Biogas

A) Biodiesel is generated by the extraction of vegetable oils with or without esterification process from seeds of plants like soya bean , ray or sun flower.

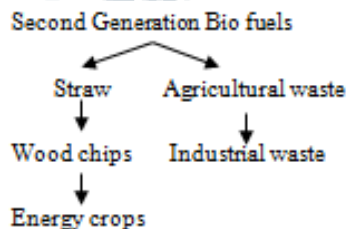
B) Ethanol is generated by the fermentation of sugar from sugar crops and starch crops .

C) Biogas is generated from anaerobic fermentation of organic wastes and crop residues .

Biodiesel is the most common biofuel used in the European countries . This fuel is very similar to the mineral diesel and is chemically known as fatty acid methyl . This oil is produced after mixing the biomass with methanol and sodium hydroxide . Biodiesel can be produced by combining oil extracted from seeds and nuts with an alcohol through a chemical process known as transesterification . Common crops used are :- 1) Palm , 2) Soya bean , 3) Rape seed . The oil content in rapeseed is 38% and in soya bean is 21% respectively . Palm oil with 40% of oil content is highest as compared to other oil seeds . The major difference between various oil feedstocks is the type of fatty acids in the triacylglycerols (TAG) . The transesterification of oil to biodiesel is the stepwise reaction of TAG with alcohol mostly methanol to form esters and glycerol. Byproduct like glycerol can be used as food and pharmaceutical uses and beet as animal feed. Bio ethanol and bio diesel can also be blended . Like 2% biodiesel with 98% petroleum diesel also known as B-2 and 5% bio diesel with 95% petroleum known as B- 5 . Currently biodiesel is not cost competitive due to increasing price of vegetable oils. Besides advantages First Generation Bio fuels had disadvantages too which led in the production of Second Generation Bio fuels and they were:-

- A) Currently more expensive than fossil diesel fuel.
- B) Conflicts with food supply.
- C) Less suitable for use in low temperatures.
- D) Reduction of fuel economy.

Second Generation Biofuels:



Second Generation Bio fuels have been developed because first generation biofuels manufacture has important limitations . Second Generation Bio fuels feedstocks include cereals and sugar crops (Energy crops) , agricultural waste and industrial waste . The crops include perennial grass,

small wood crops, Jatropa . Basically these crops have some specific time span for their production. For example- Perennial grass (switch grass) requires 3 years to reach productivity. Similarly , small wood crops (Myoanth/Miscanthus) requires 2-3 years , also in myoanth and miscanthus Rhizome removing was necessary . Whereas, in comparison to these two crops, Jatropa only requires 1-2 years for its production and in addition has high productivity.

Crop yields depend upon land, climate, irrigation and fertilization. Perennial grasses are good for carbon removing and soil stabilization, thus reducing soil erosion and increasing water quality and habitat. Jatropa is the cheapest crop for biodiesel production. Jatropa is a multiresistant that grows well on degraded or marginal land and have seeds with high oil content of about 40% . The oil can be used as fuel for vehicles, in cooking stoves etc.

Municipal waste and Industrial waste for production of Biofuel:

Food and psper industry produces large amount of residue and byproducts that can be used for bio energy production. Waste from poultry, pulp and paper from sugar and starch industry can be used as a energy source. Also, second generation technology called LIGNOCELLULOSIC PROCESSING is also popular which uses foorest materials. The Second Generation Biofuels has increased efficiency that uses the vast majority of biomass which avoids the waste seen in First Generation Biofuel production.

Impact on soil, water and biodiversity:Feedstock plantations for second-generation biofuels are usually perennial tree or grass species, the cultivation of which can have a number of positive impacts:

- A)The year round cover provided by perennial grass species can increase the water retention capacity of the soil.
- B) Perennial plantations can also considerably reduce the impact of erosion through wind and water, which is a considerable benefit compared to annual feedstocks.
- C) Soil carbon content can be increased through both root and leaf litter.

Theoretical production price for second-generation biofuels in selected countries

oil price: USD 60/bbl		Feedstock price*	USD/lge	
		USD/GJ	Btl-diesel	lc-Ethanol
Woody energy crops	global (IEA analysis)	5.4	0.84	0.91
	China	1.9 - 3.7	0.66 - 0.79	0.68 - 0.85
Straw/stalks	India	1.2 - 4.3	0.62 - 0.80	0.63 - 0.86
	Mexico	3.1	0.74	0.79
	South Africa	0.8 - 3.1	0.6 - 0.74	0.6 - 0.79
	Thailand	2.0 - 2.8	0.67 - 0.72	0.67 - 0.77

THIRD GENERATION BIOFUELS:

Third Generation Biofuels are based on improvements in the production of biomass. It takes advantage of specially engineered energy crops such as algae as its energy source. The algae are cultured to act as low cost, high energy and entirely renewable feedstock. It is predicted that algae can produce more energy per acre than conventional crops. Algae can be grown using land and water unsuitable for food production. Therefore reducing the strain on already depleted water sources. Survey depicts that algae can produce 10 times more than the best conventional feedstock can generate. Biodiesel can also be produced through chemical reactions transesterification. This process involves vegetable or animal fats and oils being reacted with short chain alcohols (typically methanol or ethanol). The alcohols used should be of low molecular weight. Ethanol being one of the most used for its low cost. However, greater conversions into biodiesel can be reached using methanol. However, there are certain steps in the transesterification process, which are

A) Feedstock pretreatment: Common feedstock used in biodiesel production includes vegetable oils, tallow and recycled vegetable oil. Recycled vegetable oil is processed to remove impurities such as dirt, cooking charred food etc.

B) Determination and treatment of free fatty acids: A sample of feedstock is titrated using standardized base solution in order to determine the concentration of fatty acids. Then these acids are either esterified into biodiesel or glycerides or removed.

C) Reactions: Process like transesterification reacts with alcohol to produce biodiesel and glycerol. If the feedstock oil is used or has high acid content, then esterification can be used to react with fatty acids with alcohol to produce biodiesel.

D) Product purification: Products of the reaction include not only biodiesel but also byproducts which must be removed to meet the standards.

The main advantages of Third Generation Biofuels are:

- A) Promising high content of energy
- B) It consumes high amount of carbon dioxide
- 3) It basic source grows fast.

ECONOMICS AND POLICIES FOR BIOFUEL GENERATION:

A) Agricultural supplies: The rapid increase in demand for liquid biofuels is connecting agriculture and energy through market and government policies. Liquid biofuels derived from agricultural crops compete with fossil fuels as biofuel volume are produced in small quantity, also oil prices are important factors for agricultural feed stocks. Agricultural crops grown for energy production also

compete with food crops for resources. For example: farmers will sell their harvest accordingly so that they can get good price for their feedstock and as consequence biofuel price will rise.

B) Granting subsidies to biofuel generation: Government supported to promote research and development facilities even at higher crude oil prices in order to promote research for sustainable fuel production.

C) Energy security: The recent increase in prices of oil have increased the incentives to promote alternate sources of energy. The strong demand from developing countries like India and China are adding concerns for future prices and supplies.

D) Climate change: The change in climate has added a concern for the government to find an alternate source. So bioenergy and biofuel is often looked as a good source to reduce the pollution and rising global temperature.

E) Subsidies and tax incentives: The distribution and uses of biofuel are subsidizing or mandating investments are complied for biofuel storage, transportation and use. Penalties or taxes are widely used to stimulate demand for biofuel and can affect the competitiveness of biofuel as compared to other energy resources.

F) Environmental impacts: The NGOs have expressed concern about potential negative environment impacts which concerns over water resources, addition fertilizer use, loss of biodiversity from increased arable cultivation and raises opportunity cost of agri-environmental measures. In response there are certain schemes which aims at encouraging the use of biofuel production systems in sustainable ways.

II. CONCLUSION

The need for Biofuels stem from the need of fossil fuels for the energy purposes. There is no doubt that the current source of fuels is drying out. The issue is that the supply demand and the environment. The scarcity of fossil fuels and the global warming on the other hand has already started placing irresistible pressures on human and ecological wellbeing. However biofuel is a competitor to the other fossil fuels based products and can be produced biologically. Biofuels can play a part in significant reduction in global energy demands. While the use of biomass and other feedstocks is ideal for biofuel. First generation biofuels are easier to yield, however, undesirable energy yields higher their feasibility. Other issues like land constrain and storage also pose concerns. In summary more research is necessary to revamp the old production

processes. Otherwise biofuels are the best alternative for the current energy resources as well as for future energy use.

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