Study of Properties and Use of Future Biofuels for Production of Low Cost Fuel

Harsha D N[1], Girish Y N[2] Manjunath H S [3] Rakshith N[4]
[1234] *Department of Mechanical Engineering, ATMECE, Mysore, Karnataka, INDIA*

Abstract
Increasing energy demand, climate change and carbon dioxide (CO2) emission from fossil fuels make it a high priority to search for low-carbon energy resources. Biofuels represent a key target for the future energy market that can play an important role in maintaining energy security. It is primarily considered as potentially cheap, low-carbon energy source. The economic development of the world is highly dependent on fossil fuel supplies which are constrained not only by limited availability but also generate high levels of pollution. Looking at the limited fossil fuel associated with problems, concerted efforts have been started to search for alternative bio fuels like bio ethanol and biodiesel. Since the diesel is being used massively in industrial commercial, agriculture and other sectors[1]. Therefore, the production and utilization of biodiesel from oil seeds crops has been getting renewed interest in recent years in the India to overcome the demerits of oil from oil seed crops.

Keywords - *Biodiesel, Biomass, Bio gas, Ethonal, Algae etc…*

I. INTRODUCTION

Since several years, the demand and price for crude oil are increasing continuously. The price of light crude oil was at about 78 US Dollar per barrel in summer 2006. The same time, discoveries of new oil fields are rapidly decreasing. New solutions have to be found to guarantee the high standard of daily life in Europe and worldwide. The development of new technologies for processing and using biofuels is steadily progressing. Biofuels are becoming more and more competitive compared to fossil fuels. The use of biofuels features a number of advantages suitable for achieving energy, environmental, agricultural and trade policies. As a result, biofuels are emerging as a popular step towards a more sustainable transportation sector, and several European countries [2] have introduced advanced policies to support the production and use of biofuels. Biofuels have been increasingly explored as a possible alternative source to gasoline with respect mainly to transport. Global biofuel (bioethanol and biodiesel) production tripled from 4.8 billion gallons in 2002 to 16.0 billion in 2007, but still accounts for less than 3% of the global transportation fuel supply.

To summarize, interest in biofuels is increasing for number of reasons:

- Reduced reliance on fossil fuels
- Reduction in greenhouse gas emission;
- National independent security of fuel supply
- Employment and economic benefits through the development of a new fuel production.

In what follows, first present data and analysis on the growing scale and location of biofuels production, investment, location and subsidy, biofuels production technology. And finally concentrates on the newest, most innovative production source into which an increasing share of risk investment is being directed, namely production of biofuel from algae. [3]

II. BIOFUELS PRODUCTION, INVESTMENT LOCATION

Biofuels can be ether wholly or partially substituted for petrol or diesel. Bioethanol is mainly made from starch or sugar crops (such as wheat, corn, sugarcane). It can be used as a 5% blend with petrol. This blend requires no engine modification, but higher proportions of ethanol only can be used with engine modification. Brazil is the world leader in producing ethanol from sugarcane[4], while corn is the main crop for ethanol production in the US. About 90% of global bio-ethanol in 2007 was produced in the US, Brazil and the EU. There is also strong interest in other countries, for example, China, India and Canada(Fig 1). Cars are currently produced in Sweden, Canada and the US that can run on up to 85% ethanol. More than half of Brazil's sugarcane crop is planted for ethanol production. Bioethanol accounts for about 20% of Brazil's fuel supply. Brazil introduced its biofuel policy via two approaches: - a blend requirement (now about 25%) and tax incentive favoring ethanol use and the purchase of ethanol-using or flex-fuel vehicles. Today, more than 80% of Brazil s newly produced cars have flexible fuel capability and some 32,000 petrol stations supply motorists with ethanol[5].

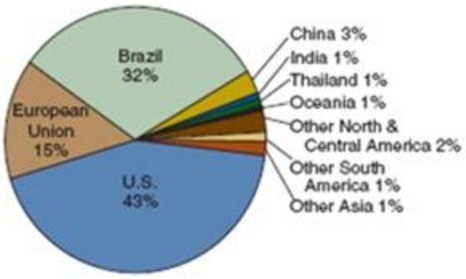

Fig.1. Global Distribution of Bio-Ethanol Production in 2007

Many uncertainties remain for the future of biofuels, including competition from unconventional fossil fuel alternatives and concerns about environmental trade-offs. Perhaps the biggest uncertainty is the extent to which the land intensity of cur-rent biofuel production can be reduced. The amount of biofuel that can be produced from an acre of land varies from 100 gallons per acre for EU rapeseed to 400 gallons per acre for U.S. corn and 660 gallons per acre for Brazilian sugarcane.

Cellulosic ethanol could raise per acre ethanol yields to more than 1,000 gallons, significantly reducing land requirements. Cellulosic ethanol is made by breaking down the tough cellular material that gives plants rigidity and structure and converting the resulting sugar into ethanol. Cellulose is the world's most widely available biological material, present in such low-value materials as wood chips and wood waste, fast-growing grasses, crop residues like corn Stover, and municipal waste.

U.S. cellulosic fuel production costs are now estimated at more than $2.50 per gallon, compared with $1.65 per gallon for corn ethanol. Venture capital and government subsidies are supporting companies interest- ed in making cellulosic ethanol commercially viable, primarily in the United States, but also in several other countries, including Canada, Brazil, China, Japan, and Spain.

In the meantime, other costs of cellulosic ethanol production need to be fully assessed, such as the impacts of harvesting grasses, trees, and crop residues on the erodibility and fertility of land resources. There are also questions regarding the upstream logistical and environmental costs of harvesting, transporting, and storing large volumes of bulky feedstock used in processing.

III. BIOFUEL PRODUCTION TECHNOLOGY

The technology of biofuel production has and continues to be improved with more advanced technology development across different sciences, notably biology, biochemistry, engineering and IT. The biofuel production process began with transformation from starch or sugar to ethanol. More recently innovators have practiced production of ethanol from cellulose and, as will be shown, may have the greatest affordable fuel supply from algae in the near future.

A. From Sugarcane, Starchy Crop To Ethanol

In history for thousands of years, fruit and grains have been converted into ethanol via fermentation. Today, sugars and starches are turned into ethanol using similar process. During the process, a series of enzymes help convert starch into sugar, and then ferment the sugar into ethanol via yeast (Figure 2). Corn, wheat and other cereals contain starch that can relatively easily be converted into sugar. Traditional fermentation processes rely on yeasts that convert six-carbon sugars (mainly glucose) to ethanol. In the US, corn grains are the preferred feedstock, where it is sugarcane in Brazil, as sugarcane is the most common crop in Brazil and many other tropical countries[6]. The organisms and enzymes for starch conversion and glucose fermentation on a commercial scale are readily available (Figure 3).

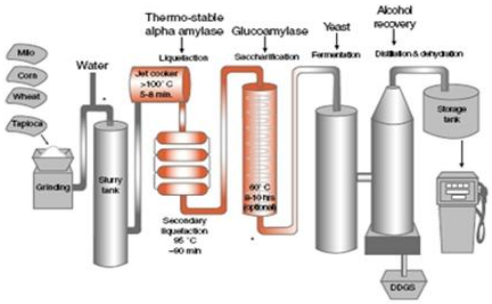

Fig.2. Conventional Ethanol Production Process

In conventional grain-ethanol processes, only the starchy part of the crop plant is used. The starchy products represent a small proportion of the total plant biomass, leaving considerable fibrous remains (e.g. the seed husks) (IEA, 2004). Current research on cellulosic ethanol production is focused on how to utilize the remaining materials to create fermentable sugar to maximize the production of ethanol than from using only sugar and starches directly available[7].

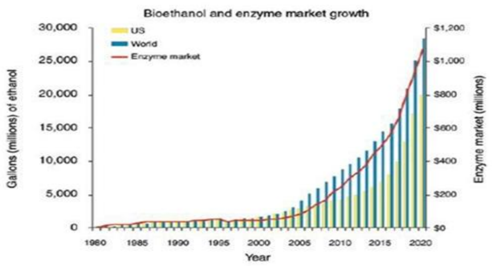

Fig.3. Rising Production of Biofuel

B. *Biodiesel Production*

The other main biofuel, biodiesel can be produced from any biological feedstock that contains oil or animal fat, through a chemical process (called "trans esterification"), reacting feedstock oil or fat with methanol and a potassium hydroxide catalyst. Soybean, sunflower, rapeseed and palm fruit are oil-seed crops used to produce biodiesel. Animal fat, or even used frying oil can be used to produce biodiesel too. Biodiesel also includes synthetic diesel fuel made through gasification or some other approach. The biodiesel process involves well-established technologies that are not likely to change significantly in the future, but efficiency can be improved by large scale production. There are some useful by-products such as glycerine, a valuable chemical used for making many types of cosmetic, medicines and foods.

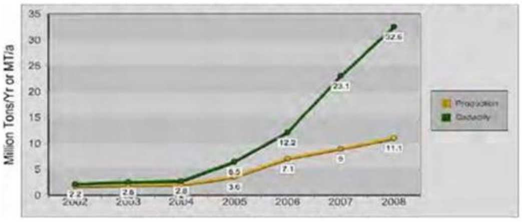

Fig.4. World Biodiesel Production And Capacity

This is likely to be constrained by environmental concerns outside Indonesia against the destruction of mangrove and other rainforest resources necessary to make way for palm-oil based biodiesel production. The global market for biodiesel is expected to increase in the next ten years. Europe currently represents 80% of global consumption and production, but the US is now catching up with a faster rate in production than Europe, from 25 million gallons in 2004 to 450 million gallons in 2007 (Emerging Markets Online, 2008). Brazil is expected to surpass US and European biodiesel production by 2015. Europe, Brazil, China and India each have targets to replace 5% to 20% of total diesel with biodiesel. If governments continued to invest more in R&D on biofuel exploitation, it would be possible to reach the targets sooner. But, as noted, the effort has a downside.

IV. ALGAE OIL EXTRACTION TECHNIQUES

Oil extraction from algae is one of the costly processes that can determine the sustainability of algae-based bio-diesel. The integrated process for producing biodiesel from algae is shown in Figure 6. Algal biomass production requires light, carbon dioxide, water and inorganic nutrients. Sea water, added with commercial nitrate and phosphate fertilizers and a few other micronutrients is a common growth medium for marine algae. Fresh and brackish water from lakes, rivers and aquifers can be used as growth media too[8]. The algal biomass passes the biomass recovery system, where the water and residual nutrients are recovered and can be recycled to the algal cultivation system. Up to 95% of algal oil can be extracted via an extraction solvent such as hexane. Once the algal oil is extracted, it is refined using transesterification processing as with the biodiesel production process described above. After algae oil is extracted, the remaining biomass residue can be used partly as high-protein animal feed and for other algal co-products. Meanwhile, the algal residue from oil extraction can be used to produce biogas through anaerobic digestion. This biogas can serve as the primary source of energy for most of the algal biomass production and process. his is one of the most important reasons that microalgae have attracted the attention of researchers in India to scientifically grow, harvest, extract oil and convert it to biodiesel.

V. CONCLUSION

The increasing demand for alternatives to fossil fuels leads to the production of biofuels from food crops such as corn, sugarcane, soybeans and palms. With the explosive growth of a corn ethanol industry in the US, the number of refineries is Dramatically increasing with more being added rapidly, as farmers expand cultivation into lands formerly set for conservation, and reduce soybean farming to make room for corn planting. There has been distortion of the price structure of an important grain commodity that is traded in world markets and used in livestock production. Will that make maize or meat more affordable to poor countries that must import it, or to the poorer people who need to buy it? When more agricultural land was diverted to biofuel production, triggering higher crop prices, it raised the world-wide debate -"food vs fuel" debate. The challenge to any nation in reducing its dependence on foreign oil is seen by scientists and technologists represented by journals like Nature and its many affiliates as too great to abandon first-generation technology for fear of unpleasant and unintended consequences; instead innovators and investors are set to learn more from comprehensive life-cycle analyses how to avoid those consequences in the first place as the biofuels market evolves.

REFERENCES

[1] Shalini Rajvanshi, Mahendra Pal Sharma "*Microalgae: A Potential Source of Biodiesel" Journal of Sustainable Bioenergy Systems, 2012, 2, 49-59.*

[2] Chisti, Y. (2007) Biodiesel from microalgae, Biotechnology Advances, Vol. 25: 294- 306.

[3] Demirbas, A. (2007) Progress and recent trends in biofuels, Progress in Energy and Combustion Science, Vol. 33:1-1

[4] Editorial, (2008) Join the dots. Nature biotechnology, Vol. 26: 837.

[5] Francisco, M. (2007) Eco-friendly jet fuel, Nature Biotechnology, Vol. 25: 959.

[6] International Energy Agency (IEA), (2004) Biofuels for transport: An international perspective

[7] Schubert, C. (2006) Can biofuels finally take center stage? Nature Biotechnology, Vol. 24: 777-784

[8] Waltz, E. (2007) Will the current biofuels boom go burst? Nature biotechnology, Vol. 25 (5): 491-492.