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SECOND GENERATION BIO-FUELS: A REVIEW

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Abstract- *Climate change and energy security issues have emphasized the implementation of 'Sustainable' energy technologies. Sustainable technologies such as Solar thermal, Solar PV, Wind, Hydro, Biomass and Biogas, Geothermal etc. were the subjects of research since then. Biomass and Biogas technology has a bright prospect among these as it uses the waste of various processes. The evolution of Bio-fuel technology has gone through different stages which are distinguished as first, second and third generation etc. The objective behind this evolution was to find a cost-effective and more efficient fuel. This review highlights the evolution, production and advancements of second generation bio-fuels.*

Keywords: Bio-fuels, First generation bio-fuel, Second generation bio-fuel, Renewable energy, Energy crisis.

1. INTRODUCTION

The first generation bio-fuels were basically produced from food crops. The usage of these fuels had been implemented in the transportation sector. But the target was not achieved by these fuels as they had certain limitations like high production and processing costs, competition for land and water use besides the GHG emissions involved. Also the first generation bio-fuels were thought to be responsible for the price increment of foods and animal feeds. The second generation bio-fuel research has indicated the possibility that the transport sector will turn to more sustainable sources of energy. Ligno-cellulosic materials including by-products, wastes and dedicated feedstock are considered to be the sources of the second generation bio-fuels. The second generation bio-fuel research projects are now heavily funded in many leading countries of the world in order to expand the sector of the fuel so that it not only serves the transportation sector, but also other energy purposes [1].

2. FIRST GENERATION BIO-FUELS

The liquid bio-fuels got a boost in research in the recent years as the oil prices rose dramatically. Biodiesel (bio-esters), ethanol and biogas were the main varieties of bio-fuels that were commercialised. Biodiesel is used to replace diesel. It is produced from the vegetable oil, residual oil and fats through the transesterification process. Bio-ethanol replaces gasoline and produced from the starch or sugar following the fermentation process. Biogas or bio-methane was used in vehicles mixed with gasoline with little modifications. Different digestible feedstock, liquid manure goes through the process of anaerobic digestion to produce bio-methane. Nowadays these three types of bio-fuels are produced from different commodities which are also used for food. Recently, the demand of edible oils has increased resulting in limitations of using agricultural food crops for producing bio-fuels [2]. Figure 1 illustrates the comparioson between first and second generation bio-fuels.

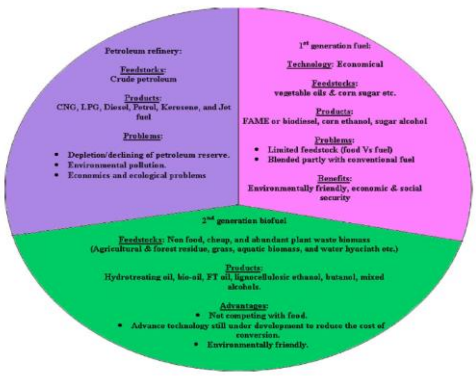

Fig.1: Comparison of petroleum fuel, first generation bio-fuel and second generation bio-fuel [2].

3. SECOND GENERTAION BIO-FUELS

To reduce or completely diminish the CO_2 impact, the second generation bio-fuels are produced from biomass. The major portion of the inexpensive and rich sources of non food materials which are derived from plants are referred to as 'plant biomass' when it comes to the topic of bio-fuel production. These are basically ligno-cellulosic materials. Plant biomass is considered to be a huge source of energy and can be burnt for producing heat and electricity. The main element of plant biomass is plant cell walls and to be more precise, it's the polysaccharides. Polysaccharides are present in about every food crops and these sugar elements play an important role in bio-fuel production. As the bio-fuel production from agricultural by-products cannot meet the demand, the necessity of new technology to produce bio-fuels was realized which led to the usage of biomass crops. Among these, there are ligno-cellulosic materials which can be used to produce bio-fuels through processes like hydrolysis, fermentation or gasification. The second generation bio-fuels are generally carbon-based fuels which are produced in a sustainable manner and uses lingo-cellulosic materials as the major resource. Through the gasification process, the ligno-cellulosic biomass products are converted to syngas and that is transformed into diesel and kerosene [2].

4. CONVERSION OF BIOMASS TO BIOETHANOL

The current production process of ethanol involves sugarcane and starch-containing materials as raw materials. The starch is converted to ethanol through a liquefaction process followed by hydrolysis. The resultant of these processes is glucose which is later fermented. There are a few things which must be carefully assessed and those are:

1. Effective de-polymerization process to convert the cellulose into soluble sugars.
2. Successful fermentation process.
3. Energy efficient project planning.
4. The usage of lignin should be cost-effective.

At first, the biomass products go through the processes of size reduction and pre-treatment. The hydrolysis process is carried out with enzymes or acids. The cellulose polymers get mixed with the enzymes and monomeric sugars are released. Then fermentation by bacteria, yeast or filamentous fungi takes place. After this process, the ethanol can be used as a fuel [3].

5. BIO-FUELS IN THE WORLD

Nowadays bio-fuels are being promoted all over the world. Brazil and United States are thought to be the front runners here. Germany, France are also in an advanced stage in this field. In Germany, the bio-fuels were exempted from tax by the government in 2002. Researchers have pointed out the fact that, for the replacement of 5% petroleum fuel the land needed to produce ethanol in EU and USA respectively are 5% and 8%. And in case of replacing 5% diesel the crop land needed in EU and USA are respectively 15% and 13%. The main driving forces behind the rise of bio-fuels are the declining fossil fuel resources and fuel import. At this time, there is an increasing attention in bio-fuel business in European countries. Sweden has excellent accessibility in biomass, and the complete use of bio-fuel in 2001 was 98 TWh, or about 16% of the nation's complete power provide. The Swedish National Energy Administration approximated that up to 160 TWh of bio-fuel could be used in Sweden by the season of 2010. The complete bio-fuel intake of China in 2000 was 219 Mtce, among which hay and stalk included 124 Mtce and fire wood included 95 Mtce. Only 15 Mtce was used by non-urban businesses, the remaining portion was mainly used in source of revenue [4].

6. HISTORICAL PERSPECTIVE OF BIO-DIESEL

The first recorded use of vegetable oil as power for a diesel power motor occurred at the Paris Globe Exposition in 1900, when peanut oil was used to power one of the displayed diesel power engines. The background was the desire of the French government to provide its exotic hives with a separate power resource as stated in reviews by the founder of the diesel power motor, Rudolf Diesel, himself. The probably first recorded use of a fuel meeting the current characterization of biodiesel is contained in a Belgian patent issued to Chavanne in 1937 with later reviews outlining this perform. The search for substitute resources of power was then largely latent until the power depression of the 1970s and early 1980's stimulated restored interest in this issue. Among the substitute types of fuels, vegetable oil-based types were reconsidered, with biodiesel in form of esters of sunflower oil to be reported in 1980. Other documents published between 1921 and 1927 explain the formation of hydrocarbon types of in the use of various catalyst-type components and from the distillation of fatty acid cleansers. Focus on breaking of various vegetable oil was performed by Chinain the Thirties, with them regarding such types of fuels as emergency replacements for petroleum-derived fuels during World War II [5].

7. BIO-ETHANOL CONSUMPTION WORLDWIDE

The worldwide ethanol market has been triggered by government policies of motivation to the use of renweable energy sources. Although in development, the worldwide market is very local, with the biggest manufacturers being also the biggest customers. In ethanol trading, South America is the biggest exporter, with the U.S. and European countries being, correspondingly, the biggest importers. In 2006, the complete business of ethanol was approximated to be 4.3 gallons. In South America, the ethanol use as bio-fuel is very common. In the 80s, more than half of the Brazil automobiles used 95% anhydrous ethanol, however, the lack of glucose and its great costs reduced this value in the following years. These days, almost all the Brazil automobiles use ethanol, in the genuine form or in combination with the fuel, where ethanol matches up to 25% of the combination. The significant number in which ethanol is included to energy in South America is also an effort made by the govt to reduce the imports of oil. In the U.S., ethanol is actually used in two forms: blended with gasoline up to 10%, or in mixes containing 85% ethanol and 15% energy, as a substitute fuel. In India, the inclusion of 5% ethanol to energy is compulsory in 10 states and 3 areas. Norway also uses mixes containing 5% ethanol in energy, while in North America and some areas of China mixes containing up to 10% ethanol in fuels may be found. In Asia, the alternative of 3% of gasoline by ethanol is approved, but initiatives will be also taken to improve this value to 10%. In Thailand, energy policy encourages the use of a 10% combination of bio-ethanol with 90% gasoline [6].

8. BIO-ETHANOL TRENDS AND PROJECTIONS

International manufacturing of bio-ethanol improved from 17.25 billion litres in 2000 to over 46 billion litres in 2007. Bio-ethanol manufacturing in 2007 showed about 4% of the 1300 billion dollars litres of fuel absorbed worldwide. National bio-fuel guidelines usually differ according to available feedstock for producing fuels and national farming policies. With all of the new government applications in America, Japan, and European countries in place, total global energy bio-ethanol requirement could grow to surpass 125 billion litres by 2020. The U.S. is the globe's biggest manufacturer of bio-ethanol energy, accounting for nearly 47% of worldwide bio-ethanol manufacturing. The U.S. generated 18.3 billion litres of bio-ethanol in 2006, up from 15 billion litres in 2005. EISA set a focus on of 57 billion litres intake of bio-fuels (mainly bio-ethanol) by 2012 [7].

9. RESEARCH TRENDS

9.1 Ethanol Based Fuels From Brassica Carinata:

One of the main difficulties faced by humanity in the 21st century is to meet the improving demand for services for power requirements by means of a more maintainable power supply. In countries that are net non-renewable power importers, anticipations about the benefit of using alternate energy resources on reducing oil imports is the primary power behind initiatives to advertise its manufacturing and use. The country of Spain is limited in household types of and more than 50% of the power used is non-renewable power centered. The promotion of substitute initiatives use is one of the major vectors in the Spanish power policy. Selected herbaceous plants such as Brassica carinata are currently under study as prospective types of bio-fuel resource. The ecological performance of two ethanol-based power applications in a traveler car as well as their comparison with traditional fuel as transportation power. E85 seems to be the best substitute when ethanol manufacturing centered efficient device is regarded with regards to greenhouse gas (GHG) pollutants and E10 with regards to non-renewable power resources use. Nevertheless, E85 offers the best environmental performance when traveling distance. In both efficient device viewpoints, the use of ethanol-based energy resources decreases the climatic change and power resources consumption. However, the initiatives to other impact signs were lower for traditional fuel [8].

9.2 Hydrogen Production From Bio-Ethanol:

Research has been carried out to produce hydrogen from bio-ethanol for a fuel cell stack. In the experiment, the primary features of the extensive pseudo powerful design execution of a Bio-ethanol processor Program along with an Energy Mobile Collection, was provided. This procedure needs to be extremely incorporated to acquire excellent effectiveness and highest possible warm restoration. Several scientists are working on subjects such as factors, kinetics, walls for the PEM, etc. which still signify start paradigms. Hence, the design is developed enough versatile to evaluate other possible kinetics, measurement, etc. In addition, the computational execution required to effectively link two professional software programs such as MATLAB and HYSYS book-keeping their potentiality to imitate this complicated procedure. The simulator outcomes for both, start and shut cycle actions, seem to indicate excellent activities. The structure and warm range details for the ESR, the most important reactor of the procedure and the warm range powerful actions show a qualitative excellent result. As upcoming operations are regarded the use of this pseudo powerful design is expected to be completely powerful [9].

9.3 Biomass Derived Feedstock Co-Processing With Vacuum Gas Oil:

An assortment of 80 wt.% VGO with 20 wt.% hydro deoxygenated pyrolysis-oil was prepared in a fixed-bed reactor replicating FCC circumstances and as opposed to handling of genuine VGO. During co-processing under FCC circumstances most of the fresh air is eliminated by means of CO2 and H2O by means of decarboxylation and lack of fluids responses. Breaking of the combination generates greater dry gas outcomes, reduced LPG outcomes in while fuel and LCO outcomes in are much like those of the cracking of VGO. Gasoline outcomes in are identical for VGO/HDO-oil co-processing and for genuine VGO cracking. Over the equilibrated FCC switch ∼75% hydrocarbon transformation of the VGO/HDO-oil give identical outcomes to that of the genuine VGO cracking.. Moreover, the phenolic portion was not transformed absolutely [10].

9.4 Design Of Regional Production Networks For Second Generation Synthetic Bio-Fuel – A Case Study In Northern Germany:

There was a research study for incorporated location, potential and technological innovation planning for manufacturing of artificial bio-diesel, performed based on current data. Thereby, central and decentralized place ideas of different capabilities are considered. Unclear improvements for manufacturing of bio-diesel in the future are included within circumstances.

Beneficial technological innovation ideas are identified regarding different risk behaviour of decision creators [11]

9.5 Second Generation Integrated With First Generation Bioethanol Production:

Models of the incorporated first and second creation ethanol manufacturing procedure from sugarcane revealed that high hydrolysis outcomes in, that may be obtained using low shades running on the hydrolysis reactor, do not cause to the best outcomes with regards to overall ethanol production; because the lingo-cellulosic content used as feedstock in second creation is also used as energy, low shades running needs more vapor on the focus phase. This research verified the significance of analysing the whole procedure to be able to better comprehend it and to information further tests seeking the stability of second creation bio-ethanol manufacturing [12].

9.6 Optimisation Of Bio-Oil Extraction Process From Beauty Leaf Oil Seed:

Seeds handling, dehydrating and oil removal techniques a significant effect on oil results in and the achievements of Elegance Foliage as upcoming creation biodiesel feedstock. Drying the seed kernel to the best possible wetness material was discovered to be essential to the achievements of both mechanical and hexane removal. Substance removal using hexane as a solution was discovered to be very effective, however due to a restricted supply of hexane and the lack of a hexane restoration program, it was not possible to make use of the potency of the method. Therefore, a potential area for enhancement or a possible upcoming venture would be to examine streamlining/automating and up-scaling the kernel planning procedure [13].

9.7 Second-Generation Bio-Ethanol (Sgb) From Malaysian Palm Empty Fruit Bunch: Energy And Exergy Analyses:

Apart from bio-ethanol, bio-diesel is also one of the most important fluid bio-fuels applied in the transport industry. Bio-diesel, which includes methyl ester, has been commonly used as only power or as preservatives in raw oil diesel power (bio-diesel blend) so they can improve the fresh air material of such power sources. The response is achieved with the aid of acidity, primary or enzymatic aspects. Lately, hand oil has attracted an improving interest in its use as a feedstock for the development of hand methyl ester (PME) mainly due to the bountifulness of oil possession in exotic nations, particularly Malaysia and Philippines. Reduced price of hand oil comparative to other veggie sebum is one of the aspects that entice interest to turn oil of this type to PME. Therefore, the supply of bio-fuel is more appropriate should it be depending on recurring biomass and not power plants such as ligno-cellulosic biomass mentioned in this perform.. The power and exergy evaluation of PME started from oil hand farming through CPO removal and hand oil improving to transesterification procedure. Palm spend, fibers, kernel and glycerol are regarded as the by-products from the overall PME manufacturing procedure[14].

9.8 Hot Compressed Water Pretreatment Of Oil Palm Fronds To Enhance Glucoserecovery For Production Of Second Generation Bio-Ethanol:

In the research, the structure of raw OPF and HCW pretreated OPF are detailed in Platforms 3 and 4, respectively. BET place and regular skin pore dimension for raw and HCW pretreated OPF were 23.41 m2/g, 79.01 Å and 48.88 m2/g, 85.43 Å, respectively. According to the IUPAC category, the skin pore dimension in this OPF connected to the mesopore group. It is expected that the solubilization of hemicellulose and lignin is the primary reason for the increase in place. The sugar generate acquired varies from 61.87 to 94.68 wt.%. Trial mistake was identified from operates 15 to 20 at the center point of the design. A regression research was conducted to fit the response function and estimate the result of sugar generate with a simple formula.The experimental run provided an actual the best possible generate of 92.78 wt.%, in good contract with the value measured using the design. It is believed that the staying sugar was deteriorated into small elements [15].

9.9 Greenhouse Gas Mitigation Potential Of ASecond Generation Energy Production System From Short Rotation Poplar In Eastern Germany:

The second generation bio-electricity generated from poplar wood chips underGerman conditions was found to enable climate change mitigation MFB ¼ 0.294 kg CO2e MJ_1 in this specific case study. Mitigating greenhouse gas emissions via bioelectricity generation from wood chip gasification is a certain option, if happening under this specific site and management conditions. However, results are not to be transferred to other bio-energy systems but have to be assessed instead system by system, because contributions to uncertainty from other system processes may be completely different [16].

9.10 Triglyceride Zeoforming:

Zeoforming unhealthy organic oils containing triglycerides can be an exciting method to enhance the low heat variety qualities of the second creation bio-components acquired from sebum during the hydro-conversion procedure. Zeoforming is not a commonly known procedure and is hardly ever used in refineries; nevertheless, there are some set ups in European countries that use light paraffinic parts as a feedstock to acquire fuel elements. This procedure operates under relatively light circumstances hydrogen. The deactivation of the zeoforming switch may be paid for by gradually helping the procedure heat variety. Hydroraffinates acquired from the zeoforming of rapeseed oil, which are then used as the co-processing feedstock. Chromatographic research of these hydroraffinates shows that isomerisation of their unhealthy acidity stores happens,which impacts the qualities of the hydroraffinates. The substance dedication of these unidentified ingredients needs additional research, which may either validate or refuse the possible fragrant personality of the unidentified ingredients [17].

9.11 Second-Generation Biofuel (Sgb) In Southeast Asia Via Lignocellulosic Biorefinery:

Despite the complicated situation of first creation bio-fuel industry in South East Asia, SGB is still prevalent over FGB to date. Presented without doing a natural assessment, first creation bio-fuel has associated itself with incorrect placement which arises from over-optimistic prediction and policymakers' extreme assurance, thereby relying on the "white elephant" trend. From the authors' perspective, appropriating budget for SGB growth would put South east Japan on a practical position in the electricity industry. Despite the expensive investment in the initial phase, SGB is very likely to bring enormous benefits to the area. It can be designed as a growth program for non-urban places by splitting the plan down into different levels. These investment strategies will gradually form a network in non-urban or minor places, provide cross-border trading tracks, link cities and cities, as well as improve the residents' living requirements. As a more maintainable and efficient bio-fuel, SGB provides South east Japan not only financial profits, but also a better atmosphere and better power protection [18].

9.12 Bio-Ethanol Produced From Cassava Feedstock In Nigeria For Cooking Purposes:

Currently the first set of 3 biorefineries is under development in Edo State at Auchi, Ehor and Benin City. Meanwhile, agreements have been finalized with NCGA for continuous supply of cassava feedstock for the refineries. Thus far, execution of the venture is rather slowly. Only 3 out of the 10,000 models of mini-refineries are under development. Due to program modify, the Govt has partly moved concentrate from bioenergy, instead it is privatizing the power industry to avoid an upcoming power problems in Nigeria. Both the area placed and the produce of cassava has to increase to take care of the several growing companies demanding cassava feedstock. The present exercise of moving farming cannot guarantee excellent produce, hence maintainable farming that will maintain your ground vitamin should be used [19].

9.13 LCA Of Second Generation Bioethanol:

The system border of the bioethanol system is determined so that at least the agriculture series and the bioethanol production are engaged as a assistance to gate border, with extra bioethanol use in the situation of a assistance to severe border. The set of engaged procedures need to be described perfectly, so that there is a company base to effectively explain the bioethanol system for the different biomass feedstocks. All of these factors, in turn, will cause difference in the overall impact assessment results of the second development bioethanol. An important feature of the 2nd development bioethanol as compared to the 1st development is in the type of feedstock use. Lignocellulosic biomass represents plant biomass made up of cellulose, hemicellulose, and ligninBiomass remains are lignocellulosic biomass produced in the farmville farm, from post-harvest handling. Biomass spend is lignocellulosic biomass produced in the farmville farm, in post-harvest handling or other activities which have no financial value or efficient uses. The choice of allocation techniques has a strong impact on the overall LCA results. The choice to use such allocation techniques is inspired mainly by practical considera- tions and information accessibility. [20].

10. BIO-FUEL ECONOMY

Before tax, bio-fuels are currently considerably more costly than traditional energy sources. The informative memorandum to the initially suggested bio-fuels instruction declares that bio-diesel expenses roughly €0.50/l to produce, while changing 1 l of traditional Diesel energy needs 1.1 l of bio-diesel. Nutrient Diesel energy expenses (net of tax) some €0.20–0.25/l. These numbers recommend that genuine bio-diesel is on the order of 120–175% more costly.Currently, there are seven manufacturers of bio-diesel in the U. S. States. Pure bio-diesel (100%) offers for about $1.50 to $2.00 per quart before taxation. Fuel taxation will add roughly $0.50 per quart. A mix of 20% bio-diesel and 80% Diesel energy will price about 15¢ to 20¢ more per quart over the price of 100% Diesel energy.An evaluation of 12 financial practicality research reveals that the estimated expenses for bio-diesel from oil seeds or creature body fat have a variety US$0.30–0.69/l, such as food and glycerin attributes and the supposition of decreased financial commitment investment expenses by having the smashing and/or esterification service included onto an current feed or tallow service. With pre-tax Diesel energy costing US$0.18/l in the US and US$0.20–0.24/l in some. The common price of a simple, unheated biogas place, not such as the price of area, is between $50 and $75 per cubic gauge potential [4].

11. CONCLUSION

The world is facing major challenges regarding energy crisis and climate change. Second generation bio-fuels provide the solution for these problems. If more people start shifting towards biofuels, a country can reduce its dependance on fossil fuels. More jobs will be created with a growing biofuel industry, which will keep our economy secure. Bio-oil can be used instead of energy resources to produce power and/or substances. Bio-fuels are created from biomass through thermochemical procedures such as pyrolysis, gasification, liquefaction and supercritical fluid removal or biochemical procedures. Ethanol, bio-diesel and bio-gas are the most useful energy resources from farming resources. Ethanol requirement is predicted to more than dual in the next ten years. Most of the sources like manure, corn, switchgrass, soyabeans, waste from crops and plants are renewable and are not likely to run out any time soon, making the use of biofuels efficient in nature [4].

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