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Biodiesel: A Renewable energy for future

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Abstract - *With the enhancement of mankind, his curiosity giving birth to new discoveries, invention and technology playing a crucial role not only on human life but surrounding the entire environmental system. Every action has a consequence. These developments has indeed been the blessing but has also exploited the natural resources, damaged the natural environmental condition ,intoxicated the surrounding, by unbalancing the steady natural chemical cycles which altogether estimated, to culminate fatal and hence decades from now, life too might be seen endangered on this planet. Modern equipment's which might seem too essential for daily use has been obnoxious for the environment. Backdrops and loop holes depicts the entire timeline after industrial revolution but had become detrimental with the world wars that shock the major misbalance in the natural chemical balance system of the environment, besides its millions of other wastage. This imbalance has led scientists to find a solution and led to the discovery of alternative fuels and one among them is biogas. The present paper gives a review on the production of biogas and its impact on society.*

Key Words: Biodiesel, Diesel engine, transesterification, performance, emission

1. INTRODUCTION

"Prevention is better than cure" in the same way preventing global warming by using eco-friendly fuels. Awareness and use of alternative medium should replace the nonrenewable age old depleting energy sources[1]. A huge statistical difference could be scaled out from that period, use of automobile, devices that produce chlorofluorocarbon gases and other wastage has been a major part of every individual[2].

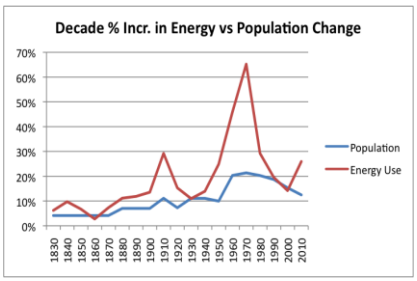

Chart-1 Energy vs population[3]

Nevertheless to count the positive impact, this has made life on earth too easy to dwell than ever before. Standing on 2016, heading towards a better future with more opportunities, safety and security has to be ensured on the other hand. Ascending through the time Pollution, Greenhouse gases, global warming, resulted into hazard for living organisms, endangered natural resources its depletion and hike price rise that imbalances the economy and increasing unavailability etc. are one of the greatest problem the world is facing today, an irreparable damage, that knowing or unknowingly the world is been undergoing ,away from the conscience of man .But it's after effect is inevitable[4]. Some resources naturally deplete without human interference, e.g.: radio-active elements such as uranium, naturally decay into heavy metals. Though metallic minerals can be re-used by recycling. Coal and petroleum cannot be recycled and once they are completely used they take millions of years to replenish.

2. NATURAL RESOURCES

The major ground, by amending the flaws, its proper utility might uplift the scenario to a vast extent: Due to the forces, gravitation, electrical and magnetic properties the primary resources, that exists naturally (without human actions) on earth[5].From sunlight, atmosphere, biosphere, hydrosphere, living nonliving all are included to it.

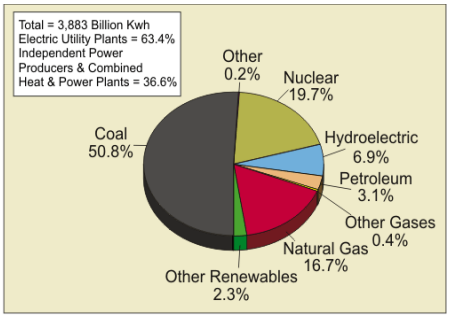

Chart-2 Power generation from different sources

3. CLASSIFICATION OF NATURAL RESOURCES

- **ON THE BASIS OF ORIGIN**

Biotic —living and organic material, Fossil fuels such as coal and petroleum (decayed organic matter).

Abiotic –Non-living, non-organic material, include land, fresh water, air and heavy metals including ores such as gold, iron, copper, silver, etc.

- **ON THE BASIS OF DEVELOPMENT STAGES**

Potential resources —may be used in the future after certain extraction. E.g.: Petroleum originating from sedimentary rocks.

Actual resources — depending upon the availability, quality and quantity[6]. E.g.: these factors affecting cost of wood.(if developed profitably in future-reserve resources)
Stock resources — lack of technology to utilize it. For example: hydrogen.

- **ON THE BASIS OF RENEWABILITY**

Renewable resources — continuous Availability, the rate of replenishment, recovery exceeds consumption, and replenish easily compared to Non-renewable.eg: sunlight, air, wind, water, etc.

Non-renewable resources –either form slowly, the rate of consumption exceeds the rate of replenishment/recovery; e.g.: minerals, fossil fuels (rate of formation is extremely slow takes millions of years), meaning they are considered non-renewable.

4. TYPES OF ENERGY

(A): Conventional Energy Sources: Energy in use, that cannot be compensated, exhaustible, once these are used (after their exploitation) are termed as conventional energy sources, installation of plants to get energy is highly expensive. E.g.: coal, petroleum.

(B): Non-conventional energy sources: In order to meet the energy demand of 21st century, researchers have developed renewable, alternate, nonconventional, natural Resources sources of energy, with the aim of pollution free, green earth.

5. INCONVINIENCE WITH CONVENTIONAL ENERGY RESOURCE

Chemical and bacterial decomposition of plant debris over 500 million years, buried under soil or clay, under specific temperature and pressure criteria to produce coal. Complex mixture of hydrocarbons, mostly alkanes and cycloalkanes. It occurs below the earth crust entrapped under rocky strata[7]. In its crude form, the viscous black liquid is known as petroleum and a gas in contact with petroleum layer which flows naturally from oil wells is termed as natural gases. If preventive steps are not taken, the existing petroleum will be available maximum up to 40 years. Due to rapid deforestation, for domestic rural utility the availability of fire wood or fuel wood becomes difficult. For nuclear energy, reactors are costly and high maintenance required[8]. There are around only 300 nuclear reactors all over the world while India has only four nuclear power stations.

6. DEVELOPMENT WITH NON CONVENTIONAL SOURCES

The most available cheap methods like solar energy, a primary energy source, non-polluting, inexhaustible by harness. Wind energy has tremendous amount of energy, converted into mechanical or electrical energy using suitable devices, e.g.: water pumps, grinding of corns etc. With the tides of the Ocean can be converted in to electrical energy[9]. Geothermal energy (heat energy obtainable from earth crust) used in power generation and refrigeration by harness.

Organic matters originated from living organisms (plants and animals) e.g.: cattle dung, agricultural wastes etc. are called as biomass, burnt to produce heat energy and, biomass energy ,electricity is produced[10].A good source of non-polluting fuel. Others like: Biogas, petro plants, Dendrothermal energy (Energy plantation), Bagasse-based plants, Energy from urban waste. fossil fuels itself are depleting at a high rate, conventional mediums are exhausting due to over use, huge population, that also negatively affect the ecosystem , environment, pollution and as the principle of supply and demand with decreasing supply ,price would rise[11]. This crisis would lead to increased alternative, renewable energy supplies as previously uneconomic sources become sufficiently economical to exploit

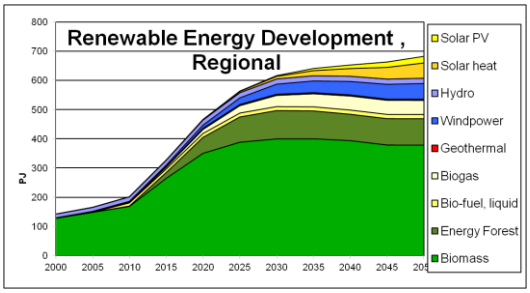

Chart-3 Renewable energy development

7. MODERN ALTERNATIVES AS IN RESCUE TO THE PROBLEM

Different alternative sources might be used to serve the demand like nuclear geothermal, etc. Artificial gasolines and other renewable energy sources currently require production and processing technologies to become economically viable BIOGAS, BIODIESEL, HYDROGEN GAS etc[12]. One of the most promising energy alternatives: by using inedible feed stocks and biomass for carbon dioxide capture as well as biofuels[13]. While these processes they are currently in practice around the world. Biodiesels are

being produced by several companies and source of great research at several universities. And could be used in ignition compression engine with no alteration to the engine. only proper blend and processing required. The most common and promising processes of conversion of renewable lipids in to usable fuels is through hydro treating and decarboxylation [14].

8. BIODIESEL

In the past decade, instead of diesel, biodiesel has been studied for the use as it is renewable, sustainable, alternative for Ignition Compression Engines. An alternative fuel similar to conventional or 'fossil' diesel are used to meet the demands[4].

EXTRACTION OF OIL: from edible and inedible seeds, vegetable oil, animal fat, tallow ,waste cooking oil etc by extracting the oil[7].

EDIBLE OIL: that could be consumed by human. E.g.: sunflower, soy

NONEDIBLE OIL: due to certain factors, these oils aren't healthy for human life.eg:

In developing countries the demand of food is high hence edible source are avoided instead non edible seeds like Mahua could be used. Used oils if used would help in balance the economical arenas

9. PRODUCTION BY TRANSESTERIFICATION

1. Base catalysis
2. Direct Acid Catalysis
3. Oil to fatty acid, to biodiesel

Glyceride+ alcohol+ catalyst->ester and glycerol.

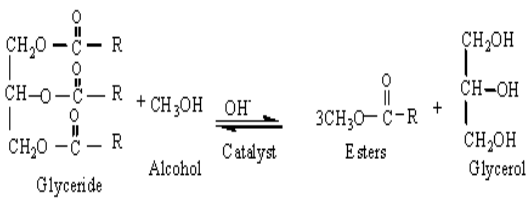

Chart-4 Transesterification reaction

Engine combustion benefits of the trans-esterification of the oil are:Lowered viscosity, complete removal of the glycerides, Lowering boiling point, Lowered flash point, Lowered pour point.

10. PRODUCT QUALITY

Prior to use as a commercial fuel, the finished biodiesel must be analyzed using sophisticated analytical equipment to ensure it meets any required specifications[4]. The most important aspects of biodiesel production to ensure trouble free operation in diesel engines are: Complete Reaction, Removal of Glycerin, Removal of catalyst, Removal of Alcohol, Absence of Free Fatty Acids[6].

11. ADVANTAGES AND DISADVANTAGES:

11.1 EFFECT ON ENVIRONMENT:

- **CARBON NEUTRAL:** this is the most important environmental impact, that it doesn`t give any output in carbon (carbon dioxide).As the plant feedstock used in the production absorbs carbon dioxide from the atmosphere when it grows. Plants absorb carbon dioxide through a process known as photosynthesis which allows it to store energy from sunlight in the form of sugars and starches[4]. After the biomass is converted into biodiesel and burned as fuel the energy and carbon is released[7]. Some of that energy can be used to power an engine while the carbon dioxide is released back into the atmosphere that was absorbed[6].

- **BIODEGRADATION:** Biodiesel is rapidly biodegradable; it degrades twice than that of petroleum on soil. Biodiesel blend increased the rate of degradation, by co metabolism[4].

- **TOXICITY:** Completely non-toxic, represent far less of a risk than fossil diesel spillages. Biodiesel has a higher flash point than fossil diesel and so is safer in the event of a crash[7].

- **REDUCTION IN CARBONYL PRODUCTION:** Substantially reduction in regular gas emission, particularly focusing on the pollutants containing Hydrocarbon. Though there has been a lack of information regarding the non-regulated compounds which also play a role in air pollution. Emissions of non-criteria carbonyl compounds during the burning of pure diesel and biodiesel blends in heavy-duty diesel engines [6]. Carbonyl emissions of formaldehyde, acetaldehyde, acrolein, acetone, propionaldehyde and butyraldehyde, noted to be higher in biodiesel mixtures than emissions from pure diesel. Biodiesel use results in higher carbonyl emissions but lower total hydrocarbon emissions, which may be better as an alternative fuel source [7].

- **CLEANER AIR:** gasoline and diesel doesn't burn more cleaner than biodiesel [4]. Emission of carbon monoxide, particulate and toxic chemicals such as (smog, etc.) are far less. Thus reducing thousands of premature death, heart attack, lung infections, aggravate respiration.

- **LESS GLOBAL WARMING:** Bio-diesel contain carbon that was taken out of the atmosphere by plants and trees ,as they consumes and grew[6]. The Fossil fuels are adding huge amounts of stored carbon dioxide (CO2) to the atmosphere, where it traps the Earth's heat Scientific Studies show that bio-diesel reduces CO2 emissions to a considerable extent and in some cases all most nearly to zero.

11.2 EFFECT ON ECONOMY

- **AFFORDABILITY:** As the supply decrease and price rises ,in such circumference it is inevitable to use alternatives, such as Biodiesel for the ICEngines as the doesn't need any alteration on the machinery part, and for best output ,only criteria is the proper blend. And is affordable for common citizens[4]. And the same automobiles could be run with blend diesel like what it used to be with biodiesel.

- **ENERGY INDEPENDANCE:** oil priced has had a disproportionate impact on the poorest countries, energy independence one day through the development of bio-diesel has become one now on a near daily basis, a bio-fuels programme is being launched somewhere in the developing world [6].

- **REDUCE HUGE EXPORT INVESTMENTAND BETTER INVESTMENT ON DOMESTIC NEEDS :** Rather than importing other countries' ancient natural resources, we could be using our own living resources to power our development and enhance our economies. Instead of looking to the Mid-east for oil, the world could look to the tropics for bio-diesel. Countries will have an economical boost, more involvement in agriculture, more employment and revival of economy [4]. Producing more bio-diesel will save foreign exchange and reduce energy expenditures and allow developing countries to put more of their resources into health, education and other serving their neediest citizens[7].

- **GROWTH OF ECONOMY BY INCREASING OCCUPANCY AND PRODUCTION:** Bio-diesel creates new market for agricultural products and stimulates development, it might change the adversity and poverty, of rural area, as bio-diesel could be produced out of crops[6]. Enormous potential manpower of farmers could save the planashing resources. In near future, especially for the two-thirds of the people in the developing world who derive their incomes from agriculture. Global market would be open for poor farmers, especially with the playing field tilted against them through trade distorting agricultural subsidies[7]. Farmers harvest well during cultivation seasons, and in a bad year farmers, starve for food and money, this would change this condition. At the community level, farmers that produce dedicated energy crops can grow their incomes and grow their own supply of affordable and reliable energy. At the national level, producing more bio-fuels will generate new industries, new Technocrats, new jobs and new markets[4].

12. DISADVANTAGES OF BIODIESEL

Quality variation of biodiesel, due to differ variety of crops, impacting on power production. Unfavorable for using at low temperature, it's better to use it with winterized diesel fuel. Food Shortage: negligence in cultivation of other crops may cause food crisis for e.g.: the production of biodiesel from corn may raise its demand and it might become more expensive which may deprive poor people from having it. Increased use of Fertilizers: Excess use of fertilizer may cause soil erosion, land pollution. Clogging in Engine: the engine dirt gets cleaned by biodiesel [4]. Sometimes it might get clogged. Some soils are not suitable for oil producing crops, increases the cost of emission of production and transportation. Water Shortage are needed .Monoculture may affect, as nutrients aren't put back to soil resulting to soil erosion. Fuel Distribution infrastructure should be developed. Nitrogen Oxide Emissions: about 10% higher Nitrogen Oxide (NO_X) production than other petroleum products, which is one the gas that is used in the formation of smog and Ozone, mixing with atmospheric moisture causes acid rain [7].

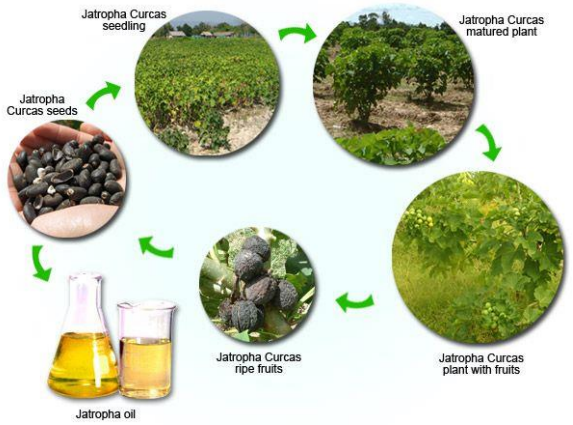

Chart-5 Cycle of biodiesel production

CONCLUSION

Biodiesel favors to reduce carbon deposits, higher oxygen content, and lower aromatic content, less emission. Higher oxygen content ,resulting in NOx formation, at Biodiesel with small content by volume of Diesel in order to help Air Pollution, and easing pressure on Scarce Resources to a great extent, without Power loss or economy loss. Biodiesel is a renewable energy source that is looked forward. Unlike other nonrenewable diesel, petrol products that will vanish in years to come. Since it is made from animal and vegetable fat, it can be produced according to the demand, also causing

less pollution than petroleum diesel. Plus it can be Used in existing Diesel Engines with little or no modifications, which makes a huge profit count. This is one of the main advantages, to become the most preferred primary transport energy source that would replace the conventional methods.

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