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POLLUTION CONTROL TECHNIQUES IN AUTOMOBILES
BIOFUELS – THE FUEL OF THE FUTURE
ADVANCED TECHNOLOGY AND ALTERNATIVE FUEL TO CONTROL POLLUTION

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ABSTRACT

The world is presently confronted with the twin crises of fossil fuel depletion and environmental degradation. Nearly 3000 different compounds, mostly organic, resulting from human activity have been identified in the atmosphere. This complex mixture of pollutants can have impacts on health and the environment. Therefore search for alternative fuels, which promise a harmonious correlation with sustainable development, energy conservation, efficiency and environmental preservation, has become highly pronounced in the present context. The fuels of bio-origin can provide a feasible solution to this worldwide petroleum crisis and global environmental degradation effects such as greenhouse effect, acid rain, ozone depletion, pollution, global warming and climate change. Transport is one of the main energy consuming sectors. The search for alternative fuels to reduce dependence on petroleum and emission of pollutants into the atmosphere has stimulated many scientific studies. The goal is to develop fuels that can be used in existing vehicles without the need for major changes in their engines. A term often used for fuel derived from renewable sources is 'biofuel', which has strong links with the concept of sustainability, whereby the use of natural resources to meet current needs should not compromise the needs of future generations.

Keywords- Agricultural wastes, Biofuel, Environmental sustainability, Pollution,

I. INTRODUCTION

In the twentieth century major research emphasis was given for the development of petroleum, coal, and natural gas based refinery to exploit the cheaply available fossil feed stock. These feedstock are used in industry to produce multiple products such as fuel, fine chemicals, pharmaceuticals, detergents, synthetic fiber, plastics, pesticides, fertilizers, lubricants, solvent, waxes, coke, asphalt, etc. to meet the growing demand of the population. Currently, the fossil resources are not regarded as sustainable and questionable from the economic, ecology and environmental point of views. The burning of fossil fuels is a big contributor to increasing the level of CO_2 in the atmosphere which is directly associated with global warming observed in recent decades. The adverse effects of greenhouse gas (GHG) emissions on the environment, together with declining petroleum reserves, have been realized. Therefore, the quest for sustainable and environmentally benevolent sources of energy for our industrial economies and consumer societies has become urgent in recent years. Consequently, there is renewed interest in the production and use of fuels from plants or organic waste. The biofuels produced from the renewable resources could help to minimize the fossil fuel burning and CO_2 production. Biofuels produced from biomass such as plants or organic waste could help to reduce both the world's dependence on oil and CO_2 production. These biofuels have the potential to cut CO_2 emission because the plants they are made from use CO_2 as they grow. Biofuels and bioproducts produced from plant biomass would mitigate global warming. This may due to the CO_2 released in burning equals the CO_2 tied up by the plant during photosynthesis and thus does not increase the net CO_2 in the atmosphere. Additionally, biofuel production along with bioproducts can provide new income and employment opportunities in rural areas. 21st Century is looking for a shift to alternate industrial feedstock and green processes to produce these chemicals from renewable biomass resources.

II. BIOFUEL

The term biofuel is referred to as solid, liquid or gaseous fuels that are predominantly produced from biorenewable or combustible renewable feedstocks. Liquid biofuels are important for the future because they replace petroleum fuels. Biofuels are generally considered as offering many priorities, including sustainability, reduction of greenhouse gas emissions, regional developments, social structure and agriculture, security of supply. The biggest difference between biofuels and petroleum feedstocks is oxygen content. Biofuels are non polluting, locally available, accessible, sustainable and are a reliable fuel obtained from renewable sources. Electricity generation from biofuel has been found to be a promising method in near future.

III. RAW MATERIALS

3.1 Crop Residues

Crops such as corn, wheat, and rice consist not just of the grains we eat or feed to livestock but also of stalks, husks, cobs, and other biomass unsuitable as direct human food. These residues generally account for about half of the total biomass in grown crops. Historically, these materials have been used for animal bedding, burned, or left on fields. However, recent scientific advances now allow producers to turn agricultural residues into biomass-based fuels or to use them to generate electricity. And because they are a by-product of today's primary crops, such residues can be used to produce energy without expanding the amount of land agriculture.

3.2 Wastse from Livestsock

Livestock raised in very large confined animal feeding operations (CAFOs) produce nearly unmanageable concentrations of manure, which can be used for bioenergy, but also regularly pollute water supplies in many parts of the country. Fortunately, on the smaller end of the livestock production scale, farmers can use anaerobic digesters to convert manure into biogas while reaping economic and environmental benefits.

Fig.1. Raw materials

IV. INFORMATION ON DIFFERENT BIOFUEL TYPES

4.1 First-generation biofuels

The production of first-generation biofuels is characterised by mature and well-established technologies.

Biodiesel

Biodiesel is mainly made from rapeseed (in the EU), soya bean and palm oil through transesterification FAME (fatty acid methyl ester) biodiesel, the most common biofuel in the EU, is usually derived from vegetable oils and animal fats by a chemical process known as transesterification17. The process involves filtering the feedstock to remove water and contaminants, and then mixing it with an alcohol (usually methanol) and a catalyst. This causes the oil molecules (triglycerides) to break apart and reform into methyl esters (biodiesel) and glycerol, which are then separated from each other and purified. The process also produces glycerine, which can be used as animal feed and chemical feedstocks, and also has many other small-scale uses. The feedstock can be vegetable oil, such as that derived from oilseed crops (e.g. rapeseed, sunflower, soya bean, palm oil), used oil (e.g. frying oil) or animal fat. Methyl esters can either be blended with conventional diesel or used as pure biodiesel.

Blending of biodiesel with conventional fuels up to 7 % does not require engine modifications.

Bioethanol

Bioethanol is made by fermentation and distillation of cereals and sugar-based crops. Bioethanol is the most widely produced biofuel globally. The largest producers are the USA, Brazil, the EU, China and India. First-generation bioethanol production is a well-established technology, based on a fermentation process followed by distillation. Bioethanol is produced from a wide variety of feedstocks. In Brazil, sugar cane is the preferred feedstock owing to its very high sugar content and fuel yield. In North America, about 200 production plants produce about 53 billion litres of ethanol annually from starch crops such as maize. Most European ethanol is produced using sugar beet and grains, while in China and India the main feedstocks used are maize and sugar-cane molasses respectively. Less popular bioethanol feedstocks include cassava (South-East Asia and China), sweet sorghum (China), and sweet potato (China). The cultivation of alternative sugar crops such as sweet sorghum opens up new possibilities in Europe, especially in hotter and drier regions such as southern and eastern Europe. Sweet sorghum requires less water or nutrients and has a higher fermentable sugar content than sugar cane as well as a shorter growing period. By-products vary according to the bioethanol production method and the feedstock used. For example, ethanol from starchy crops produces useful livestock feed, typically in the form of dried distiller's grains with solubles (DDGS).

Bioethanol can be used in petrol (gasoline) engines at low blends such as E10 (also known in Brazil and the USA as 'gasohol') – a mix of up to 10 % bioethanol and at least 90 % petrol – with no or little engine modification for most cars (around 85 %) circulating in the EU (and all cars manufactured after 2010). It can be supplied in the same way as petrol through existing retail outlets.

Butanol

Butanol is an alcohol that can be used as a transport fuel. It is a higher member of the series of straight-chain alcohols, with each molecule of butanol ($C_4H_{10}O$) containing four carbon atoms rather than two as in ethanol. Butanol was traditionally produced by acetone-butanol-ethanol (ABE) fermentation (the anaerobic conversion of carbohydrates by strains of Clostridium into acetone, butanol and ethanol). Indeed, 85 % butanol/petrol blends can be used in unmodified petrol engines. Butanol can also be transported in existing petrol pipelines, and it produces more power than ethanol. Biobutanol can be produced from cereal crops, sugar cane, sugar beet, etc. It can also be produced from cellulosic raw materials.

Methanol

As the most basic alcohol, methanol is a desirable choice as a transportation fuel owing to its efficient combustion, ease of distribution and wide availability around the globe. Methanol is used in transportation in 3 main ways – directly as fuel or blended with petrol; converted into dimethyl ether (DME) to be used as a diesel replacement; or as a part of the biodiesel production process. Methanol is an ideal fuel for transportation, in large part because of its efficient combustion and low cost compared to all other fuels. When combusted, reformulated petrol produces a number of harmful and toxic by-products that are reduced or eliminated by replacement with methanol.

4.2 Second-generation biofuels

Second-generation biofuels are mainly obtained from woody crops and wastes/residues Second-generation biofuels are produced from lignocellulosic biomass or woody crops, agricultural and forest residues, wood wastes, the organic part of municipal solid wastes (MSW) and energy crops. If made from forest or crop residues, they do not have to be grown on pasture or arable land and do not, therefore, compete with food supplies. Advanced biofuels also have the potential for much higher levels of production, very low GHG emissions and reduced volatility in production costs.

Hydro treatment of used oils has been proposed as an alternative to fossil fuels in transport

In the past few years, the hydrotreatment of vegetable oils, animal fats or waste cooking oils has been proposed as an alternative process to transesterification (the conventional process to make biodiesel) for producing biofuels. Hydrotreatment of vegetable oils and animal fats is a way of producing biobased diesel fuels of high quality with a high degree of compatibility with existing fuel logistics, engines or exhaust after-treatment devices.

Used cooking oil (UCO) is available in large quantities and is becoming widely exploited

Recently, used cooking oil (UCO) has been gaining ground as a feedstock for second- generation biofuel production via the hydrotreatment process. In general, the hydrotreatment of used/waste oils and animal fats has been seen as important for low-cost biodiesel production from recycled feedstocks. Large quantities of UCO are available. The US Energy Information Administration estimates that globally approximately 378 million litres (100 million gallons) are generated each day.

Second-generation biofuel production remains very low

Policy support for advanced biofuels – from lignocellulosic feedstocks based on biomass, such as wood and agricultural residues – has stimulated the construction of the first commercial-scale advanced biofuel plants, notably in Europe and the US. Advanced biofuels offer some clear advantages over conventional biofuels derived from food crops. In 2012, US production of advanced biofuels from lignocellulosic feedstocks reached 2 million litres. It was anticipated that 36 million litres would be produced in 2013, driven partly by demand from the military.

4.3 Third-generation biofuels

Production of third-generation biofuels (mainly from algae) is still at the research and development stage.

The most accepted definition of third-generation biofuels is ‘fuels that are produced from algae-derived biomass’. This has a very distinctive growth yield compared with classical lignocellulosic biomass.

Algae-based fuels are likely to play an important role in third-generation biofuel production, as they are considered a sustainable feedstock for biofuels and bioproducts from biorefineries. Many types of algae could be used: some cultivated specifically for biofuel production and some that are wastes collected from polluted waters. Production of biofuels from algae usually relies on the lipid content of the microorganisms. Species such as Chlorella are therefore targeted because of their high lipid content (around 60 to 70 %) and their high productivity at 7.4 grams per litre per day (g/L/d) for Chlorella protothecoides. In addition, there are types of algae that contain high proportions of vegetable oil that could be used for biodiesel.

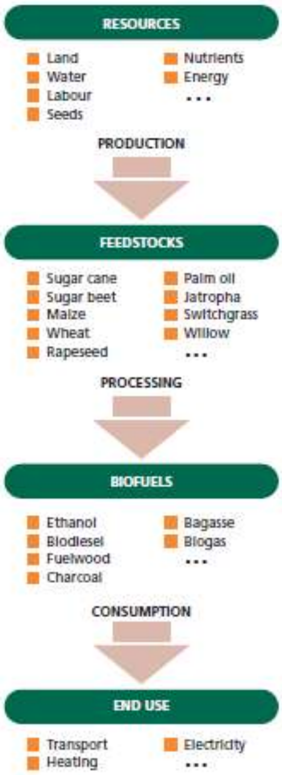

Fig.2. Biofuels–from feedstock to end use

V. BENEFITS OVERVIEW

Benefits of biodiesel production

Cleaner Environment: Biodiesel is proven to Reduce Dangerous Emissions, Which Contribute to Climate Change: Biodiesel is the only alternative fuel to voluntarily perform EPA Tier I and Tier II testing to quantify emission characteristics and health effects. That study found that B20 (20% biodiesel blended with 80% conventional diesel fuel) reduced total hydrocarbons by up to 30%, Carbon Monoxide up to 20%, and total particulate matter up to 15%. Research also documents the fact that the ozone forming potential of the hydrocarbon emissions of pure biodiesel is nearly 50% less than that of petroleum fuel. Pure biodiesel does not contain sulfur and therefore reduces sulfur dioxide exhaust from diesel engines to virtually zero. Biofuels, when blended with conventional fuels, reduce air pollutant emissions such as sulfur, particulates, carbon monoxide and hydrocarbons. Ethanol and biodiesel are also less of a hazard if they spill or leak, since they are rapidly biodegradeable in water.

Health Benefits: Biodiesel is Safer for People to Breathe: Research conducted in the US shows Biodiesel emissions have decreased levels of all target polycyclic aromatic hydrocarbons (PAH) and nitrited PAH compounds, as compared to petroleum diesel exhaust. PAH and nPAH compounds have been identified as potential cancer causing compounds. Targeted PAH compounds were reduced by 75 to 85 percent, with the exception of benzo(a)anthracene, which was reduced by roughly 50 percent. Target nPAH compounds were also reduced dramatically with biodiesel fuel, with 2-nitrofluorene and 1-nitropyrene reduced by 90 percent, and the rest of the nPAH compounds reduced to only trace levels. All of these reductions are due to the fact the

Biodiesel fuel contains no aromatic compounds.

National Security: Biodiesel Reduces our Dependence on Foreign Oil: Biodiesel can play a major role in expanding domestic refining capacity and reducing our reliance on foreign oil. The 500 million gallons of biodiesel produced in the U.S. in 2007 displaced 20 million barrels of petroleum, and increased production and use of biodiesel will further displace foreign oil. In addition, biodiesel is an extremely efficient fuel that creates 5.54 units of energy for every unit of fuel that is required to produce the fuel.

VI. CONCLUSIONS

Biofuels are promoted in many parts of the world and concern of environmental and social problems have grown due to increased production of this fuels. Production of biofuels promises substantial improvement in air quality through reducing emission from burning of the fuel used in vehicle engines. Some of the developing countries have started biofuel production and utilization as transport fuel in local market.

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