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PRODUCTION AND UTILIZATION OF BIOGAS IN DUAL MODE FUEL IN IC ENGINE FOR POWER GENERATION APPLICATIONS

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ABSTRACT

Electricity is credibly the most multipurpose form of energy and is important in economical growth of any developing country. Since decades increase in global dependence on fossil fuels has led to the release of CO_2 into the atmosphere. For around 70% of total emissions counting carbon dioxide, methane and some traces of nitrous oxide are mainly from fossil fuel combustion for heat supply, electricity generation and transport. To reduce the affect of GHG, alternative fuels are the best option to use for transportation and power generation applications. Today, the use of biomass-derived biogas is more promising fuel for rural electrical power generation and is addressing technique for controlling emissions levels. In this context, this paper mainly presents the status and perspectives of production and utilization of biogas as fuel in internal combustion engine for power generation applications. The purification & storage methods and combustion characteristics of biogas in diesel engines are also investigated in this paper

Keywords: Biogas, IC Engine, Power Generation, Renewable Eenergy.

I INTRODUCTION

Renewable energy will play a vital role in world's future. The percentage of world's total energy demand supplied by the renewable energy sources (RES) is 14% of total demand [1]. The renewable energy sources include biomass, hydropower, geothermal, solar, wind and marine energies. All these mentioned sources of energy are domestic and clean or inexhaustible energy resources. Among all these, biogas is particularly important because of its use in internal combustion engines, that are the main source of power for transport vehicles and also commonly used for generators of electrical energy. This biogas use is reasonably proven by biogas properties, which make it to be usefull for IC engines. ICEs are, in fact, the leading prime-mover technology applied in DG applications under 1000

kW generation capacity [2] Producing the renewable energy in decentralized mode is one of the ways to fulfil the rural and small scale energy needs in a reliable, affordable and environmentally sustainable way [3]. Increasing demand and reduced supply, unused potential, air pollution and environmental issues are the key drivers for renewable energy. One attribute of renewable and alternative sources of energy is that they are best suited for developing decentralized power plants to fulfil the energy needs of rural and remote areas. Biodiesels obtained from vegetable oils present an alternative to diesel oil since biodiesels have many advantages when compared to fossil fuels. Biofuels as a source of fuel are capable of reducing the consumption of fossil fuels and pollution caused by them; therefore to reduce the affect of GHG emissions and to fulfill the energy demands these can be the best alternative fuels [4]. Use of biofuels such as liquid fuels (vegetable oils and bioethanol) and gaseous fuel (biogas) in an internal combustion (IC) engine for various applications proves more promising. The fig 1 diagram shows carbon cycle of anaerobic co-digestion of animal and organic waste [5].

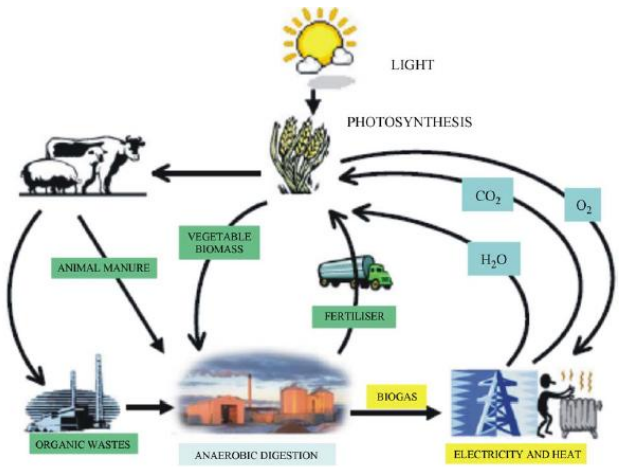

Fig 1 Schematic diagram of carbon cycle of anaerobic co-digestion of animal and organic waste[5].

II BIO-GAS AS ALTERNATE FUEL FOR ELECTRICITY GENERATION

The access to electricity in rural and particularly remote areas of developing countries, like India is difficult due to low population densities, low energy consumption levels per capita high fuel cost and poor road connectivity which constrains transportation. India is the largest cattle breeding country and produces raw material in bulk required for production of biogas.Bio-wastes and biomass can be used effectively by applying technologies like biomass gasifiers [6], biogas [7], liquid biofuels (ethanol etc.) [8], pellet fuel [9] and bio- power generation [10] to improve energy yields. In rural areas where energy generating resources are available in bulk in the form of biomass can be used for distributed energy generation. With the use of distributed energy generation the need of extending transmission lines to remotely populated centers can be avoided, dependence on conventional fuel sources can also be reduced. Biogas typically refers to a gas produced by anaerobic digestion of various organic matter in the absence of oxygen. Organic waste such as dead plant and animal material, animal dung, and kitchen waste can be converted

into a gaseous fuel called biogas. Biogas comprises primarily methane (CH_4) and carbon dioxide (CO_2) and may have minute amounts of hydrogen sulphide (H_2S) and moisture. The use of methane separated from biogas as a fuel will reduce harmful engine emission and will keep the environment clean. It is economical and slurry can be used as organic manure. The gases methane, hydrogen and carbon monoxide (CO) are used in combustion process and release of this energy allows biogas to be used as a fuel.

Methane: - 55to75%

Carbon dioxide: -24to44%

Nitrogen gas: - 5 to 6.5%

Hydrogen sulphide: -0.2to0.4%

III BIOGAS AS ALTERNATE FUEL FOR IC ENGINES

Use of renewable and alternative fuels for internal combustion (IC) engines is necessary due to uncertainties associated with the future availability of fossil fuel. The biogas collected is flammable and this provides several options for utilization like heating, cooking and for power generation. Internal combustion engines are attached to electrical generators which produce electricity for on farm use or sale to an electric company Biogas can be used as a fuel in any country for domestic cooking and heating, can now be used in a gas engine to convert the energy in the gas into electricity as shown in fig 2[11]. Power generation from biogas is quite possible in both duel fuel mode and 100 percent biogas run engine.

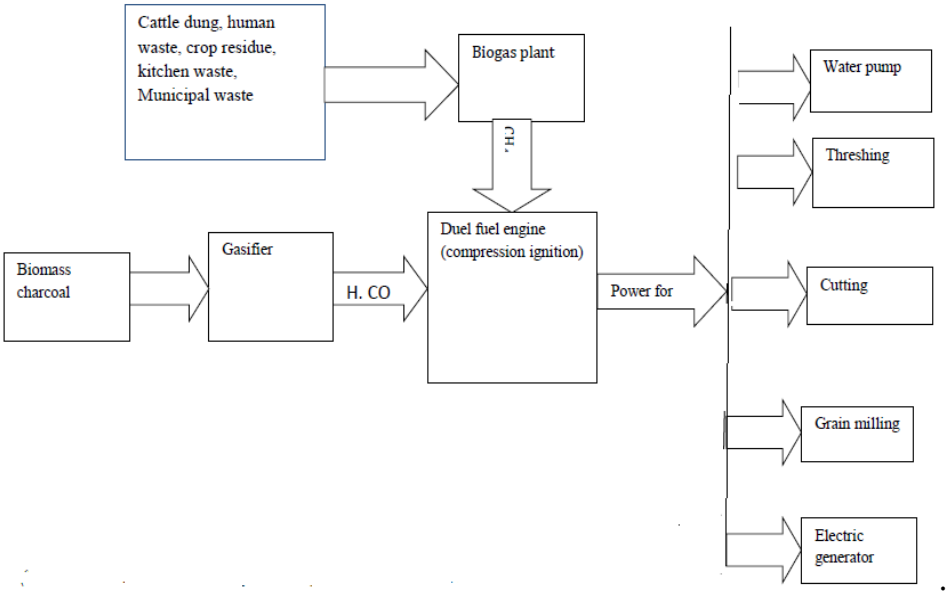

Fig 2 Dual fuel IC engine fuelled with different bio-fuels and their uses[11]

IC engines cannot run directly on biogas because of high self-ignition temperature of biogas. So minor modifications in IC engines will allow the use of gaseous biogas fuels efficiently and is technically more competent compared to fossil diesel. [12].In dual fuel engine gaseous fuel called the fuel is inducted with air into the engine cylinder. Due to high octane number gaseous fuel and air mixture are not auto ignite. So for supporting combustion a small amount of diesel, usually called pilot fuel is injected into the engine. The primary fuel in dual fuelling system is homogeneously mixed with air that is responsible for low level of smoke [13]. Dual fuel engine can use a wide variety of primary and pilot fuels usually of high cetane number. Biogas can also be used in dual fuel mode with vegetable oils or biodiesel as pilot fuels in diesel engines. Use of biogas normally leads to deterioration in performance and emission characteristics of duel fuel engine and can be increased with the addition of hydrogen and LPG and removal of CO_2 and H_2S from raw biogas [14].

IV BIODIESEL AS A FUEL IN IC ENGINES

The best way to use vegetable oil as fuel in IC engine is to convert it in to biodiesel. **Biodiesel** can be produced from straight vegetable oil, animal oil/fats, tallow and waste cooking oil. The process used to convert these oils to biodisel is called transesterification. Transesterification is the reaction of a fat or oil with an alcohol to form esters and glycerol. To improve the reaction rate and yield a catalyst is usually used. The alcohols that are used in the transesterification process are methanol, ethanol, propanol, butanol and amyl alcohol [15]. The most commonly used transesterification is Alkali-catalysed transesterification than acid-catalysed transesterification as t is much faster than the latter.The resulting biodiesel characteristics are quite similar to conventional diesel. It contains no petroleum products, but it is compatible with conventional diesel and can be blended in any proportion with mineral diesel to create a stable biodiesel blend. The level of blending with petroleum diesel is referred as Bxx, where xx indicates the amount of biodiesel in the blend (i.e. B10 blend is 10% biodiesel and 90% diesel. It can be used in CI engine with no major modification in the engine hardware [15].

V CONCLUSIONS

Electric energy is one of the driving forces in the nation's growth India should produce it adequately. To fulfill the power demands of growing population there is a need of sustainable energy sources in India .Biogas, a traditional energy generating technology seems promising satisfying the energy needs of both urban and rural population. Conditions available in India such as climate, biomass availability and hands on operation etc are encouraging for biogas generation and utilization . A number of commercial CHP plants have been well designed and developed around the world as alternatives to the use of fossil fuel for electrical power production. Thus there is an urgent need to utilize biogas technology and/or other renewable energy sources in combinations for Indian as well as global bright electric energy future.

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