Biogas: An Alternative Source of Energy

Vaishnavi S. Miskin
Dept of Civil Engineering
Bhivarabaisawant college of Engineering and research Narhe

Abstract- *Biogas is a modern form of bioenergy that can be produced through anaerobic digestion or fermentation of a variety of biomass sources. It can be use for cooking, for agricultural use, as a transport fuel, for electric power generation. Biogas systems turn the cost of waste management into a revenue opportunity for farms, dairies, and industries. Converting waste into electricity, heat, or vehicle fuel provides a renewable source of energy that can reduce dependence on foreign oil imports, reduce greenhouse gas emissions, improve environmental quality, and increase local jobs.The present paper gives an idea of the use of biogas.*

I. INTRODUCTION

Biogas is a sustainable, renewable and environment friendly source of energy that can be produced and consumed without degrading the environment. Utilization of biogas for thermal and engine applications and spent slurry as an organic fertilizer instead of chemical fertilizers contributes in reduction of greenhouse gas emission on both energy and agriculture sector [5].It has health, agricultural, economic and environmental benefit through reduced deforestation and greenhouse gas (GHG) emission which offers more carbon trading that increase the adaptive capacity against present global issue of climate change and its mitigation. Utilization of biomass-based energy resources through appropriate technological interventions has become very important for environmental conservation and sustainable development .

Biogas energy technology is considered as economically and technically feasible in among poor people of rural areas[31].

Biogas is a combustible mixture of gases (see Fig. 1). It consists mainly of methane (CH) and carbon dioxide (CO) and is formed from the anaerobic bacterial decomposition of organic compounds, i.e. without oxygen.. Methane and whatever additional hydrogen there may be – makes up the combustible part of biogas. Methane is a colourless and odourless gas with a boiling point of -162°C and it burns with a blue flame. Methane is also the main constituent (77- 90%) of natural gas. Chemically, methane belongs to the alkanes and is the simplest possible form of these. At normal temperature and pressure, methane has a density of approximately 0.75 kg/m.

The production and utilization of biogas from anaerobic digestion provides environmental and socioeconomic benefits for the society as a whole as well as for the involved farmers. Utilization of the internal value chain of biogas production enhances local economic capabilities, safeguards jobs in rural areas and increases regional purchasing power. It improves living standards and contributes to economic and social development. Municipal solid waste generation has become a global issue as it is adversely affecting the environment as well as public health all over Int.J.Curr.Microbiol.App.Sci (2018) 7(7): 2175-2186 2177 the world and it is more serious in developing countries because of rapid urbanization and population growth.

Biogas production and upgradation Biogas production process is an anaerobic process in which the substrate or organic waste is decomposed by micro-organisms in absence of air and biogas is produced which mainly consists of methane and carbon dioxide. The methane gas is combustible gas and used as fuel. The principle biogas production process is mainly a methane fermentation process and involves four major steps viz. Hydrolysis, Acidogenesis, Acidogenesis and Methanogenesis. The biogas produced through these steps is further upgraded for methane enrichment as it can be then used as commercial gaseous fuel in automobiles (Fig. 1). Hydrolysis In this very first step, long chains of the complex carbohydrates, proteins and lipids are broken into shorter ones as sugars, amino acids and fatty acids respectively. Hydrolysis is relatively slow step and it can limit the rate of overall anaerobic digestion process.

$C6H10O4+2H2O \rightarrow C6H12O6+H2$

Acidogenesis In this step, the products of hydrolysis used as substrate and further converted into higher organic acids such propionic acid butyric acid to acetic acid by acidogenic bacteria.

$C6H12O6 \rightarrow 2CH3CH2OH + 2CO2$ $C6H12O6 + 2H2 \leftrightarrow 2CH3CH2COOH + 2H2O$[4] $C6H12O6 \rightarrow 3CH3COOH$

Acetogenesis The acetogenic bacteria convert the higher organic acids into subsequent acetic acid and hydrogen gas.

$CH_3CH_2COO^- + 3H_2O \leftrightarrow CH_3COO^- + H^+ + HCO_3^- + 3H_2$ $C_6H_{12}O_6 + 2H_2O \leftrightarrow 2CH_3COOH + 2CO_2 + 4H_2$[4] Int.J. Curr. Microbiol. App. Sci (2018) 7(7): 2175-2186 2178 $CH_3CH_2OH + 2H_2O \leftrightarrow CH_3COO^- + 3H_2 + H$.

II. USE OF BIOGAS FOR DIFFERENT PURPOSES

a) TRANSPORT

Bio-CNG, an upgraded biogas has fuel quality close to that of natural gas as it is possible to use in vehicles that runs on natural gas fuel. Bio-CNG is a methane enriched gaseous fuel that is compressed and bottled at a pressure of 20-25MPa containing more than 97% methane. It is very similar to the regular CNG in terms of its fuel properties, engine performance, emissions and economy . The comparative performance study of constant speed IC engine using CNG and bioCNG showed similar results in terms of specific gas consumption, brake power output and thermal efficiency . Application of BioCNG for transportation can substantially reduce GHG in the range of 60-80% in comparison to gasoline.

b) ELECTRIC POWER

Recently there are various technologies are available to generate electricity from biogas on household and industrial level. In principle, the chemical energy of the methane gas is converted into mechanical energy in a controlled combustion system by heat engine. Basically, there are two types of generators are being used to generate electricity from biogas i.e. one is duel fuel mode and other runs on 100 % biogas. The duel fuel models are basically diesel generators in which biogas is supplied through air mix normally in 80:20 proportion where biogas acts as a primary fuel and diesel is the pilot fuel. While the 100% biogas generators run only on biogas and there is no need of any other fuel either for starting or for operation. But these generators require some modification for biogas operation and its cost is high with high maintenance as compared to duel fuel mode generators.

c) COOKING

In India, most of the household energy used for cooking only. It is estimated that domestic cooking in India uses approximately 1104TWh of energy. Biomass-firewood, crop residue or cow dung- is the prime source of energy for domestic cooking as the 87% of rural households and 26% of urban households depends on biomass for cooking, and on a life cycle basis, compared to conventional biomass fuels (dung cakes, fuelwood, crop wastes) as well as LPG. But it is only fractionally costlier than kerosene and LPG, however, they have severe supply constraints in the rural areas.

d) INDUSTRY

The installation of biogas plants at an industrial complex has increased and become an alternative option to solve the waste management problem. The biogas plant at factory site is an excellent avenue to dispose of waste in a cost-effective manner and simultaneously generate heat and/or electricity. Industries that are related to processing of agricultural and allied products have high potential for using anaerobic digestion include cattle and poultry industry, fruits & vegetables industry, pulp and paper, sugar, breweries, and leather etc.

e) AGRICULTURE AND FORESTRY

As compared to fresh manure, digested slurry from 1 kg of dung can yield up to extra 0.5 kg Nitrogen. Considering economic value of the bio-slurry as manure the investment in process can be gained back in three to four years. It is estimated that the use of bio slurry annually saves 39 kg of Nitrogen, 19 kg Phosphorus and 39 kg Potassium per household.Bio slurry use can solve problems of soil degradation in areas where dung has been used as a burning fuel and implies that less artificial fertilizer has to be bought which bring revenue to the household.

ADVANTAGES OF BIOGAS

- Renewable Energy Source
- Reduced Greenhouse Gas Emissions and Mitigation of Global Warming
- Reduced Dependency on Imported Fossil Fuels
- Contribution to EU Energy and Environmental Targets
- Waste Reduction
- Job Creation
- Flexible and Efficient End Use of Biogas
- Additional Income for the Farmers Involved

LIMITATIONS OF BIOGAS

- The Impact of Methane on the Climate
- Few Technological Advancements
- Contains Impurities
- Effect of Temperature on Biogas Production
- Less Suitable For Dense Metropolitan Areas

III. CONCLUSION

Biogas is a very helpful source of energy which will helpful as a alternate source of energy. It is a renewable energy which we will get from waste matter and very economical source of energy. In India this technique is not so far used by society but we have to focus on its use.

REFERANCES

[1] Peter Jacob Jørgensen, PlanEnergi and Researcher for a Day – Faculty of Agricultural Sciences, Aarhus University ( ), 2nd edition, Editor: Anna Busch Nielsen & Finn Bendixen, English translation: Margit Schacht,

[2] Al Seadi, T. (2001). Good practice in quality management of AD residues from biogas production. Report made for the International Energy Agency, Task 24- Energy from Biological Conversion of Organic Waste. Published by IEA Bioenergy and AEA Technology Environment, Oxford shire, United Kingdom.

[3] Godliving, Y; Mtui, S (2007).Trends in Industrial and Environmental Biotechnology Research in Tanzania, African Journal of Biotechnology Vol. 6 No. 25 pp. 8 - 8 .

[4] Jain, MK; Sigh, R; Taure, P(1981).Anaerobic Digestion of Cattle Waste, Agricultural Waste 3, pp. 65-73 .

[5] Nayak, S.K., Pattanaik, B.P.(2014). Experimental investigation on performance and emission characteristics of a diesel engine fuelled with mahua biodiesel using additive. Energy procedia. 54; - .