

Growing demand of energy and the exhausting of fossil fuel, the research and development of renewable energy has attracted more attention. Energy is an essential prerequisite for accelerated economic development and improved quality of life for citizens of any country. Due to rapid industrialization and urbanization in last few decades, there is a huge pressure on depletable crude oil, coal and other fossil fuels. This resulted into need for finding alternative sources of energy. Now-a-day, CNG (Compressed Natural Gas) vehicles are increasing day by day and government also focusing on it. Conventional CNG is also a limited source like fossil fuel so there is a need of an hour to switch on renewable fuel. Bio-CNG is emerging as promising fuel for future and it can be obtained from biomass. Biogas is one of the most important renewable sources of energy which may cope up to cater for the need of heating and power. Biogas is generated by the biological degradation of organic compound, has been considered as a valuable energy carrier, and it is now playing a key role in emerging market of renewable energy.

What is Biogas?

Biogas is a promising renewable fuel and produced by anaerobic digestion of biomass such as cattle dung, vegetable waste, municipal solid waste, poultry droppings, industrial waste water and landfill etc. Main products of the anaerobic digestion are biogas and slurry. Biogas comprises of 60-65% methane, 35-40% carbon dioxide, 0.5-1.0% hydrogen sulphide, rests of water vapours, etc. Biogas is non-toxic, colour less and flammable gas. It has an ignition temperature of 650 - 750 °C. Its density is 1.214 kg m⁻³ (assuming about 60% Methane and 40% CO₂). Its calorific value is 20 MJ m⁻³ (or 4700 kcal.). It is almost 20% lighter than air. Biogas, like Liquefied Petroleum Gas (LPG) cannot be converted into liquid state under normal temperature and pressure. It liquefies at a pressure of about 47.4 kg cm⁻² at a critical temperature

of - 82.1 °C. Removing carbon dioxide, hydrogen sulfide, moisture and compressing it into cylinders make it easily usable for transport applications & also for stationary applications. Already CNG technology has become easily available and therefore, bio-methane (purified biogas) which is nearly same as natural gas, can be used for all applications for which CNG is under used.

Bio-CNG

The application of biogas is not just confined to domestic use but with its purification, we can run CNG vehicles. The pure form of biogas is known as bio-CNG or bio-methane. Purification means removal of CO₂, water vapour, H₂S, etc. Bio-CNG or bio-methane contains about 92-98 % of methane and only 2-8 % carbon dioxide. The calorific value of Bio-CNG or bio-methane is about 13,000 kCal kg⁻¹, which is 2.7 times higher than that of raw biogas and calorific value of conventional CNG is 12500 kcal kg⁻¹. Property of the Bio-CNG or bio-methane is same as conventional CNG. It is an ideal fuel for automobiles and power generation. The low emission levels of Bio-CNG or bio-methane also make it a more environment-friendly than conventional CNG.

Conversion of Biogas to Bio-CNG

Being Non-combustible constituent of biogas, carbon dioxide does not contribute to the combustion; in fact it lowers the heating value of biogas and increases the compression and transportation costs. Biogas can be said Bio-CNG after the separation of carbon di oxide and hydrogen sulphide from it. The separation process is known as purification of biogas or scrubbing of biogas. Purification is the important phase in conversion process. There are various methods of purification of biogas, i.e., water scrubbing, adsorption (physical and chemical), cryogenic separation, membrane technology, biological upgrading, pressure swing absorption.



Fig 1: Biogas scrubbing system developed at ICAR-CIAE Bhopal

(Source: CRP on EA, Annual Progress Report 21-22)

Table 1: Comparison of Bio-CNG with Conventional CNG

	Bio-CNG	Conventional CNG
Source	Renewable	Non renewable
Calorific Value	13,000 kcal/kg	12500 kcal/kg
CO ₂ Emission	less	High
Cost	Rs. 45-50 /kg	Rs. 65-70 /kg

Bio-CNG plants in India:

Asia's largest Bio-CNG plant is Gowardhan bio-CNG plant which is situated in Indore (M.P.) and plant inaugurated by Prime Minister of India on 19th February 2022. Plant capacity is 550 tone bio-CNG per day and also produces 100 metric ton compost bio-fertilizers per day. Gas produced from plant is proposed to run 400 buses for public transport in Indore city.

Another example of bio-CNG plant is the Banas, Asia's largest milk processing cooperative located at Palanpur in the state of Gujrat, India. At this site, a 3500 cubic meter biogas reactor for the production of bio-CNG and organic manure has been installed. The gas produced from plant is delivered to bio-CNG filling station established on roadside to refill CNG vehicles. Everyday 100 CNG vehicles are being served by Banas bio-CNG plant. Waste product is used for bio-fertilizer at farmer's land. Everyday this unit produces about 8 tons of solid fertilizers and 70,000 liters of liquid fertilizer.

Fig 2: Banas Bio-CNG plant



(Source: <https://www.theblogtimes.com/post/cattle-dung-to-bio-cng-and-bio-fertilizer>)

Need to switch on Bio-CNG or Bio-methane:

There are many benefits of bio-CNG are as follows:

1. It's a renewable energy
2. It produces less carbon as compared to fossil fuel
3. Bio-CNG is mainly produced from MSW and agriculture waste.
4. It is non-polluting gas.
5. Approximately half the cost of gasoline and diesel - and less than other types of CNG fuel.
6. Bio-CNG has higher calorific value than conventional CNG.
7. Waste product, i.e., slurry can be good source of organic manure.

Summary

Considering properties, characteristics, waste utilization & environmental benefits of Bio-CNG from biogas, bio-CNG has evolved as future fuel. Bio-CNG offers excellent opportunity of farm waste management. In Indian scenario, where population of livestock's is 305 million in 2021, Bio-CNG has a great potential in transportation sector.

References

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