

Biogas Generation, Purification And Bottling Development In India – A case study

Introduction

Biomass resources such as cattle dung, agriculture wastes and other organic wastes have been one of the main energy sources for the mankind since the dawn of civilization. There is a vast scope to convert these energy sources into biogas. Biogas production is a clean low carbon technology for efficient management and conversion of fermentable organic wastes into clean cheap & versatile fuel and bio/organic manure. It has the potential for leveraging sustainable livelihood development as well as tackling local and global land, air and water pollution. Biogas obtained by anaerobic digestion of cattle dung and other loose & leafy organic matters/ biomass wastes can be used as an energy source for various applications namely, cooking, heating, space cooling/ refrigeration, electricity generation and gaseous fuel for vehicular application. Based on the availability of cattle dung alone from about 304 million cattle, there exists an estimated potential of about 18,240 million cubic meter of biogas generation annually.

India is implementing one of the World's largest programme in renewable energy. The country ranks second in biogas utilization. Biogas can be generated and supplied round the clock in contrast to solar and wind, which are intermittent in nature. Biogas plants provide three-in-one solution of gaseous fuel generation, organic manure production and wet biomass waste disposal/management.

Biogas is a product of bio-methanation process when fermentable organic materials such as cattle dung, kitchens waste, poultry droppings, night soil wastes, agricultural wastes etc. are subjected to anaerobic digestion in the presence of methanogenic bacteria. This process is better as the digested slurry from biogas plants is available for its utilization as bio/organic manure in agriculture, horticulture and pisciculture as a substitute/supplement to chemical fertilizers. In contrast, when biomass is subjected to combustion/gasification process, it ends up in the destruction of biomass and only ash is left after extraction of energy. Therefore, the bio-methanation process of converting biomass into gaseous fuel is superior and a sustainable process that needs to be preferred for such biomass materials that can be processed in biogas plants.

Biogas Composition and Properties

Biogas comprises of 60-65% methane, 35-40% carbon dioxide, 0.5-1.0% hydrogen sulphide, rests of water vapors etc. Biogas is non-toxic, color less and flammable gas. It has an ignition temperature of 650 - 750⁰C. Its density is 1.214kg/ m³ (assuming about 60% Methane and 40% CO₂). Its calorific value is 20 MJ/m³ (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/cm² at a critical temperature of -82.1⁰c. Removing carbon dioxide, Hydrogen Sulfide, moisture and compressing it into cylinders makes 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 CNG, can be used for all applications for which CNG are used. Purified biogas (bio-methane) has a high calorific value in comparison to raw biogas.

Technology Demonstration on Biogas Bottling under RDD&D

First time in the country during the year 2008-09, a new initiative was taken for technology demonstration on biogas bottling projects in entrepreneurial mode, for installation of medium size mixed feed biogas plants for generation, purification and bottling of biogas under RDD&D policy of MNRE after R&D. Installation of such plants aims at production of CNG quality of Compressed Biogas (CBG) to be used as vehicular fuel in addition to meeting stationary & motive power, electricity generation,

thermal application etc. needs in a decentralized manner through establishment of a sustainable business model in this sector. There is a huge potential for installation of such plants in various areas. Under the demonstration phase, the Ministry has sanctioned a central financial assistance for a limited number of such projects for implementation following an entrepreneurial mode in different states namely Chhattisgarh, Gujarat, Haryana, Karnataka, Maharashtra, Punjab, Madhya Pradesh, Andhra Pradesh and Rajasthan.

So far, 11 numbers of biogas bottling projects of various capacities and technologies have been commissioned in the country after obtaining required licenses for filling and storage of compressed biogas in CNG cylinders from Petroleum & Explosives Safety Organization (PESO), State Pollution Control Board (PCB) etc.

IIT, Delhi is assigned for technical monitoring & handholding of the consultants/promoters and preparation of documentation on different types of technology which may emerge out of these projects.

The details of commissioned biogas bottling projects are given below:

Sl. No.	State		Name of the project / organization	Capacity of the plant (m ³ /day)	Estimated production of CBG (kg/day)
i	Maharashtra	1.	Mr. N.C. Mujumdar Director Ashok Biogreen Pvt. Ltd., Vill. Talwade, Tahasil Trimbak, Dist.-Nasik Email: cmd@ncm.co.in	500	200
		2.	Dr. A. V. Mohan Rao Director M/s Spectrum Renewable Energy Pvt. Ltd., Vill. – Kodoli, Block –Panhala, Warana nagar, Dist.–Kolhapur Email. – info@srel.in	20000	8000
ii	Punjab	3.	Dr. Ashwini Kumar Watts Promoter Anand Energy, Vill.-Kalatibba, Teh.-Abohar, Dist.- Ferozepur Email: anandenergy@ymail.com	600	240
		4.	Shri Sachin Dhawan Partner SASK Energy, Vill.-Najabt Kukrian, P.O. Lubaniawali, Tehsil & Dist. – Muktsar Email: sachin.dhawan86@gmail.com	1000	400
		5.	Ms. Seema Garg Partner Sanjh Deep Gas Energy, Vill./P.O.-Mehma Sarja, Tehsil- Bhatinda, Dist. - Bhatinda Email: sanjhdeepgroup@gmail.com	5000	2000

iii	Karnataka	6.	Mr. T. Anand Director Maltose Agri Products Pvt. Ltd., Vill.- Huskur, Post -Aralumallige, Tal.- Doddaballapur, Dist.- Bangalore rural E-mail: a9880039666@gmail.com	1000	400
iv	Haryana	7.	Mrs. Jyoti Marya Partner Shashi Energies, Near Green Vally Public School, Ratiya Road Tohana, Tehsil.- Tohana, Dist.- Fatehabad Email: maryadeepak@gmail.com	600	240
		8.	Mr. Abhay Sinha, Managing Director Option Energy Pvt. Ltd, Shree Haryana Gaushala, Vill.&Block – Hansi, Dist. Hisar Email - abhaysinha12@hotmail.com	1000	400
		9.	Shri Raj Paul Midha Director 21 st Century Enviro Engineers (P) Ltd. Vill.- Begu, Block– Sirsa, Dist. – Sirsa Email: century_21@sify.com	4216	1686
		10.	Mr. Amit Kadian Partner Amit & Sumit Dairy Farm, Vill.- Jahajgarh, Tehsil-Beri, Dist.- Jhajjar Email: kadianmilkpoint@gmail.com	700	280
v	Rajasthan	11.	Shri Din Dayal Singla, Partner Singla Bio-Energy, Vill.-Siaghawali, Tehsil–Sadulsehar, Dist.–Sri Ganganagar Email - singlabioenergy@gmail.com	1000	400
Total				35616	14246

The purity of biogas is more than 90% Methane and this has being corroborated through tests conducted by National Accreditation Board for Testing and Calibration Laboratories (NABL) and compressed to 150 bar pressure for filling in cylinders. The purified biogas is equivalent /similar to CNG.

The purified biogas is filled in CNG cylinder and supplied to mid-day meal scheme, mess, Hotel, industries etc. for various purposes such as cooking & heating etc.. Calorific value of purified biogas is equivalent / similar to CNG. As a matter of fact, the biogas bottling plants are one of the most potent tools for mitigating climatic change by preventing black carbon emission from biomass chulha since biogas is used as a cooking fuel and methane emissions from untreated cattle dung and biomass wastes are also avoided. The purified biogas can be bottled in CNG cylinders and wherever CNG is currently used, biogas bottling can be used as an alternative.



Used in Mid-day meal scheme



Used in Manufacturing of plastic tanks



Used as vehicular fuel

The slurry which comes out of the biogas plant is directly or after drying used as bio/organic manure for improving soil-fertility and reducing use of chemical fertilizers. It is also non-pollutant because it is free from weed-seeds, foul smell and pathogens. The slurry is rich in main nutrients such as Nitrogen, Potassium and Sodium (NPK) alongwith micronutrients - Iron & Zinc etc. As such there is no pollution from biogas plant. The slurry/manure of biogas plant is being sold to the farmers and used in liquid/solid form by them in agricultural crops. The field trials have indicated the excellent growth in agro-production and substantial improvements in the quality.



Dry or Liquid Slurry used in Agricultural field

Payback Period

The Biogas bottling project of 1000m³/day capacity installed at Singla Bio-Energy, Vill.– Siaghawali, Teh.-Sadulsehar, Dist.–Sri Ganganagar (Rajasthan) with the investment of Rs. 1.95 crore by the promoters. The viability of the project is given below:

Sl. No.	Particulars	Amount (Rs. in lakh)
I	Expenses in one month	
1	Raw Materials	1.55
2	Electricity	0.12
3	Labour	0.64
4	Bank loan & interest	3.75
5	Miscellaneous	0.83
	Total	6.89
II	Income in one month	
1	Compressed Biogas	8.05
2	Organic Manure	1.75
	Total	9.80
III	Profit	
1	Monthly	2.91
2	Annually	34.92

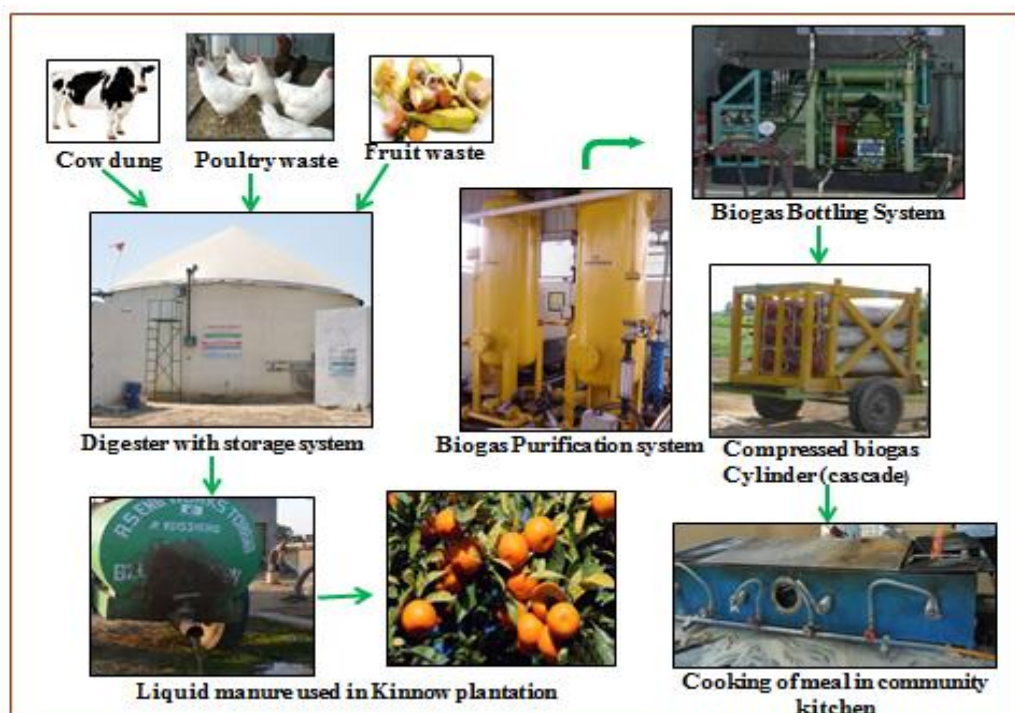
IV	Payback Period	
1	Without subsidy	5 to 6 years
2	With subsidy	3 to 4 years



Biogas bottling project at Singla Bio-Energy, Vill.–Siaghawali, Teh.-Sadulsehar, Dist.–Sri Ganganagar (Rajasthan)

This biogas bottling project will be able to replace fuel & manure worth of about Rs. 35 lakh annually. The full cost of the project would be recovered within four to six years. The separation and bottling of CO₂ and extraction of Humic acid from slurry would further improve viability of biogas bottling plants. The biogas bottling project provide three-in-one solution of gaseous fuel generation, bio /organic manure production and wet biomass waste disposal/management.

The schematic diagram of the Biogas bottling project 1000m³/day capacity installed at Singla Bio-Energy, Vill.–Siaghawali, Teh.-Sadulsehar, Dist.–Sri Ganganagar (Rajasthan) is given below:



Conclusion

As a matter of fact, the biogas-bottling plants are one of the most potent tools for mitigating climatic change by preventing black carbon emission from biomass chulha since biogas is used as a cooking fuel and methane emissions from untreated cattle dung and biomass wastes are also avoided. The purified biogas can be bottled in CNG cylinders and wherever CNG is currently used, compressed biogas (CBG) can be used as an alternative.

There is a vast potential for the production of biogas in the country. In addition to the energy production, biogas plants also provide bio-manure and are helpful in dealing with the problems of waste management, providing clean environment and mitigating pollution in urban, industrial and rural areas. Biogas is also a prominent alternative to petroleum fuel like LPG, CNG and diesel.
