

# Review on Feasibility analysis of Biogas plant in central India

Abhishek Kumar<sup>1</sup>, Dr. Rajeev Arya<sup>2</sup>, Prof Amit Khare<sup>3</sup>, Prof. Shamir Daniel<sup>4</sup>

1 M.Tech Scholar, Dept of Mechanical Engineering, Truba Institute of Engineering & Information Technology, Bhopal, India

2 Dr. Rajeev Arya, Dept of Mechanical Engineering, Truba Institute of Engineering & Information Technology, Bhopal, India

3 Prof Amit Khare, Dept of Mechanical Engineering, Truba Institute of Engineering & Information Technology, Bhopal, India

4 Prof. Shamir Daniel, Dept of Mechanical Engineering, Truba Institute of Engineering & Information Technology, Bhopal, India

**Abstract:** In the fast growing world energy and climate is the most important concern. The world is using its conventional energy tremendously which have huge environmental impact. Energy from hydrocarbons contributes 2/3rd of the total world requirements which is exhaustive in nature. India have more dependency on the imports of petroleum which causes a heavy burden of Bill's for country.

India have such a wide growing economy which increases energy demand. This can be fulfilled by using the renewable energy. We call renewable technologies clean and green because they produce few of any pollutants. The development in BigCNG taking shape in the energy market which reduce conventional sources.

BioCNG can be produced from various sources such as animal waste, sewage treatment, cities wastes etc. These have huge methane potential. This paper reviews the sustainable model for biogas plant also provides the detailed available technological analysis in Central India energy needs. It improves the environmental conditions of world and help in maintaining Earth's average temperature.

**Keyword:** BioCNG, Financial analysis, Technical analysis, Social, Organic Fertilizer, MNRE, NPV, Anaerobic Digester, Emission, Payback Period.

## INTRODUCTION

Energy is the lifeline of every society and country. It is the future wealth of any country. Due to scarcity of petroleum and coal it threatens supply of fuel throughout the planet also problem of their combustion results in research in several corners to urge access the new sources of energy, like renewable energy resources. Solar energy, wind energy, different thermal and hydro sources of energy, biogas are all renewable energy resources [3]. But, biogas is different from other renewable energies due to its characteristics of using,

controlling and collecting organic wastes and at an equivalent time producing fertilizer and water for use in agricultural irrigation. Biogas doesn't have any geographical limitation neither it requires advanced technology for producing energy, also it's very simple to use and apply [1].

In India, the economic growth is being dependent on the power sector, has required a huge growth in electricity demand over the last two decades. India has achieved tremendous success in developing its electricity system. The total power generation capacity in 1947, the year the country attained independence was only 1360 MW, and by 31st December 2019 it grew to 368788 MW, of which 23% (85908 MW) energy is generated by Renewable Energy Sources.[3]

## Biogas

BIOGAS is produced by microbes through the biodegradation of organic material under anaerobic conditions. Natural generation of biogas is an important part of bio-geochemical carbon cycle. It can be used both in rural and urban areas.

The philosophy of Biogas plant is based on the pronouncement that "Nothing should go waste" and that all organic waste products should be put to such a good use, so as to give you good returns in terms of Biogas and Organic manure.

## Characteristics

Composition of biogas depends upon feed material also. Biogas is about 20% lighter than air has an ignition temperature in range of 650 to 750 °C. An odorless & colourless gas that burns with blue flame similar to LPG gas. Its calorific value is 20 Mega Joules (MJ) /m<sup>3</sup> and it usually burns with 60 % efficiency in a conventional biogas stove.

This gas is useful as fuel to substitute firewood, cow-dung cake, petrol, LPG, diesel, & electricity, depending on the nature of the task, and local supply conditions and constraints.

Biogas digester systems provides a residue organic waste, after its anaerobic digestion(AD) that has superior nutrient qualities over normal organic fertilizer, as it is in the form of ammonia and can be used as manure. Anaerobic biogas digesters also function as waste disposal systems, particularly for human wastes, and can, therefore, prevent potential sources of environmental contamination and the spread of pathogens and disease causing bacteria. Biogas technology is particularly valuable in agricultural residual treatment of animal excreta.

## LITERATURE REVIEW

S J Malik et al. [35] has made a feasibility analysis of the BioCNG plant from 100 TPD press mud plant in which they made a proper conversion and techno commercial aspects of bio CNG. BioCNG is the purified form of biogas where all the unwanted gases are removed to produce (>96%) pure methane gas. Bio CNG is exactly similar as commercially available natural gas. This paper reviews the BioCNG from Press Mud.

The study by Ardolino et al. [30] conveyed the advantage of the practical application of biomethane as transport fuel, also highlighting the limited share of biogas upgrading to the gross environmental benefits of the anaerobic digestion process.

Ardolino and Arena [31] analysed the “biogas road” and the “syngas road” for biomethane production, which shows the high latency in order of energy efficiency and carbon utilisation of the syngas road.

Starr et al. [32] examined two innovative biogas upgrading technologies, namely alkaline absorption with regeneration (AwR) and bottom ash for biogas upgrading (BABIU), interpreting various process configurations and compared them with well-developed technologies. Environmental performances of BABIU technology appears to be far better than those of AwR and corresponding to those of commercial available technologies. Anyway, both of these innovative processes are still at pilot-plant scale, then need a further and positive scale-up before their commercialisation.

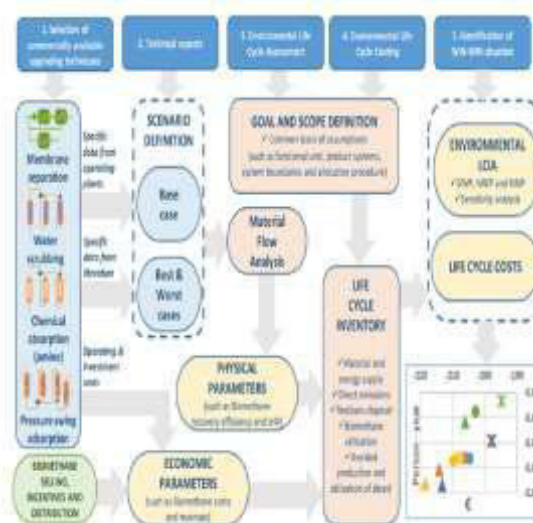
Leonzio [33] focused on chemical absorption with various solvents, searching out that even though mono-ethanolamine solution has the highest upgrading ratio, it still needs some technical and environmental betterment.

## Methodology

The survey of different previous works found that it is important to note that non-renewable resources are significantly depleted by human use, whereas renewable resources are produced by ongoing process that can sustain indefinite human exploitation. Therefore the dependency of the

renewable resources i.e. biogas is rapidly increasing worldwide because the domestic waste of the world population around 7.7 billion as of April 2019 is increase day by day which adversely affected the environment and global warming, so that biogas create the great opportunity for energy fulfillment and reduce the carbon dioxide and methane emission for preventing global warming.

Evaluate the potential of biogas technologies for treating Cow Dung. Evaluate the economic feasibility of plant according to the market requirement and expectations. Analyze the direct benefit that can be possible to be obtained from the biogas plant towards the locality.



Structure of paper

## WORKING OF PLANT

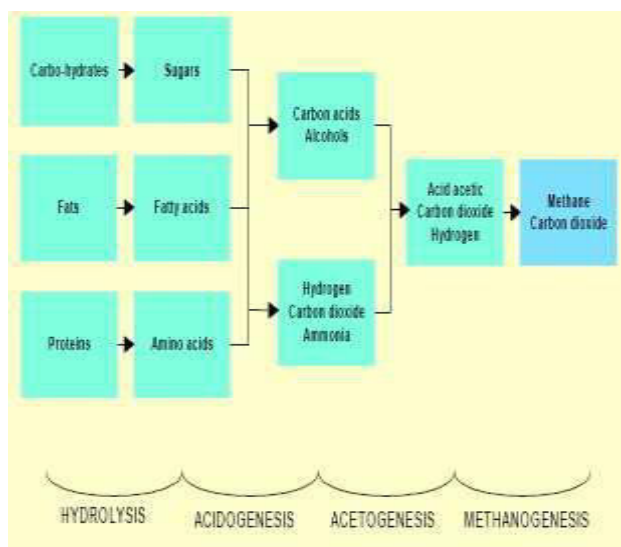
The MINISTRY OF NEW AND RENEWABLE ENERGY (Waste to Energy Division) Government of India has sanctioned Madhya Pradesh First Biogas Bottling Plant with the capacity of 3000m<sup>3</sup> per day Under the Program on Energy from Urban, Industrial and Agricultural Wastes/Residues at The M/S Shri Dayoday Urja Evam Jaivik Khaad Pvt. Ltd. At Vill – Dob Barkhedi Abdullah, Sukhi Sevania, Tehsil Huzur Dist: BHOPAL (M.P) 462010. The Plant is based on the German Technology in the biogas systems which will be

implemented and constructed under the Consultation of CIED. The CIED provided the technical and management consultation for the plant. They recently constructed the India’s biggest BioCNG Plant which is working in Gujarat Successfully. It has the capacity of 21000 cubic meter Per Day. The State Nodal agency of the Project is Madhya Pradesh Urja Vikas Nigam Ltd. which has undertaken the supervision of the plant for is operation. The Plant has a wider area coverage of 2 acres of land. The Plant has to run to produce the Biogas for the commercial supply to the nearby

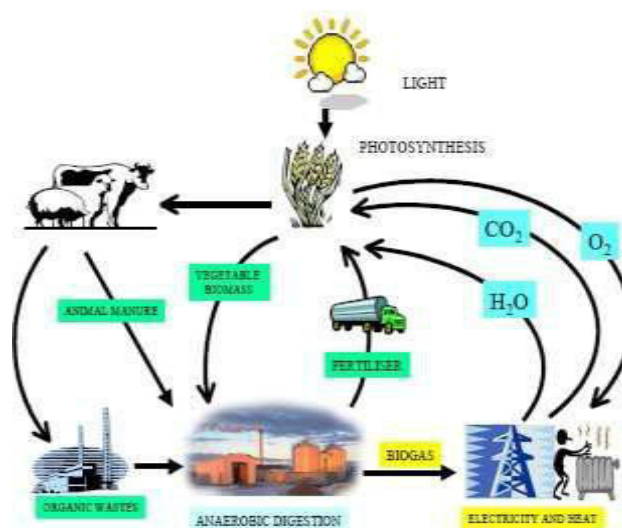
Industrial Area which will be able to use the gas for the heating purposes in the furnace in order to reduce pollution. The Gas produced by the Plant has a huge demand in the Govindpura Industrial Area of Bhopal for their proper working.

### Technology

Anaerobic Digestion can be a process of decomposition of organic matter in the absence of air. The products of the digester are gas and digestate. Digestate is the component which gets substrated in the process of taking biogas. In operation of AD, little or no heat is generated in divergence to aerobic decomposition (in presence of oxygen), like which is in the case of composting. The energy, which is chemically attached within the substrate, remains for the most part within the produced biogas, in sort of methane. The system of biogas formation may be a result of joined process steps, during which the initial material is regularly weakened into smaller units. Particular groups of micro-organisms are involved in each individual step. These organisms successively decompose the products of the previous steps.



**Figure 1 The main process steps of Anaerobic Digestion (AD)**



**Figure 2 The sustainable cycle of biogas from AD**

In the AD process, pressure is the mixing power which influences the gas recirculation especially for technologies lacking mixing systems. An increment in pressure during the AD process leads to high carbon dioxide concentrations in liquid phase. Carbon dioxide has a high solubility in comparison to methane. The solubility of carbon dioxide is approximately 40 times more than methane. For this reason, an increase of pressure can result in high concentration of CO<sub>2</sub> in the substrate stimulating the methane production. Additionally, an increase in the partial CO<sub>2</sub> pressure decreases the pH value lowering the non-ionized ammonia concentration. On the other hand, a decrease in the partial CO<sub>2</sub> partial pressure increases the pH level lowering the non-ionized hydrogen sulphide concentration.

### Temperature

The biomethanation process can occur at different temperature ranges: between 25-42°C known as the mesophilic range, between 43-55 °C thermophilic range and at temperature below 20°C psychrophilic range [20]. At mesophilic temperatures the anaerobic digestion process is more stable than at thermophilic and psychrophilic conditions due to at this temperature range the anaerobic bacteria are more tolerant to changes in the environment [29].

### pH

The acidity or alkalinity of solutions is measured by the pH. This parameter influences on the growth of methanogenic bacteria and thus on the methane production. The optimum pH value for the anaerobic digestion process is the range of 6.5-7.5. The pH is a determining parameter for AD because at low pH values the methane formation is inhibited. When the pH value is low, it can be regulated by the addition



of lime or sodium carbonate. However, this can represents additional costs for the AD process.

#### Pressure

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**Figure 3 PSA for Biogas Enrichment**



**Figure 4 Granules of Organic Fertilizer**

The technology which is more popular for the biogas enrichment is PSA (Pressure swing

adsorption). This is a typical system which consist of the vessels in series that is capable of removing CO<sub>2</sub>, H<sub>2</sub>S, water vapour from the biogas series. After passing through the vessel the gas has attained the presence of Biogas CH<sub>4</sub> upto 95%.

The amount of organic fertilizer produced is equivalent to the amount of digestate composted.

#### CONCLUSION

The technology selected for treating this amount of waste was the dome-shaped digester. This technology suits better the conditions of the area in comparison to the other available biogas technologies evaluated by analyzing the lifespan, the technical knowledge and skills, the structure and the investment costs benefits.

The model for the techno-economic analysis was defined based on the dome-shaped technology. The results from techno-economic analysis showed that implementation of a biogas plant in the central India is economically suitable for the present scenario. These results are calculated when organic fertilizer are commercially used for earning revenues.

Three scenarios (base, worst and best) for each of selected upgrading techniques (membrane separation, water scrubbing, chemical absorption with amine solvent, and pressure swing adsorption) have been assessed by means of the combined utilisation of an attributional environmental Life Cycle Assessment and a complementary environmental Life Cycle Costing.

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