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Review Paper on Energy Generation with Restaurant Waste

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Abstract

India is one of the fastest developing economies in the world. Two of the burning problems which have surfaced due to development include solid, liquid & organic waste management and energy crisis. Somewhere we are short of collecting waste and dumping them properly is also a burning issue. Now days in India an organic waste is a major issue it covers up to 40 % of total waste. The organic waste can be hazarders and led to environmental health issues. Besides it we are generating huge waste but fact is we don’t have much area for dumping. According to data from Bhopal Municipal Corporation (BMC), Bhopal is no exception to waste disposal problem with average waste generation of around 700 metric tons or above per day. Nearly half of the waste generated is biodegradable. Presently BMC disposes all the waste in landfill at Bhanpura. With increasing population, it poses a huge challenge as Bhanpura has almost reached its maximum capacity. This research is based over a central zone of Bhopal (MP Nagar), from MP Nagar Zone 1 area which generate 6800-7500kg waste per day which contain rich organic waste up to 70-80 % of it from various restaurants and stalls. This study aims to study the potential of the harnessing energy from biodegradable waste, mainly food waste and FVW, using bio methanization technique. It is limited to MP Nagar Zone1 area Bhopal on the basis of fixed dome biogas plant. To insure produced Renewable energy supply can providing environmental & economic sustainability benefits in the residential, food industry and manufacturing industry.

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I. Introduction

Restaurant waste is organic material having the high calorific value and nutritive value to microbes, that’s why efficiency of methane production can be increased by several orders of magnitude as said earlier. It means higher efficiency as well as size reduction of reactor and cost reduction of biogas production. Also in most of cities and places, restaurant waste is disposed in landfill or discarded which causes the public health hazards. Either we can dump them to landfill or can use the potential of wastes to energy, adopting waste to energy technique.

II. Objective

Objective for this research paper is to provide integrated energy solutions to MP Nagar Zone 1 area in an environmentally friendly and socially responsible manner with the available data from BMC ltd., Indian institute of agriculture science and research (IIASR) and Indian institute of forest science (IIFs). In other words, I shall strive hard to provide power in a way that is sustainable in the long term. I believe it is essential not only to make profits but also to care about people and protect the environment. We will lead by example through a commitment that empowers users (restaurant owners) ensuring the excellence at all levels of operations, performance, products and services. Simultaneously, actively contribute towards welfare of society and social uplift of the under privileged section of the community. Using bio methanization technique, harnessing energy from biodegradable waste and food waste, and using generated biogas as a fuel to generate electricity for MP Nagar Zone 1 area. Design overall plant for generated food waste to harness energy from it, and scope for replacing LPG with produced gas. This project will carry all possible scenario of waste to energy for MP Nagar Zone 1.

- ❖ Effective overall plant design for MP Nagar Zone 1 Area.

  - Plant design
  - Plant efficiency
  - Plant costing
  - Plant feasibility
  - Other scope of energy transformation

III. Literature review

ARTI – appropriate rural technology of India, Pune (2003) has developed a compact biogas plant which uses waste food rather than any cow dung as feedstock, to supply biogas for cooking. The plant is sufficiently compact to be used by urban households, and about 2000 are currently in use – both in urban and rural households in Maharashtra. The design and development of this simple, yet powerful technology for the people, has won ARTI the Ashden Award for sustainable Energy 2006 in the Food Security category.

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Component	Concentration (by volume)
Methane (CH_4)	55-60 %
Carbon dioxide (CO_2)	35-40 %
Water (H_2O)	2-7 %
Hydrogen sulphide (H_2S)	20-20,000 PPM (2%)
Ammonia (NH_3)	0-0.05 %
Nitrogen (N)	0-2 %
Oxygen (O_2)	0-2 %
Hydrogen (H)	0-1 %

Dr. Anand Karve (ARTI) developed a compact biogas system that uses starchy or sugary feedstock (waste grain flour, spoilt grain, overripe or misshapen fruit, non edible seeds, fruits and rhizomes, green leaves, kitchen waste, leftover food, etc). Just 2 kg of such feedstock produces about 500 g of methane, and the reaction is completed with 24 hours. The conventional biogas systems, using cattle dung, sewerage, etc. use about 40 kg feedstock to produce the same quantity of methane, and require about 40 days to complete the reaction. Thus, from the point of view of conversion of feedstock into methane, the system developed by Dr. Anand Karve is 20 times as efficient as the conventional system, and from the point of view of reaction time, it is 40 times as efficient. Thus, overall, the new system is 800 times as efficient as the conventional biogas system.

Shalini Singh [5] et al. (2000) studied the effect of microbial stimulant aquasan and teresan on biogas yield from cattle dung and combined residue of cattle dung and kitchen waste respectively. The result shows that dual addition of aquasan to cattle dung on day 1 and day 15 increased the gas production by 55% over unamended cattle dung and addition of teresan to cattel dung : kitchen waste (1:1) mixed residue 15% increased gas production.

Kumar et al.,[6] (2004) investigated the reactivity of methane. They gave the result that it has more than 20 times the global warming potential of carbon dioxide and that the concentration of it in the atmosphere is increasing with one to two per cent per year. The article continues by highlighting that about 3 to 19% of anthropogenic sources of methane originate from landfills. This gives the picture that how biodegradable waste are causing harm to the atmosphere.

What is BIOGAS

BIOGAS is produced by bacteria through the bio-degradation 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. Biogas is a clean and efficient fuel. It is a mixture of: – Methane (CH4) – Carbon dioxide (CO2) – Hydrogen (H2) – Hydrogen Sulphide (H2S). The chief constituent of biogas is methane (65%).

Table-1: Different Components of Bio Gas & their Concentration (by volume.)

Production of Biogas - The biogas plants, There are two types of biogas plants in usage for the production of biogas. These are:

- The fixed- dome type of biogas plant.
- The floating gas holder type of biogas plant.

Raw materials required

- Forms of biomass listed below may be used along with water.
    - Animal dung or Poultry wastes
    - Plant wastes (Husk, grass, weeds etc.)
    - Human excreta
    - Industrial wastes(Saw dust, wastes from food processing industries)
    - Domestic wastes (Vegetable peels, waste food materials)

Working of Fixed Dome type Biogas Plant

The various forms of biomass are mixed with an equal quantity of water in the mixing tank. This forms the slurry. The slurry is fed into the digester through the inlet chamber. When the digester is partially filled with the slurry, the introduction of slurry is stopped and the plant is left unused for about two months. During these two months, anaerobic bacteria present in the slurry decomposes or ferments the biomass in the presence of water. As a result of anaerobic fermentation, biogas is formed, which starts collecting in the dome of the digester.

Working of Floating Gas holder type Biogas Plant

Slurry (mixture of equal quantities of biomass and water) is prepared in the mixing tank. The prepared slurry is fed into the inlet chamber of the digester through the inlet pipe. The plant is left unused for about two months and introduction of more slurry is stopped. During this period, anaerobic fermentation of biomass takes place in the presence of water and produces biogas in the digester. Biogas being lighter rises up and starts collecting in the gas holder. The gas holder now starts moving up.

The gas holder cannot rise up beyond a certain level. As more and more gas starts collecting, more pressure begins to be exerted on the slurry. The spent slurry is now forced into the outlet chamber from the top of the inlet chamber. When the outlet chamber gets filled with the spent slurry, the excess is forced out through the outlet pipe into the overflow tank. This is later used as manure for plants. The gas valve of the gas outlet is opened to get a supply of biogas. Once the production of biogas begins, a continuous supply of gas can be ensured by regular removal of spent slurry and introduction of fresh slurry.

IV. Work plan

Construction of biogas plant & Site selection for biogas plant:

- To make plant operation easier and to avoid wastage of raw feedstock the plant must be as close as possible to the feedstock supply and water source.
- The edge of the foundation of the plant should be at least two meters away from any other structures to avoid risk of damage during construction

PARAMETERS	VALUES
Energy Content	6-6.5 kWh/m3
Fuel Equivalent	0.6-0.65 l oil/m3 biogas
Explosion Limits	6-12 % biogas in air
Ignition Temperature	650-750 °C
Critical Pressure	75-89 bar
Critical temperature	-82.5 °C
Normal Density	1.2 kg/m3
Smell	Rotten Eggs

Table-2: Different Parameters of Bio Gas & their Values which make it comparable with conventional fuels

Energy calculation of proposed biogas plant for 3-4 restaurants generated food waste

biogas/bio energy plant efficiency calculation.

Formula to calculate total gas production

For food waste max gas production /kg = 0.05 m3
Total gas =Total waste in kg x 0.05

Calculation for 4 restaurants each producing 10 kg waste and if we are successful to collect that all

Total will be 10x6=40

Total gas=0.05x60 =3 m3 if > 1m3 =19 Mega joules

So 2x19=57MJ

To convert it to KWh >> 57/3.6 =15.83 KWh

Conversion to electrical energy

Note: When we convert it to electrical energy 65% of energy lost as Heat & other mechanical losses as utilized by electrical generator**.**

So that,

15.83*35/100 = 5.54 kWh (is available as electrical energy from 40kg food waste.

Consumption

We can run

22watts of 10 Cfls + 3 fan of 80 watts

>>For 12 hours easily…on 5.54 kWh (el) energy

Calculation for cooking

Medium Stove uses 9 MJ of energy /hr

Waste from three restaurants is fuel for stove to run for more than 3 hours

Proof:

10x3=30kg dung

Total gas=0.05x30 =1.5 m3

So 1.5x19MJ= 28.5 MJ

To calculate total running hour of stove with gas we have 28.5/ 9= 3.16 hours

Limitations of biogas plant for a food waste

- ➢ The construction costs of biogas plants vary between different localities; they are often high relative to the income of the potential users.
- ➢ Initial cost of installation of the plant is high.
- ➢ Food wastes are dependent to the customer frequency at restaurants.

Benefits of Biogas plant treatment

- ➢ Waste treatment benefits
- ➢ natural waste treatment process
- ➢ mature technology
- ➢ Reduces volume of waste for transport, land application, (vs. not using digestion)
- ➢ very efficient decomposition
- ➢ complete biogas capture
- ➢ nutrient recovery and recycling

Energy benefits it gives:

- ➢ useful applications, including:
- ➢ baseload / dispatchable energy source (vs. intermittent wind and solar)
- ➢ Distributed generation (which means lower transmission / transportation costs and higher reliability)
- ➢ Direct replacement for non-renewable fossil fuels

Environmental benefits

- ➢ Dramatic odor reduction
- ➢ reduced pathogen levels
- ➢ reduced greenhouse gas emissions

If we utilize these gases so they are not mixing with environment to pollute it.

V. Way forward

The present study simply appearance at the feasibleness of harnessing energy victimisation biomethanation technology. more study has to be done on technical specifications of the biomethanation plant like size of the plant, form of steriliser, etc. This study provides suggestions for institutionalization of the technology. This study targeted on one space of Bhopal. there's got to extensively study the doable institutional mechanisms and tailor them as per desires of various areas among Bhopal.

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