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# Design of Biogas Plant for Samarth College Campus & Study of Its Eco-Friendly Feasibility

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***Abstract:*** *In College campus there are two messes of college and school where large amount of food waste generates. Which can be used for production of biogas. The biogas released acts as an environmentally sustainable energy source. The Establishment of biogas creates an organic processing facility to generate biogas which will be more cost effective, eco-friendly and can be utilize for the renewable energy. In this research the production of biogas is done from the kitchen food waste. The research study also deals with the amount of generation of biogas from kitchen food waste and eco-friendly feasibility of biogas plant.*
***Keywords -****Anaerobic digestion, Biogas production, Eco-Friendly feasibility, Kitchen waste.*

## I. INTRODUCTION

Anaerobic digestion process has widely been employed for treatment of various organic wastage, because the process can be used for production of value-added products such as an energy-rich gas and bio-fertilizer. In our project we are going to design Biogas plant from the waste food of SGOI, Belhe, Pune campus.

Biogas is the mixture of gases produced by the breakdown of organic matter in the absence of oxygen (an aerobically), primarily consisting of methane and carbon dioxide.

Biogas can be produced from raw material such as agriculture waste, manure, municipal waste, plant material, Sewage, green waste or food waste. Biogas is a renewable energy source in India, it is also known as "Gobar Gas"

Biogas is produced by anaerobe digestion with methanogen or organism which digests material inside a closed system, or formation of biodegradable material. This closed system is called as anaerobic disaster, bio-digester or a bioreactor.

Biogas is a primarily methane (CHR) and carbon dioxide (CO2) and may have shall amount of hydrogen sulfide (H2S) and moisture.

The gases methane, hydrogen and carbon dioxide (CO) can be combusted or oxidized with oxygen. This energy release allows biogas to be used as a fuel it can be used for any heating purpose such as cooking.

It is can also be used in a gas engine to convert the energy in the gas into electricity

### 1.1Nature of the Problem Statement

Method of disposal food waste is not an eco-friendly process.

Also pay additional charges to dispose the waste.

Ultimately contents are wasted which might lead to different types of threat to human health and environment.

### 1.2 Purpose

To study college campus food waste potential with different feed for design of biogas plant.

Quantify waste management of campus waste to study economical feasibility of biogas plant.

To determine the cost benefit analysis

## II. LETERATURE REVIEW

1. A.J. Dere*, S.R. Kalbande and V.P. Khambalka 'Review on Biogas Production from Different Waste' International Journal of Current Microbiology and Applied Sciences (ISSN), Oct 2017.

Percentage of methane content (the main constituent) in biogas produced from different fermentable materials is almost the same. Building robust relationships with manufacturers supplying the industry, in view of their involvement in R&D programs. This review reveals that cotton wastes can be treated an aerobically and are a good source of biogas

2. Om prankish, Anil Kumar, Ankle Pandect, Rebind Kumara, Vend Liguria. 'A Review on Biogas Plant' International Research Journal of New Technologies in Science and Engineering (IRJTSE), Oct 2021.

The Study about biogas production has shown that municipal waste that is available in huge quantity everywhere can be a good source of energy if the government seriously works on it. In this area lot of scope is

available for entrepreneur to start the biogas production plant near the industrial area to fulfil the need of energy requirement of industry and residential area and also maintain the city neat and clean.

## III. INDENTATIONS AND EQUATIONS

**DESIGN BASED CALCULATION**

**Amount of food waste generated**

- Number of students in both hostel = 600
- As per food waste index survey ,

Food waste generation = 0.15kg/cap per day

- Amount food waste = 600 x 0.15
  =90 kg per cap per day
- Amount of kitchen waste in mess and canteen = 10kg per day
- Total food waste = 90+10
  = 100kg per day

**Amount of feedstock**

- Total waste (W) = 100 kg
  = 100 lit.
- For the feedstock slurry waste to water ratio should be used 1:1
- Amount of feedstock slurry = total food waste + equal amount of water
  = 100 lit. + 100 lit.
  = 200 lit. /day
- Retention time = 40 days
- Total amount of feedstock = 200 x 40
  = 8000 lit.
  = $8m^3$

**Gas production rate (G)**

- 1 kg of food waste produce 0.24 $m^3$ of biogas
- Gas production rate (g) = 0.24 x total amount of food waste (w)
  = 0.24 x 100
  G = 24 $m^3$/day

**Components of biogas plant**

- inlet tank
- digester chamber
- fixed dome
- outlet tank

**Design of digester chamber**

- volume of digester ( Vd) = ($\pi$/4) x $d^2$ x h ----------( where, d=diameter of digester, h=height of digester)
  8 = ($\pi$/4) x $d^2$ x h
- Usually, d/h ratio = 2
  d = 2 h
  8 = ($\pi$/4) x $(2h)^2$ x h
  h = 1.36 m
  d = 2h
  d= 2x 1.36
  d = 2.72 = 2.75m
- diameter of digester = 2.75m

height of digester = 1.36 m

**Design of fixed dome**

- gas production rate = 24$m^3$/day
- volume of gas holding fixed dome (VG) = ($\Pi$/4) x $Dg^2$ x Hg

Where, Dg = diameter of cylindrical part of fixed dome Hg = height of fixed dome
Dg = 2.75m
Hg = height of cylindrical part of fixed dome

- VG = ($\Pi$/4) x $Dg^2$ x Hg

24 = ($\Pi$/4) x $(2.75)^2$ x Hg
Hg = 4.05 m

- Diameter of cylindrical part fixed dome = 2.75m

- Height of cylindrical part of fixed dome = 4.05m
- Dimensions of upper part of dome
- provide dome angle = $18^0$
- Radius of dome (r) = (1/2) dg r = 1.375m
- height of upper part of dome = h
- Tan 180 = h/1.375
- h = 0.45m
- radius of upper part of dome = 1.375m
- Height of upper part of dome = 0.45m

**Design of slurry inlet and outlet tank**

- Daily slurry volume = 200 lit.
- Volume of inlet tank = 0.2 $m^3$
- Volume of rectangular tank = l x b x h
- Assume , h = 1m
- Take, l = 1.5 x b
- Volume of inlet tank = (1.5xb) x b x 1

  $0.2 = 1.5b^2$

  B = 0.365m

  L = 1.5x 0.365= 0.55m
- Dimension of inlet tank :

  Length = 0.55m

  Breadth = 0.365 m

  Height = 1.2 m
- Dimension of outlet tank:

  Length = 0.55m

  Breadth = 0.365 m

  Height = 1.2 m

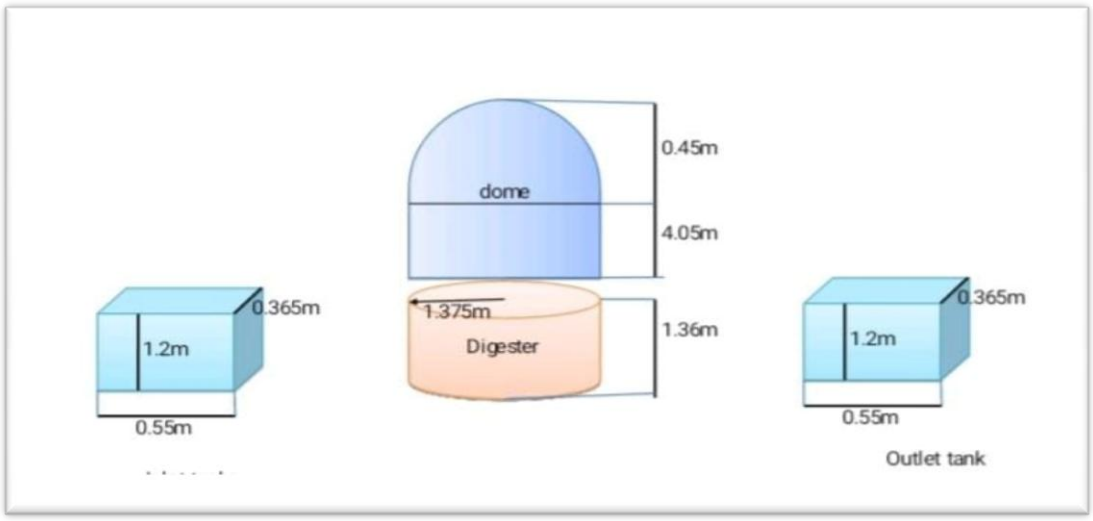


**Figure.1Components and dimensions of biogas plant**

## IV.FIGURES

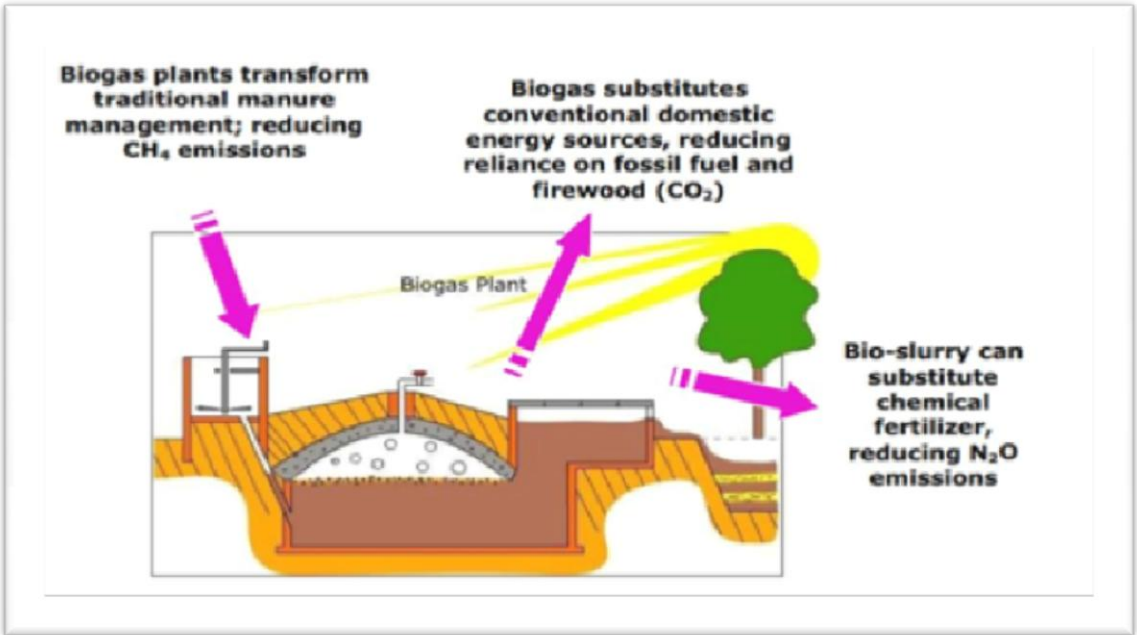


**Figure .2 Biogas Plant**

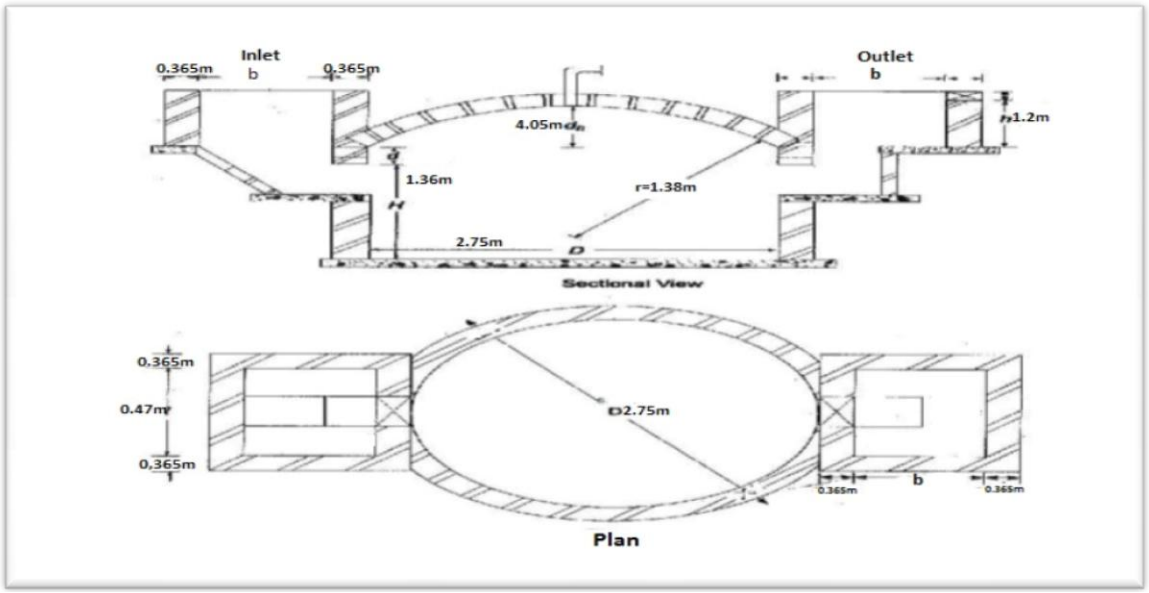


**Figure.3 Design Layout with Calculated Dimensions**

## V.RESULT

- Total food waste produce = 100 kg per day
- Gas production rate (g) = 24 $m^3$/day
- 1 $m^3$ biogas is equivalent to 0.4 kg LPG.
- Saving of LPG per day = 0.4 x 24
  = 9.6 kg
- Produce biogas is used for cooking purpose.
- Digested slurry is used as organic fertilizer.

## VI. CONCLUSION

We have design fixed dome type biogas plant for Samarth Group of Institutions of all college campus waste like, mess, hostel, canteen and garden waste which collect 120kg of food waste per day. This produce biogas can generate combustible fuel of methane which can useful for cooking and also used to generate electricity. The effective and clean waste management of collage food court kitchen waste is done by

establishment of biogas plant in college campus area and solution is developing by studying the economic measures and gas production per day.

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