Design of Proposed Biogas Plant for Sharad Institute of Technology College of Engineering Campus & Study of Its Feasibility

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ABSTRACT

In sharad Institute of Technology college of Engineering College campus at Yadarv, there are two messes of college where large amount of food and kitchen waste generates, which can be used for production of biogas. The biogas released acts as an environmentally sustainable energy source. Biogas is produced by the bacterial decomposition of biodegradable matters. The proposed plant is designed for processing food and kitchen waste, wood waste, Paper waste, gross clippings and leaves waste, Bio mass waste, human waste and composition waste segregated organic food waste.

In this research, the production of biogas is done from the kitchen food waste, Paper waste, gross clippings and leaves waste, bio mass waste, human waste and composition of segregated organic food waste. Biogas production requires anaerobic digestion. A biological conversion processes that covert organic bio mass into methane-rich biogas, the process also produces digestate, which can be used as fertilizer. This research was to create biogas plant to get biogas and organic manure which has a lot of demand in market for organic farming. This research is very cost effective, eco-friendly, generate a high- quality renewable fuel, and reduce carbon dioxide & methane emissions in atmosphere. Creating a biogas plant in colleges, schools and hostels is beneficial for eco-friendly environment. Kitchen and vegetable waste, human waste, biomass waste, paper waste was collected from college campus. Digester works on the principle of anaerobic digestion system to produce biogas. The anaerobic digestion is a process of breaking the organic compost in to organic slurry and methane and carbon dioxide.

Kitchen waste produces biogas, a valuable energy resource. Anaerobic digestion is a microbial process for production of biogas, which consists of primarily methane (CH4) & carbon dioxide (CO2). Now a day’s every country is giving importance for this biogas and we can generate electricity. The addition of sodium hydroxide (NaOH) in digester is to maintain the alkalinity and pH to 7. Biogas Production and utilization from a proposed real time plant at Sharad Institute of Technology college of Engineering (SITCOE) is monitored.

Keywords: Waste paper, Kitchen waste, Food Waste**.** Bio gas, Human waste

1. INTRODUCTION

Producing and utilizing renewable energy both in a global and a national context is necessitated by the synergistic effect of climate change and the long term, continuous price rise of fossil fuels. The main reasons for the spread of renewable energy sources are to increase the security of the energy supply or in optimal case, to realize total energy independence

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 this proposed research, we are going to design

Biogas plant in sharad Institute of Technology college of Engineering (SITCOE) campus from the kitchen and vegetable waste, human waste, biomass waste, paper waste which was collected from sharad Institute of Technology college of Engineering College campus at yadarv, the paper deals with production and utilization of biogas.

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. Bio gas compositions are: Methane 50-70%, carbon dioxide 30-50%, Nitrogen 5-10%, oxygen 1-5% and Hydrogen sulphide 1-2%.

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 has globally remained a renewable energy source derived from plants that use solar energy during the process of photosynthesis. Being a source of renewable natural gas, it has been adopted as one of the best alternatives for fossil fuels after 1970’s world energy crisis [1]. Biogas is a colourless, flammable gas produced via anaerobic digestion of animal, plant, human, industrial and municipal wastes amongst others, to give mainly methane (50-70%), carbon dioxide (30-50%) and traces of other gases such as nitrogen, hydrogen, ammonia, hydrogen sulphide, water vapour etc. [2]. It is smokeless, hygienic and more convenient to use than other solid fuels [3].
Biogas production has a three stage biochemical process comprising hydrolysis, acidogenesis /acetogenesis and methanogenesis.

$(C_6H_{10}O_5)_n + nH_2O \rightarrow n\,(C_6H_{12}O_6)$ – Hydrolysis

$n\,(C_6H_{12}O_6) \rightarrow n\,CH_3COOH$ - Acetogenesis/Acidogenesis

$3nCH_3COOH \rightarrow n\,CH_4 + CO_2$ – Methanogenesis

Biogas technology amongst other processes (including thermal, pyrolysis, combustion and gasification) has in recent times also been viewed as a very good source of sustainable waste treatment / management, as disposal of wastes has become a major problem especially to the third world countries [4]. The effluent of this process is a residue rich in essential in organic elements like nitrogen and phosphorus needed for healthy plant growth known as bio-fertilizer which when applied to the soil enriches it with no detrimental effects on the environment [5]. The content of biogas varies with the material being decomposed and the environmental conditions involved [6]. Potentially, all organic waste materials contain adequate quantities of the nutrients essential for the growth and metabolism of the anaerobic bacteria in biogas production. However, the chemical composition and biological availability of the nutrients contained in these materials vary with species, factors affecting growth and age of the animal or plant [6]. Various wastes have been utilized for biogas production and they include; animal wastes [7, 8, 9], industrial wastes [10], food processing wastes [11], plant residues [12, 13,] etc. Many other wastes are still being researched as potential feedstock for biogas production. Paper wastes are one of such wastes being considered as a potential feed stock. Waste papers are readily available from schools, offices, printing presses, factories etc., and in some developing countries are littered on the street as waste

. A full study was undertaken to investigate the biogas production potentials and capabilities of the kitchen and food waste, Bio mass waste, Paper waste, human waste in terms of its cumulative biogas yield, onset of gas flammability and effective retention period. The study revealed that though kitchen and food waste, Bio mass waste, Paper waste, human waste is a very good biogas producer, with effective retention period of 77 days, its gas flammability ceased for a period of two weeks before resumption. It was concluded that these wastes would require some form of treatment like co-digesting it with animal wastes to impart sustained gas flammability. Cellulosic wastes are generally known to be poor biogas producers because of their poor biodegradability. One treatment method for improving the biogas production of various feed stocks is co-digesting them with animal or plant wastes.

It is necessary to create a complex biogas production and utilization system for energy while we focus on the environment and waste disposal. The centre of the system must be integrated waste-management and environmental energy utilization. The subject of this research is: how to meet collectively the energy and waste disposal requirements without transformation of the system

1.1 Addressed Problems

Waste generators, such as large industries, hotels, schools and colleges, food malls are facing nipping problems in disposing off generated organic waste, as the infrastructure for waste management is not developing in accordance with the waste generation. Smelling waste piles, unreliable waste collection along with internal storing and waste logistic issues are occurring out of this situation.

Beside this, the disposal problems of organic waste are twofold. Firstly, organic materials causing severe environmental problems through methane emission in landfill applications. Secondly, disposed organic waste is the prime source of diseases and contamination of air and water.

In general, it is a common practice that organic waste is dumped in large landfill pits which leads to significant uncontrolled methane emissions while degrading. As per the Inter Governmental Panel for Climate Change (IPCC) methane is considered 21 times more harmful than carbon dioxide.

1.2 Purpose of Bio gas plant

In college campus, kitchen and vegetable waste, human waste, biomass waste, paper waste potential with different feed are considered for design of biogas plant. Quantify waste management of campus waste to study economical feasibility of biogas plant and to determine the cost benefit analysis.

.2. ANALYSES OF WASTES

Physicochemical analyses

Ash, moisture and fiber contents were determined using AOAC (1990) method[20]. Fat, crude nitrogen and protein contents were determined using Soxhlet extraction and micro-Kjedhal methods described in Pearson (1976) method. Carbon content was carried out using Walkey and Black (1934) method, Energy content was carried out using the AOAC method described by Onwuka while Total and Volatile solids were determined using Renewable Technologies (2005) method.

Biochemical analysis

The pH of the paper soaked in water was taken before charging of the waste while the ambient and influent temperatures of all the wastes were monitored daily throughout the retention period.

Microbial analysis

Total viable counts (TVC) for the wastes slurries were carried out to determine the microbial load of the samples using the modified Miles and Misra method described by Okore. This was carried out at four different periods during the digestion; at the point of charging, at the point of flammability, at the peak of production and at the end of the retention period.

Statistical Analysis

The standard deviation was carried out using SPSS 15.0 version.

3. TYPES OF BIOGAS PLANTS

Biogas plants are divided as Fixed Dome Biogas Plant and Floating Drum Biogas plant.

3.1 Fixed dome biogas plant

A fixed-dome plant consists of a digester with a fixed, non-movable gas holder, which sits on top of the digester. When gas production starts, the slurry is displaced into the compensation tank. Gas pressure increases with the volume of gas stored and the height difference between the slurry level in the digester and the slurry level in the compensation tank. The costs of a fixed-dome biogas plant is relatively low. It is simple as no moving parts exist.

There are also no rusting steel parts and hence a long life of the plant (20 years or more) can be expected. The plant is constructed underground, protecting it from physical damage and saving space. While the underground digester is protected from low temperatures at night and during cold seasons, sunshine and warm seasons take longer to heat up the digester.

No day/night fluctuations of temperature in the digester positively influence the bacteriological processes. The construction of fixed dome plants is labor-intensive, thus creating local employment. The basic elements of a fixed dome plant (Nicarao Design) are shown in the Figure 1.

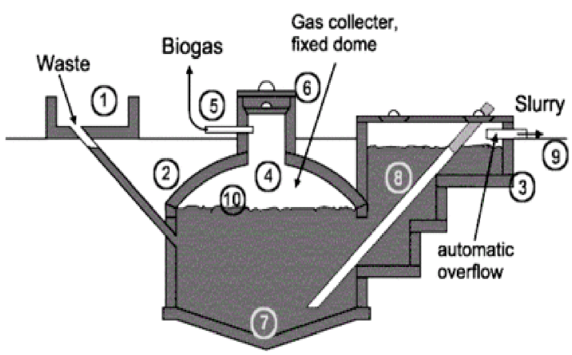

Fig.1 Fixed Dome Bio gas plant

A fixed-dome plant comprises of a closed, dome-shaped digester with an immovable, rigid gas-holder and a displacement pit, also named 'compensation tank'. The gas is stored in the upper part of the digester. When gas production commences, the slurry is displaced into the compensating tank. Gas pressure increases with the volume of gas stored, i.e. with the height difference between the two slurry levels. If there is little gas in the gas-holder, the gas pressure is low

3.2 Floating Dome Bio gas plant

On 1956, Jashu Bhai J Patel from India designed the first floating drum biogas plant, popularly called Gobar gas plant. Floating-drum plants consist of an underground digester (cylindrical or dome-shaped) and a moving gas-holder. The gas-holder floats either directly on the fermentation slurry or in a water jacket of its own. The gas is collected in the gas drum, which rises or moves down, according to the amount of gas stored. The gas drum is prevented from tilting by a guiding frame. When biogas is produced, the drum moves up and when it is consumed the drum goes down

The basic element of a Floating-dome plant is shown in Figure 2.

Fig.2 Floating Dome Bio gas plant

If the drum floats in a water jacket, it cannot get stuck, even in substrate with high solid content. Now the gas drum is full of biogas and that's the reason it moves up ward. They are chiefly used for digesting animal and human feces on a continuous-feed mode of operation, i.e. with daily input. They are used most frequently by small to middle-sized farms (digester size: 5-15m^3) or in institutions and larger agro-industrial estates (digester size: 20-100m^3).

4. COMPONENTS AND MATERIEALS USED IN BIOGAS PLANTS

In sharad Institute of Technology college of Engineering College campus at Yadarv, two 3m^3 Biogas plants are proposed to be constructed, in that raw materials are mostly we are using kitchen and food waste comes from college canteens. we need only kitchen waste or Biodegradable waste which take less time to decompose and give results within 24 hrs and at installation first, we use to fill Bio digester tank with cow dung completely we have to wait for it until it produces Biogas, later we use whatever we want like kitchen waste, vegetable waste, farming waste and among all the waste materials, kitchen waste have high calorific value and high nutritious value so that it produce high amount of gas, it requires less waste but if we compared to dung, it requires more waste to produce Biogas. Fixed Dome biogas plant has erected and it has high efficiency of emitting or releasing methane gas compared to other type of biogas plants

4.1. Vegetable and Kitchen waste

Most biogas digesters use cow dung to produce biogas. There are many other organic materials as mentioned above that can be used to produce biogas like leftover food scraps, vegetables etc. Some digesters can be fed with grey water (grey water is a term used to refer to used water). Other common organic materials used in biogas digesters include sewage, glycerin, algae and grasses. In short, anything organic can be fed to the digester provided it's biodegradable and has very small amounts of cellulose. Kitchen wastes have high nutritious value compared to the reaming waste materials.
The vegetable and Kitchen waste are shown in Figure 3 and Figure 4.

Fig.3 vegetable Waste

Fig.4 Kitchen Waste

4.2 Bio mass waste

Biomass, or biogenic (plant or animal products), materials such as paper[14], cardboard, food waste, grass clippings, leaves, wood, and leather products are used for bio gas generation.

The Biomass waste is shown in Figure 5.

Fig.5 Biomass Waste

4.3. Grinder

Grinder is a machine used to grind the vegetable waste or cow dung and kitchen waste to make the mixture more volatile or smooth. we use grinder to mix waste properly and the waste obtained after grinding is mixed with same quantity of water is the perfect mixture ready for treatment for generating biogas

The grinder used is shown in Figure 6.

Fig.6 Grinder

4.4. Biogas Balloon

Biogas balloon is used to store the generated biogas or to transport from one place to another place without any leakage. The Plant offer an extensive range of Biogas Balloons for Storage and Transportation, which is fabric based holder that finds wide usage in storing generated bio-gas in gas holder[9]. Hence, this caters to the need of many sago and starch industries in production and storage of gas for its effluent treatment plants.

The Biogas Balloon used is shown in Figure 7

Fig.7 Biogas Balloon

4.5. Inlet Tank

The raw material like vegetable waste or kitchen waste or cattle dung is mixed with water before pouring it in the inlet tank, after mixing properly we pour those mixture in inlet tank and there is an automatically structure to send that mixture to the digester tank.

4.6. Digester

Digester is a huge tank which fermentation process takes place means all 4 processes are taking place in this tank, those are

- Hydrolysis
- Acedogenesis
- Acetogenesis
- Methanogenesis

After completing these all processes only Biogas is generated and this generated Biogas is passed from gas outlet valve and the remaining slurry formed due to the formation of Biogas is sent to the outlet or slurry tank [21]

4.7. Slurry tank

Slurry tank collects the slurry formed in the Digester tank and the slurry obtained is very smooth and we use that slurry for organic farming because the slurry obtained is 10 times more nutritious then normal cow dung and other fertilizers, slurry obtained after completion of biogas formation is preferable and very healthy for farming

5. SCIENTIFIC BACKGROUNDS

5.1 Biomass-based Energy Production; Biogas

Energy is a complex system; hence, energy production and energy-conversion require systemic thinking, for which firstly a change of aspect is necessary [27]. The primary view-point is to satisfy the energy demands with the lowest possible stress on the environment. Furthermore, ecological thinking should prevail increasingly during the planning and operating of the different kinds of technical equipment and facilities. It can be determined that the biomass-based energy system can mean the necessary transformation of the energy structure. Researchers of several domestic and foreign universities and research institutes have specialized in the feasibility of biogas production from different kinds of biomass. Brau examined the types and degradation features of basic material, while Llabrés and Müller et al. and Borbély examined the anaerobe degradation of different kinds of substrates based on liquid pig manure and examined the output-increasing effect of pre-treatment processes and the kinetics of cellulose. Gunaseelan, Lehtomäki et al, Mata et al and Panichnumsin et al [5-8] studied the fermentation of manures and different kinds of plant additives. In their experiments, the positive synergistic effects created the possibility of higher methane productivity. They established that the top of sugar-beet doping causes higher hydrogen-sulphide content in biogas and that increasing the ratio of additives causes a decrease methane productivity[18]. Houdková et al built a laboratory fermentation unit for the experimental determination of biogas production [9]. Kalyuzhnyi et al [10] studied the integrated mechanical, biological and physical-chemical treatment of liquid pig manure. He created a mathematical model of anaerobe decomposition and revealed and described the principal controller factors with numerical experiments. Meanwhile Misra also emphasizes the elaboration of a practical model for empirical validation.

5.2 Utilization of Biogas in Gas Engines

Biogas is a gaseous matter similar to natural gas and can be utilized in many ways. Biogas has different combustion and compositional characteristics compared to natural gas, so it needs a different system of preconditions compared to the combustion of natural gas [11]. One way to use biogas is its utilization in internal combustion engines. The basic national research institutes for combustion engineering examined the feasibility of the combustion of low heat value gases with inert content-among them biogases, the technical and economic effect of their application, and the combustion properties of biogas [12, 13]. In the 1960s, Sándor undertook experiments to verify the necessity of gas-engines[28]. Neyeloff-Gunkel specialized in the modeling and simulation of the combustion of biogas. Porpatham examined how bio-fuel from biomass can be applied as a fuel in internal combustion engines. They tested the operation and the emission of a one-cylinder, four-stroke engine fuelled by natural gas, biogas and their mixtures[17]. Huang-Crookes did experiments on a one-cylinder, four-stroke, spark ignited engine at constant speed, using increasing compression-ratios, given CO2 content (37.5%) and air access ratio (0.97). The increasing compression-ratio caused intensively increasing NOx and HC emission. Crookes made further tests with changing CO_2 content. He determined that increasing the CO_2 content results in a decrease in NOx emission, which can be due to decreasing combustion speed and combustion peak-temperature[26].

6. TECHNICAL DATA

6.1 Input: Segregated Organic Waste

Biogas is produced by the bacterial decomposition of biodegradable matters. The proposed plant is designed for processing food and kitchen leftovers, composition of segregated organic food waste: The generated food waste for the biogas plant can be raw or cooked; it must be fresh and not degraded[19].

Feed stocks like wood shavings, straw, grass, coconut shells, non degradable oils, contaminants,disinfectants,contaminated/adulterated food waste should be ideally avoided for feeding into the biogas plant as it will reduce efficiency of bio-gas output generation[16]. Soft papers, paper tissues and other fibrous materials may be accepted to a certain extent, but takes longer time for getting digested. The overall mass of these slow degrading materials should not exceed 2% of the total incoming materials. Disturbing factors in the mechanical process of the biogas plants are bones above 100 mm length and should be avoided in order to reduce maintenance of the moving mechanical parts.

6.2 Design Based calculation

Amount of food waste generated

Number of students in both hostels =500
As per food waste survey,
Food waste generation = 0.15kg/student per day
Amount food waste = 500 x 0.15
= 75 kg per day
Amount of kitchen waste in mess and canteen
= 10 kg per day
Biomass waste = 10 kg per day
Other waste = 5 kg per day
Total waste per day = 75+10+10+5
= 100 kg 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 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 produces 0.2 -0.5 m^3 of biogas
Gas production rate (g) = 0.2 x total amount of waste (w)
= 0.2 x 100
Gas production = 20 m^3/day

Design of digester chamber

Volume of digester (V_d) = $(\pi/4) \times d^2 \times h$
(Where, d=diameter of digester, h=height of digester)

$8 = (\pi/4) \times d^2 \times h$
Usually, d/h ratio = 2
d = 2 h
$8 = (\pi/4) \times (2h)^2 \times h$
h = 1.4 m
d = 2h
d= 2x 1.4
d = 2.8 m
Diameter of digester = 2.8m
Height of digester = 1.4 m

Design of fixed dome

Gas production rate = $20m^3$/day
Volume of gas holding fixed dome (VG) = (π /4) x Dg2 x Hg

Where, Dg = diameter of cylindrical part of fixed dome Hg = height of fixed dome
Dg = 2.8m
Hg = height of cylindrical part of fixed dome
$VG = (\pi/4) \times Dg^2 \times Hg$

$24 = (\pi/4) \times (2.8)^2 \times Hg$
$Hg = 3.9$ m

Diameter of cylindrical part fixed dome = 2.8m
Height of cylindrical part of fixed dome = 3.9m
Dimensions of upper part of dome Provide dome angle = 180
Radius of dome (r) = (1/2) dg
r = 2.8/2 = 1.4 m
Radius of upper part of dome = 1.4m
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 = 1.5b2
b = 0.36 m
l = 1.5x 0.3= 0.5m

Dimension of inlet tank:
Length = 0.5m
Breadth = 0.36 m
Height = 1.2 m

Dimension of outlet tank:
Length = 0.5m
Breadth = 0.36 m
Height = 1.2 m

6.3 Proposed Biogas Plant for Sharad Institute of Technology College of Engineering Campus at Yadrav

In Sharad Institute of Technology College of Engineering Campus, the proposed 6m^3 Biogas plants are constructed, in that raw materials are mostly kitchen waste comes from College canteen every day along with biomass and human waste but we need only kitchen waste or Biodegradable waste which take less time to decompose and give results within 24 hrs and at installation first[25], we use to fill Bio digester tank with cow dung completely we have to wait for it until it produces Biogas, later we use whatever we want like kitchen waste, vegetable waste, farming waste, sewage waste, biomass waste and among all the waste materials[15]. Kitchen waste has high calorific value and high nutritious value so that to produce high amount of gas, it requires less waste. 1 kg of food waste produce 0.2 to 0.5 m^3 of gas/kg of waste [24]. Whatever the waste we take, how much waste is considering, we have to take the same quantity of water to make sure output is very smooth and fertile organic manure. On average, 1kg of bio mass waste (such as paper, green leaves, grass clippings) produces 0.3-0.5m^3 of biogas[22]

To produce the 6 m^3 gas, we need 30kg of food waste and 30 kg of water, mix thoroughly and send it to slurry tank after Biogas is being generated[23]

Peepal waste managers, Hyderabad realized the importance of biogas way years ahead and they are pioneers in that industry and achieving excellence in Biogas energy sources

Peepal Waste Managers, started with a mission and vision to provide economically sustainable and state of art solutions in the field of Waste Management. Peepal is of the view that waste management is a vast area and it need to be addressed in synergy with different technology available for disposal, based on different substrate.

Depending upon the input of the designed capacity, the proposed biogas plant will show the following savings/benefit analysis (per day basis) in Table 1.

Table 1. Saving Potential

Size of the plant (input capacity)	**100 kg's/day**
Dimension of plant	10*15ft
Generation of Biogas per day(m^3/day)	20
Equivalent of LPG kg's/day	6.7

LPG replaced cost per day @75 RS/kg	503
Waste dumping and handling expenses,approx. assumption	5
Generation of Liquid manure per day(depending up on raw material @rs 5)	34
Total savings per day (approx...)for LPG replacement/day	542
Savings per annum	1,97,830
Capital Investment	2,00,000
Return on Investment	One year

7. Biogas Production and utilization in Proposed Biogas Plant SITCOE, Yadrav

The Biogas Production and utilization of Proposed Biogas Plant SITCOE, Yadrav is shown in Table 2.

Table 2. Proposed Biogas Plant SITCOE, Yadrav

Raw material	Biogas produced/day	Biogas utilized/day	Balloon Storage	Slurry
Kitchen waste(10kg)+Food waste(75 kg)+Bio mass(10kg)+ other waste (5Kg) Total Wate:100Kg	20 m^3	12	08 m^3	150 kg

8. SKGS Model Primary Output: Biogas

Various factors such as feed stock and operation method of the plant may change the biogas composition and quantity. Based upon the assumed feed stock and proposed treatment technology the following parameters can be assumed:

Gas types	Specification
Biogas	60-65 m^3
Methane CH4	65.00 %
Carbon dioxide CO2	39.00 %
Oxygen O2	0.10 %
Nitrogen N2	0.40 %
Hydrogen sulphide H2S	200.00 ppm
Temperature	35.00 o C

SKGS Model Bi-Product: Organic Manure or Fertilizer

It is a state of the art method to convert the wet digested slurry into nutrient rich, ready to use, organic fertilizer for landscaping and horticulture application Liquid manure slurry of approx. 50 liters per day for respective model, can also be used directly in garden as liquid fertilizer.

Operating Parameters

Plant is capable of running at 20% to 100% of its design capacity, depending upon the quality of the input (raw material) the output may vary. Plant is capable to run for 365 days but under normal conditions

Environmental Saving – SKGS-50 Model

Preventing of adding 30 tons of Carbon Dioxide emission in atmosphere. Indirectly reducing Carbon Dioxide absorption load on 1500 full grown trees. The Schematic Diagram of SKGS Plant is shown in Fig 8.

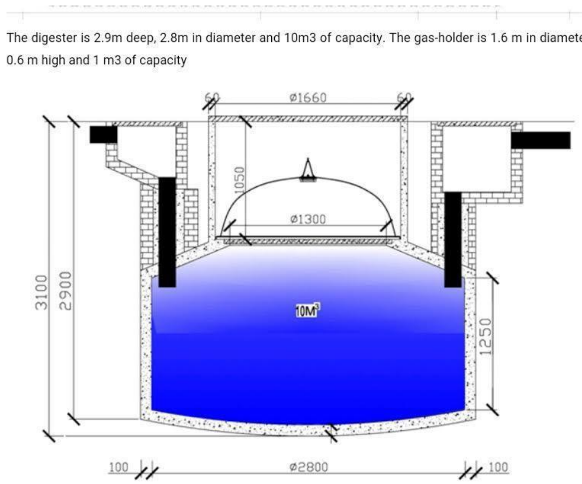

Fig.8 Schematic Diagram of SKGS Plant

The by-product of the biogas generation process is enriched organic, which is a perfect supplement to or substitute for chemical fertilizers and Biogas Journey is shown in Figure 9.

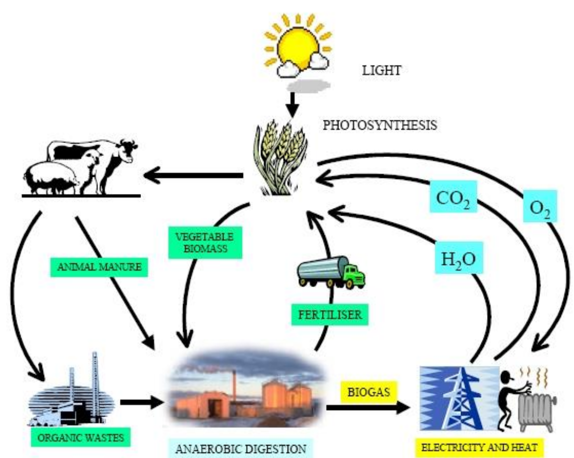

Fig.9 A Simple and Low-Cost Technology That Encourages A Circular Economy

The technology used to produce biogas is quite cheap. It is easy to set up and needs little investment when on a small scale. Small bio digesters can be used right at home, utilizing kitchen waste and animal manure. A household system pays for itself after a while, and the materials used for generation are absolutely free. The gas manifested can be used directly for cooking and generation of electricity.

9. HOW SKGS MODEL IS DIFFERENT FROM OTHER MODELS

1. NexGen Technology, Compact, 'Easy to Use'

2. Engineered & Integrated as a 'single unit'

3. Less Space Required

4. 15% higher Bio-Gas Output Efficiency compared to traditional Biogas plant

5. Manure bi-product is nutrient-rich & ready to use (EB- ++ Model)

6. Fixed Structure, Closed Loop, Zero Leakage System

7. Insulated & Temperature Controlled Digester to ensure optimum & consistent bio-gas output across seasons (EB- ++ Model)

8. Designed to meet aesthetic, safety, hygiene and odour standards of premier hospitality and commercial sectors, in line with international norms

9. More seamless installation and integration at site

10. Showcase environmental technology – 'Green Flag' Initiative

10. Innovative Technologies in Biogas Production:

Advancements in biogas production technologies have revolutionized the waste-to-energy sector. Advanced anaerobic digestion systems, such as high-solid anaerobic digestion and two-stage digestion processes, have significantly improved the efficiency of biogas production. Co-digestion of various waste streams has also proven to be an effective method in enhancing biogas yields.

Pre-treatment methods, including mechanical, thermal, and chemical processes, have been developed to optimize biogas production. These methods help in breaking down complex organic compounds and increasing the accessibility of organic matter to the anaerobic microbes

11. Utilization and Conversion of Biogas:

Biogas upgrading technologies play a crucial role in removing impurities from the biogas stream. Biogas purification is essential for the production of bio methane, a high-quality form of biogas suitable for injection into natural gas grids or as a vehicle fuel.

The applications of biogas and biomethane are diverse, ranging from electricity generation to heat production in industries and households. The potential for injecting biogas into natural gas grids provides an opportunity for renewable energy integration and decarburization of the natural gas sector

12. Integration of Waste-to-Energy Innovations:

Waste-to-energy innovations, particularly in biogas production, can be integrated with other renewable energy sources to create a more sustainable energy mix. The coupling of biogas production with solar or wind energy can ensure a continuous and reliable supply of renewable electricity.

Integration with waste management systems is another crucial aspect. By utilizing organic waste streams, waste-to-energy technologies can divert significant amounts of waste from landfills, reducing environmental pollution and greenhouse gas emissions

Moreover, waste-to-energy innovations align with the principles of the circular economy by promoting resource recovery and minimizing waste generation. The integration of biogas production with circular economy principles ensures a sustainable and closed-loop approach to waste management and energy production

Anaerobic digestion, a crucial process in biogas production, breaks down organic matter in the absence of oxygen. Combined Heat and Power (CHP) systems play a vital role in converting biogas into usable energy is shown in Fig.9

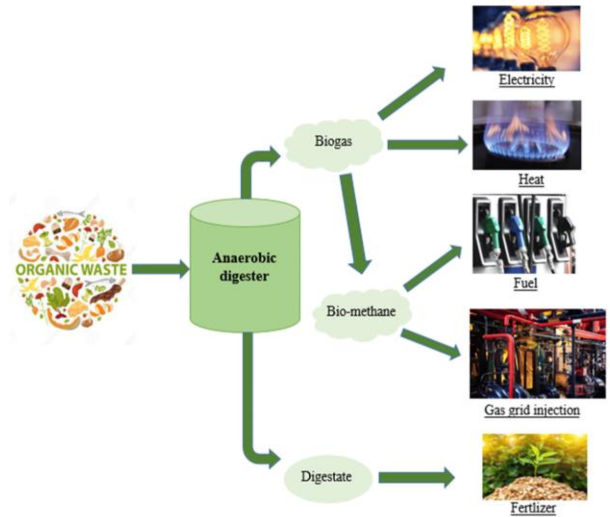

Fig.9 Waste-to-Energy

13. Current Trends or Developments

Recent advancements in biogas production technologies have focused on improving the efficiency and scalability of biogas plants. Research findings have shed light on optimizing biogas yields and quality through process optimization and microbial enhancements.

Government policies and incentives play a crucial role in promoting waste-to-energy innovations. Many countries have implemented supportive policies to encourage the adoption of biogas production technologies, offering financial incentives and favorable regulatory frameworks

14. Challenges or Controversies

While waste-to-energy innovations in biogas production offer numerous benefits, there are some challenges and controversies associated with this sector. Environmental concerns related to emissions from biogas production need to be addressed through advanced emission control technologies.

Land requirements and potential land-use conflicts pose challenges in scaling up waste-to-energy projects. Balancing the demand for land resources with the need for sustainable energy production requires careful planning and strategic decision-making.

Socio-economic considerations and public acceptance are also important factors. Engaging local communities and addressing any concerns or misconceptions regarding waste-to-energy technologies is crucial for their successful implementation

15. Future Outlook

The potential for scaling up waste-to-energy innovations in biogas production is significant. As technologies continue to advance, biogas production can play a pivotal role in the transition to a low-carbon economy. The integration of biogas production with other renewable energy sources and waste management systems will further enhance its sustainability.
Emerging technologies and research directions, such as the use of microbial consortia and novel reactor designs, hold promise for improving biogas yields and quality. Continued research and development efforts, combined with supportive government policies, will contribute to the growth and widespread adoption of waste-to-energy innovations**.**

16. CONCLUSION

Biogas Production and utilization from a proposed Biogas plant at Sharad Institute of Technology College of Engineering Campus at Yadrav using Fixed dome bio gas plant is proposed. The results of the proposed 6m^3 bio gas plant are recorded as: Total food waste produced is 100 kg per day. Gas production rate (g) is 20 m^3/day. Bio gas utilized per day is 12 m^3/day. Bio gas stored in Baloon is 08 m^3/day. The slurry obtained is 150 kg which is used for fertilizer purpose. After installation of the plant, per day savings will be Rs 542 and the annual savings will be Rs1,97,830. If we consider the price for Construction and Commissioning of complete plant with two 3Cum Biodigesters, One Pre Digester, Two HDPE/MS Domes, HOSE, Two Biogas Stoves, Biogas Balloon (5Cum), Pulverizer, Booster including maintenance of one year is Rs 2,00,000-00, then payback period is just around one year. The Produced biogas is used for cooking purpose and also for used for production of electrical energy. Digested slurry is used as an organic fertilizer.

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