BIOGAS PRODUCTION FROM KITCHEN WASTE

A report submitted in partial fulfillment for the degree of

B. Tech

in

Civil Engineering

by

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HYDERABAD

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DECLARATION

I declare that this project Thesis/Report titled **BIOGAS PRODUCTION FROM KITCHEN WASTE** submitted in partial fulfillment of the degree of **Bachelor of Technology in Civil Engineering** is a record of original work carried out by me under the supervision of **DR.O.S.D. HIMA BINDU**, and has not formed the basis for the award of any other degree or diploma, in this or any other Institution or University. In keeping with the ethical practice in Thesis/Reporting scientific information, due acknowledgements have been made wherever the findings of others have beencited.

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17/May/2025

CERTIFICATE

This is to certify that the project Thesis/Report entitled **BIOGAS PRODUCTION FROM KITCHEN WASTE** submitted by **B. Rama krishna, A. Nandu Yadav, N. Shiva** to the **Gokaraju Rangaraju Institute of Engineering andTechnology**, **Hyderabad**, in partial fulfillment for the award of the degree of **Bachelor of Technology in Civil Engineering** is a *bona fide* record of project work carried out by him/herunder my/our supervision. The contents of this Thesis/Report, in full or in parts, have not beensubmitted to any other Institution or University for the award of any degree or diploma.

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ABSTRACT

A canteen is ready in our institute with its individual dedicated dirt, which produces a large amount of kitchen waste every day, which provides an opportunity for more useful packages. Instead of removing this biological waste with traditional techniques, we will take advantage of it for permanent resource repetition through biogas production. Biogas are produced through anaerobic digestion, in a biological way as microorganisms decompose organic matter in an oxygen-lun environment. The intention of our mission is to create an organic processing function that converts kitchen waste into biogas. This technique provides many advantages: it is economically possible, environmentally friendly, reduces the dependence of fossil fuels, distracts organic waste from landfill and reduces climate emissions including carbon dioxide and methane. By installing a biogas reactor at the edge of the canteen, we intend to use a decentralized waste-to-electric version that promotes pure power generations and corresponds to inexperienced complex projects in our group.

For this assignment, we collected kitchen waste from the university cantine to work as raw material number one for the reactor. The biogas plant acts as an anaerobic digestive gadget, which produces biogas including methane (CHO) and carbon dioxide , this is essential for electricity era.It is vital to identify the unique shape and yield of those gases to conform the use as renewable gasoline resources. Digester is effectively driven at a fair pH level (approx. 7), maintained by means of everyday adding sodium hydroxide (NAOH). To start the method, we made our very inoculum through combination with clean kitchen waste through a combination of fermented cow mowing solution. This inoculum was then applied to the seeds of a 20-liter laboratory scale reactor, which was saved at 37 ° C, which is good for mesophile digestion.

The manufacturing of biogas proved to be in particular green while making use of materials high in starch and sugars, highlighting a significant possibility for electricity healing from these waste sources. The digester was supplied continuously to copy actual operational eventualities. The biogas generated can be utilized for quite a number power necessities, main to each value reductions and environmental benefits for the organization.

Keywords: Anerobic Digestion, BOD, Biogas, Kitchen Waste, Digester, Environmental

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ABBREVIATIONS/NOTATIONS/NOMENCLATURE:

- **Abbreviation:**

  • **Ad -** anaerobic digestion

  • **ch4-** methane

  • **CO_2 -** carbon dioxide

  • **naoh -** sodium hydroxide

  • **OPF -** organic processing facility

  • **MSW -** Municipal Fixed Waste

  • **Res -** renewable energy sources

- **Notation:**

  • **CH_4 -** Talk about methane gas in biogas

  • **CO_2 -** carbon dioxide fuel elements in biogas

  • **PH -** hydrogen capacity; A means of acidity or alkaline

  • **Naoh -** sodium hydroxide, used to hold pH stability

  • **° C -** ° C, a temperature unit

- **Nomination:**

  • **Anarobic digestion (AD):** In an organic way where microorganisms are destroyed, organically counted in the absence of oxygen to provide biogas.

  • **Biogas:** A combination of gases produced through anaerobic digestion of natural substances, and a combination of large methane (CHO) and carbon dioxide (COO).

  • **Methane (CH_4):** Primarily combustible aspect of biogas, which is used as Akshaya gasoline.

  • **Carbon dioxide (CO_2):** a non-combustible gas found in biogas; The greenhouse contributes to the effect if untreated is released.

  • **Sodium hydroxide (NAOH):** A strong alkaline substance is used to keep the pH stability of Dizzter.

  • **Inoculum:** A microbial subculture (usually obtained from cow muck and organic waste) is used to initiate anaerobic digestion.

  • **Mesophile digestion:** Anaerobic digestion that occurs at light temperatures, usually around 37 ° C, which is the standard of gold for many microbial groups.

• **PH:** A scale is used to specify the acidity or alkalinity of the dizziness; Neutral pH (7) is perfect for biogas production.

• **Organic processing plant (OPF):** The function designed to convert organic waste into useful through biogas such as biogas through biogas.

• **Kitchen waste:** Biodegradable natural waste generated from cooking and food training, enriched by starch, sugar and organic

Renewable Energy: Energy derived from natural processes that are replenished constantly, such as biogas.

CHAPTER 1
INTRODUCTION

1.1 GENERAL

The restrained availability of petroleum and coal poses a sizable risk to global gas resources. Additionally, the environmental troubles related to their combustion have precipitated extensive research into opportunity energy resources, in particular renewable strength. Renewable assets include solar power, wind power, various thermal and hydro sources, and biogas. Biogas is unique amongst those alternatives because of its potential to utilize, manipulate, and convert natural waste into strength while simultaneously generating fertilizer and water for agricultural irrigation. It is not limited via geographical obstacles and does not necessitate advanced era for energy manufacturing, making it sincere to put in force and use.

Deforestation offers a major mission in developing international locations which includes India, wherein a significant part of the populace is based on charcoal and firewood for strength, leading to the destruction of forests. This deforestation no longer simplest diminishes soil fertility thru erosion however also poses fitness dangers due to the smoke generated from burning dung and firewood, which contributes to air pollution. There is an pressing need for environmentally friendly strength alternatives.

Kitchen waste, which are natural ingredients with excessive calories for bacteria and diet, can significantly decorate methane production efficiency. This development is translated into large reactor sizes and reduces fees for the production of biogas. In many urban areas, kitchen waste is often sent to garbage dumps or abandoned incorrectly, with the future public health risk and the disease that includes malaria, cholera and typhoid. Poor waste control practices, such as uncontrolled dumping, as a result of severe negative results: they pollute the surface and groundwater through the leaching, and promote the spread of disease and gaming vectors such as flies, mosquitoes and mice, and free the rich oads and methane, contribute to a fantastic fuel with fuel.

Mankind has the ability to effectively address this challenge through the use of methane. However, we have not yet received benefits due to lack of understanding of basic scientific principles, such as the fact that work production is random on the energy available for that work. This theory is evident in current practice, where low calories such as cattle, dung, distillery waste, municipal fixed waste (MSW) and sewage are used in biogas plants, resulting in production production. By incorporating kitchen waste and food hook, we can significantly increase the efficiency of this system. Proper handling of kitchen waste will be performed in an environmentally friendly and cost -effective way with the speed of the hostel. When evaluating the cost -effectiveness of waste management, it is necessary to consider factors beyond financial implications. Incorrect disposal of food can lead to uneven conditions, which can be effectively controlled. This approach also adds value to biogas plants. Natural processes associated with microorganisms can be used to treat kitchen waste and other biodegradable materials such as paper and mass. Recently, various technological advances have been introduced to reduce costs associated with biogas production. New methods have been designed to accelerate fermentation for gas -producing bacteria, reduce reactor size, use starch and sugar for production, change feeding materials for fermentation and optimize waste output for better use. In addition, the equipment has been compressed to facilitate gas production in small places, such as the backyard.

The operating costs of larger facilities can be reduced on a per-unit basis to the extent that, within the current economic landscape, very large anaerobic digestion facilities can be profitable, while smaller ones may not be. This phenomenon is known as economies of scale. Should energy prices continue to rise and the demand for local waste treatment and fertilizers increase, this economic framework may undergo significant changes.

1.2. BIOGAS

Biogas is generated with the aid of bacteria via the anaerobic decomposition of organic count number. The natural manufacturing of biogas performs a vast function inside the biogeochemical carbon cycle and is relevant in both rural and urban settings.

Table 1: Composition of biogas.

Component	**Concentration (by volume)**
Methane(CH4)	55-60%
Carbon dioxide	35-40%
Water(H2O)	2-7%
Hydrogen Sulphide	20-20,000 ppm(2%)

Ammonia(NH3)	0-0.05%
Nitrogen(N)	0-2%
Oxygen(O2)	0-2%
Hydrogen(H)	0-1%

1.3. CHARACTERSTICS OF BIOGAS

The composition of biogas is inspired through the type of feed material. Biogas is about 20% lighter than air, and a ignition temperature starts from 650 to 750 ° C. It is a dry and odorless gas burning with a blue flame, like a very liquid petroleum gas (LPG). The calorie value is 20 mega joule (MJ) according to the cubic meter, and it usually gets 60% combustion efficiency used in a traditional biogas area.

This gas acts as an alternative gas for wood, cow muck, gasoline, LPG, diesel and strength, depending on the exact utility and local availability of sources. Biogas digitors produce a remaining natural waste according to anaerobic digestive methods, which have better nutritional functions than standard natural fertilizer, as it is usually miles as ammonia and can be applied as a compost.

In addition, anaerobic biogas digitors such as waste systems, especially for human waste, acts, which helps to reduce environmental pollution and reduce bacteria due to pathogens and disease. The biogas era is especially useful for the treatment of agricultural residues, as well as animal emissions and kitchen waste.

A. Characteristics of Biogas

1. Variation in volume in relation to temperature and pressure.
2. Variation in calorific value based on temperature, pressure, and moisture content.
3. Variation in water vapor in relation to temperature and pressure.

B. Influencing Factors on Biogas Yield and Production

Several elements impact the fermentation process of materials in aerobic conditions, including:

- The amount and type of organic matter
- The temperature
- The pH level, including acidity and alkalinity of the substrate
- The flow rate and dilution of the material

Table 2: General Features Of Biogas

Energy Content	6-6.5kWh/m3
Fuel Equivalent	0.6-0.65loil/m3 biogas
Explosion Limits	6-12%biogas in air
Ignition Temperature	650-750*C
Critical Pressure	75-89bar
Critical temperature	-82.5*C
Normal Density	1.2kg/m3
Smell	Bad eggs

Advantages of Biogas Technology:

- Origin of current.
- Conversion of organic waste to extraordinary fertilizer.
- Increase in sanitary conditions through reduced pathogens.
- Environmental signings with soil, water and air protection.
- Micro -economic benefits through the supply of power and fertilizer options.
- Macroeconomic blessings as a result of decentralized power generation and environmental protection.

C. Production process:

A trendy Biogas system consists of several main components:

- compost collection
- anarobic digester
- the storage of waste
- Gas production
- Use of gas.

Biogas represents a permanent power supply. Methanogens, which are microorganisms that produce methane, perform the final level function of a sequence of microorganisms that destroy the natural count, finally refunds the ecosystem of the achievements of the ecosystem.

1.4. The principle of biogas manufacturing:

Organic materials are located in a various range, which occurs from each residing organisms and disintegrated substances. These natural substances include carbon (C) blended with different elements which includes hydrogen (H), oxygen (O), nitrogen (N) and sulfur (s), resulting in various organic compounds which include carbohydrates, proteins and lipids. In nature, microorganisms (MOS) ease the complicated carbon systems in easy compounds thru a digestive procedure.

There are two primary types of digestive techniques:

- Aerobic digestion
- anaerobic digestion

Aerobic digestion happens within the presence of oxygen and effects within the manufacturing of a fuel mixture concerning carbon dioxide (CO_2), which contributes to global warming. Conversely, the incomplete digestive disc occurs within the absence of oxygen and produces diverse gasoline combos, mainly methane. This methane produces an electricity manufacturing of 5200-5800 KJ/M3 whilst the usual is burned at room temperature, which gives a permanent and environmentally pleasant alternative for fossil fuels, which is not diagnostic.

CHAPTER 2
LITERATURE REVIEW

1. **Patel, R. (2024). Kitchen waste for strength: a round economic system approach. Waste control and studies, 42(2), 112-125.**

   Patel exams biogas manufacturing from kitchen waste within the circular economist shape, which specializes in waste validation and resource recovery. The look at compares one of a kind uncooked cloth compositions and their outcomes on methane manufacturing. Patel emphasizes financial and environmental advantages of decentralized biogas plant life to reduce landfill addiction. Research also highlights the political interventions required to scale the biogas device in kitchen-based in growing countries.

2. **Smith, A. (2025). Progress to complete digestion for handling urban waste.**

   Smith explores advanced reforms in anaerobic digestion (AD) technology for urban kitchen waste, which emphasizes AI -Devesh adaptation for better biogas dividend. The role of microbial consortia was exposed to minimizing production and reducing the time to reduce production time. Smith also discussed the coverage structure, which helps to decentralize biogas vegetation in smart cities. The study concludes that the integration of IoT with ad structures can significantly improve performance

3. **Philip, A., Bhat, S. M., Sharma, N., and Poddal, B. (2024). A better biogas generation review through analogy Prevention of animal and food waste.**

   Philip and colleagues undergo collections of kitchen waste with livestock manure, focusing on substrates such as banana peel and onion. They feel that methane production increases in addition to ammonium chloride and reduces the retention time. The study emphasizes the importance of environmental conditions such as temperature and pH in optimizing biogas dividends. Authors suggest that integration of fruit waste and cum fertilizer improves biogas production under mesophile conditions.

4. **Lee, H. (2023). Microbial consorti -optimization for extended biogas generation.**

   The Li kitchen examines the role of microbial consortia to improve biogas production efficiency from waste. The study identifies important bacteria and ancient species that increase methanogenesis under different PHS and temperature conditions. Lee's findings suggest that biographies can significantly reduce the storage time for digestion. Research provides practical insight into using inoculum composition in small -goal biogas systems.

5. **Warts, H., Obaidat, A., Khalid, H. B. A study on the experimental evaluation of biogas**

generation by combining kitchen waste and chicken fertilizers.

Warts et al. Do an experimental study on biogas production from kitchen waste mixed with chicken fertilizers. Research checks the effect of separating the relationship between kitchen waste for chicken fertilizers on biogas yield. Conclusions indicate that co-digestion increases methane production compared to mono pension. The study also examines the effect of pH and temperature on digestive efficiency. The results suggest that optimal conditions can significantly improve biogas construction.

6. **Pillarska, A, At All... (2023). Intall digestion of meals waste - a small evaluate.**

   Pillarska et al. Provide a brief observation of anaerobic digestion (AD) methods for meals waste, and highlights the capability for the production of renewable strength. The overview discusses the impact of different parameters inclusive of temperature, ph and substrate composition on the biogas yield. The writer additionally examines the challenges related to the variation in meals waste and proposes techniques for process optimization. Research highlights the ecological blessings of digestion for speech to reduce greenhouse gasoline emissions.

7. **Garcia, M. (2022). The effect of publicity on biogas provides from organic waste.**

   Garcia analyzes the effect of sampled kitchen waste with agricultural residue and sewage sludge. The study indicates that Co-Co-substrate C/N improves the balance, leading to high methane materials. Garcia also evaluates the economic viability of such systems in rural and peri-urban surroundings. Research concludes that the processing process can significantly increase the productivity of the biogas by reducing instability.

8. **Gupta, L. (2022). To assess the economic viability of community biogas plants using kitchen waste.**
   Gupta analyzes the cost -effectiveness of biogas plants on society that use the kitchen waste as raw material. The study includes early investments, operating costs and comparative analysis of the return. Conclusions indicate a Peback period of 3-5 years, depending on construction capacity and waste accessibility. Research emphasizes employment generation and energy savings in rural areas. Gupta emphasizes the importance of state grants and public awareness of the success of the project. Studies conclude that biogas plants in society are a viable solution for permanent waste management.

9. **Mehta, S. (2021). Life cycle evaluation of biogas production from kitchen waste in urban surroundings.**

   Mehta performs a life cycle evaluation (LCA) to assess the environmental effects of biogas production obtained from kitchen waste in urban surroundings. The study considers factors such as greenhouse gas emissions, energy balance and use of resources. The results suggest that biogas systems reduce carbon footprints widely compared to traditional waste methods. The region has also been identified to improve research, including raw material collections and efficiency in digester. The study provides a framework for assessing the stability of biogas projects.

10. **Zhang, L. (2021). Handling technology for kitchen waste in biogas production.**

Zhang kitchens undergo various pre -treatment methods (mechanical, chemical and biological) to improve waste biological degradability. The study found that soluble organic material in ultrasound disabilities increases the liberation, increases biogas output. Zhang also discusses the cost-profit analysis of different techniques, and recommends mild thermal tinning for small-scale applications. Research emphasizes the requirement for energy-efficient pre-proclamation methods.

11. **Kumar, S. (2020). Decentralized biogas system for household waste.**
Kumar evaluates decentralized digestion of biogas as a permanent solution for household waste management. Research evaluates different digester designs, emphasizing cost-effectiveness and operational simplicity. Kumar highlights the social and environmental benefits of such systems, especially in off-grid communities. Research asks for state incentives to promote biogas units that are widely adopted in development areas.

12. **Reddy, N. (2020). Kitchen General Capacity for Bioga Production: Review of current technology.**
Reddy undergoes existing techniques for biogas manufacturing from kitchen waste, focusing on efficiency, scalability and flexibility. The observe classifies diverse equal digestive structures and evaluates their outcomes measurements. Challenges along with raw cloth variability, pollution and renovation are mentioned. Reddy highlights a hit case research from one-of-a-kind fields, reflecting sensible programs.

13. **Opoku, M. J., and Fee-Buffo, B (2020). Biodegradable kitchen waste from waste generated in biogas production, science and technology Campus, Ghana.**

Kwame Nkrumah University at Opoku and Fair Buff Ghana checks biogas production from kitchen waste generated on science and technology campus. The study uses a multi -phase anaerobic digestive system operated under mesophile conditions. Conclusions reveal an average biogas output of 8.9 ± 3.15 liters per day. Research shows the opportunity to use institutional kitchen waste for renewable energy production.

14. **Kumar, S. (2019). "Increasing biogas dividends from food waste the usage of enzymatic pre -remedy."**

Kumar examines the role of enzymatic pre -treatment (cellulus, lipase) to sell biogas manufacturing from kitchen waste. The examine reports an increase of 35% in methane dividends in comparison to untreated waste. Kumar emphasized the price -powerful enzyme buying from fungal cultures. Challenges consist of enzyme stability under distinct pH situations. Research shows that pilot-scale assessments for commercial viability.

15. **Kumar, R. (2019). Adaptation of anaerobic digestive parameters for biogas production of kitchen waste.**

Kumar checks surest situations for analogy digestion of kitchen waste to maximise biogas yield. The look at emphasizes the significance of keeping suitable ph tiers and temperature. Conclusions suggest that a mesophile temperature variety increases microbial interest. Research additionally highlights the advantages of preheling methods.

16. Verma, p. (2019). Design and manufacture of a portable biogas dizster for home use.

Verma has developed a compact biogas dazester for urban houses, which in particular makes use of kitchen waste as raw material. Field experiments suggest that it produces enough gasoline to meet each day cooking requirements. This studies emphasizes the promise of decentralized energy solutions.

17. Kumar, S. (2019). Comparative study of biogas production from various organic waste.

Kumar compared the yield of biogas with kitchen waste, cow muck and agricultural residue. The study found that the kitchen waste produces the highest methane material. Sami digesting with cow muck improves stability and gas production. Research suggests that kitchen waste as a viable raw material for biogas plants.

18. Patel, S. (2017). Design and implementation of a domestic biogas plant when using kitchen waste.

Patel offers a comprehensive case study on the development of a biogas function for small scales for domestic applications. The design uses widely available materials and highlights cost - effectiveness. This system effectively converts everyday kitchen waste into usable biogas. The study includes fully planned and operating instructions.

19. Ode, e. (2018). "Small -scale biogas digestion for household waste.

Odey evaluates the performance of laptop biogas digestion in Nigerian homes. The findings contained a 1.2 m biogas/day from 5 kg of waste, which is sufficient for cooking. Odey emphasizes user training for maintenance and safety. Obstacles of social acceptance, such as odor problems, are discussed. The study recommends grants to promote adoption.

20. Wang, Y. (2017). "Effect of temperature on the weird digestion of food waste."

The thermophile vs. Mesophile digestion for WANG kitchen waste. Thermophile systems (50–55 ° C) show 30% more methane production, but require more energy. The study recommends the mesophile system (35–40 ° C) for cost -sensitive areas.

21. Mittal, s (2016). "Biogas production from municipal food waste.

Mittal assesses the viability of biogas plants on municipal fame in India. The cost of Breekwane is estimated at $ 0.12/kWh. Mittal highlights the role of authorities' incentive in scaling projects. Challenges include waste insulation and collection logistics. The study compared biogas with compost and consumer.

22. Gupta, M. (2016). Evaluation of the effectiveness of antity digestion for the treatment of kitchen waste.

Gupta considers the performance of various anaerobic digests design in the treatment of kitchen waste. The study compares models with solid gun and liquid growth when it comes to gas production. The results suggest that liquid diameter provides high efficiency. This study also addresses challenges related to maintenance and operation.

23. Abbasi, T. (2015). "Biogas of kitchen waste: Raw material composition and process

parameters.

Abbasi undergoes important factors that affect biogas yields, such as C/N ratios, moisture content and particle size. The study recognizes fruit/vegetable waste as optimal due to high biological degradation. Abbasi asks for standardized protocols for waste characterization. Disclosure with livestock manure is recommended for balanced nutrients.

24. Guyen, T. (2015). "Biogas production from municipal food waste.

The guy evaluates biogas plants at the municipal level that processes 10 tonnes of food waste per day. This system reduces release of landfills by 40% and generates sufficient electricity for 200 homes. Important challenges include raw materials and lacks pollution in politics.

OBJECTIVES:

Increase in gas production through different methods, comparison with traditional plants, analysis of different parameters such as temperature, pH, total and volatile solid concentration, alkalinity and with nitrogen ratios from carbon evaluation of compatibility to both laboratories and fields to promote production using additives, nutrients and nitrogenic sources.

A. Workplan:

This study is done in two stages: the first on the laboratory scale and the second using plastic tanks. The kitchen waste used in this research is taken to the speed of hostel and canteens, with ripe rice, vegetables and vegetable issues that have been abandoned. This waste is treated using a mixer grinder to create a solution by mixing it with water. On the laboratory scale, the experiment is used as a digestion using 1-liter, 2-liter and 20-liter bottles, and uses a combination of different concentrations and waste. Many parameters for entrance and flow, including total solid, volatile solid, volatile fatty acids, pH, temperature, nitrogen, carbon and phosphorus will be evaluated. Next, in a 20-liter layout. Plastic containers were studied to evaluate gas production. A large -scale Frp tank with a capacity of 5000 liters will be used from the digester. Various parameters will also be evaluated, including:

- Total solids: Increase feed in waste from 100 grams to 5 kg to inspect the power on gas production and waste quality.
- PH: Monitoring of changes in pH levels and their regulation.
- Temperatures.
- Produced the quality and amount of biogas.

Figure-1: Bottle

Figure-2: Saline Pipe

B. Precautions while collecting sample:

1) Kitchen waste: A specified container must be allocated for coconut shell, eggshell, peeling and chicken or mutton, which will be treated separately using a mixer grinder. Different containers with a capacity of 5 liters will be used to collect wet waste, cooked food and expired dairy products. Vegetable clippings, such as peels, bad potatoes and coriander leaves, will be put together in the bag.

2) Establishment: An important factor in ensuring efficient operation of the plant is to prevent interruptions caused by dense organic waste that does not reach microorganisms for digestion. A practical solution of this problem is to convert fixed waste into a liquid solution, which can be achieved by using a mixer to facilitate conversion in solids.

Figure-3: Kitchen Waste

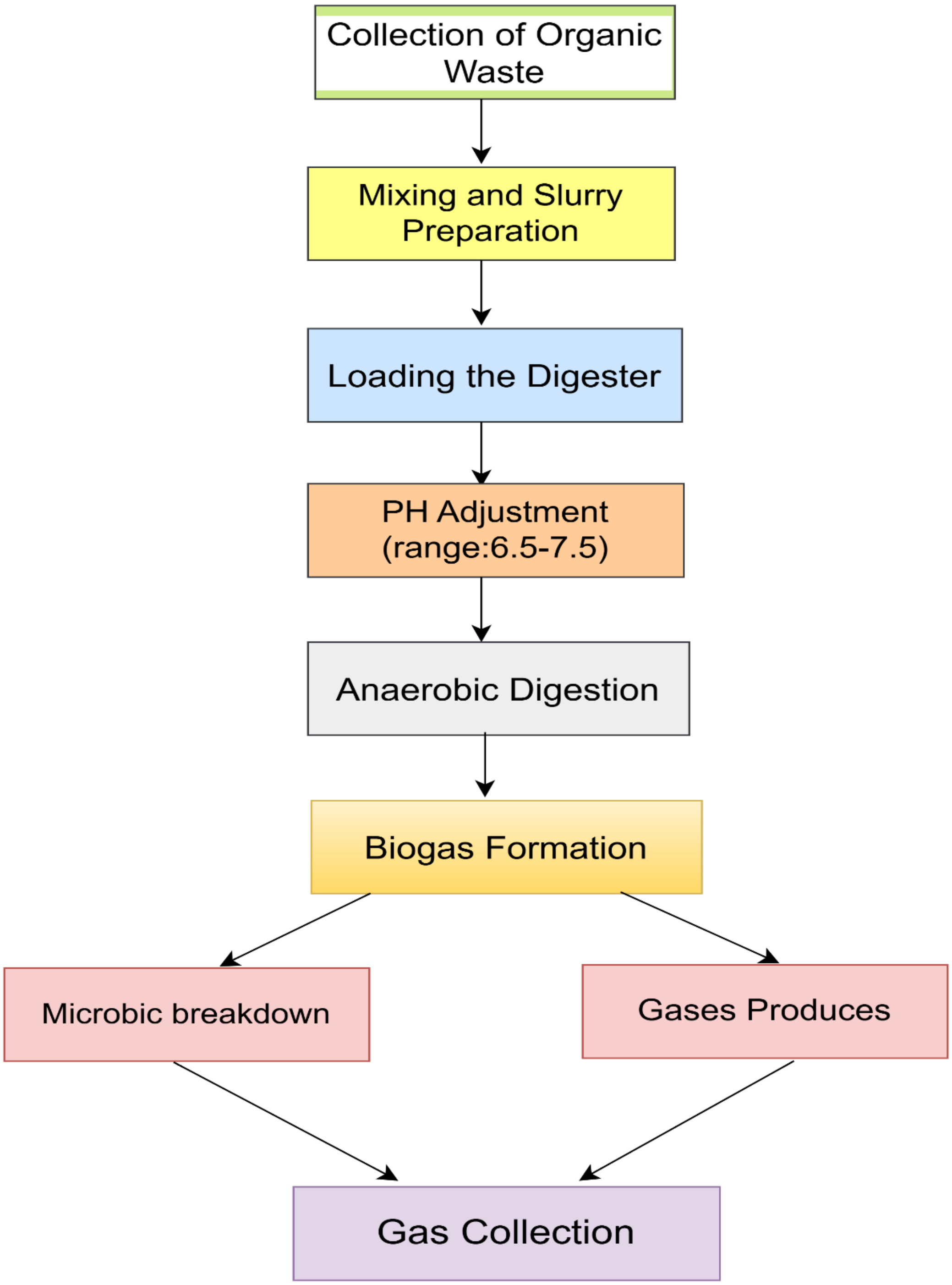
C. Analysis of Gas Produced In Our Reactor:

Syringe Method: The syringe method changed into applied to measure the concentrations of methane and carbon dioxide within the produced gas. A syringe prepared with a bendy tube and a diluted sodium hydroxide (NaOH) solution become utilized to examine the proportion of carbon dioxide, as NaOH efficiently absorbs CO2 whilst leaving methane unaffected.

1) Procedure: Prepare a a hundred ml answer of dilute sodium hydroxide with the aid of dissolving NaOH granules in about a hundred ml of water. Introduce a 20-30 ml pattern of biogas produced at some point of the experiment into the syringe, making sure that the syringe is to start with full of water to reduce air infection, after which insert the tube. Cease into the NaOH answer, then expel extra gasoline to gain a 10 ml fuel sample. • Next, take round 20 ml of the solution and make sure the tube's quit stays submerged within the NaOH answer at the same time as shaking the syringe for 30 seconds. • Position the syringe downward and

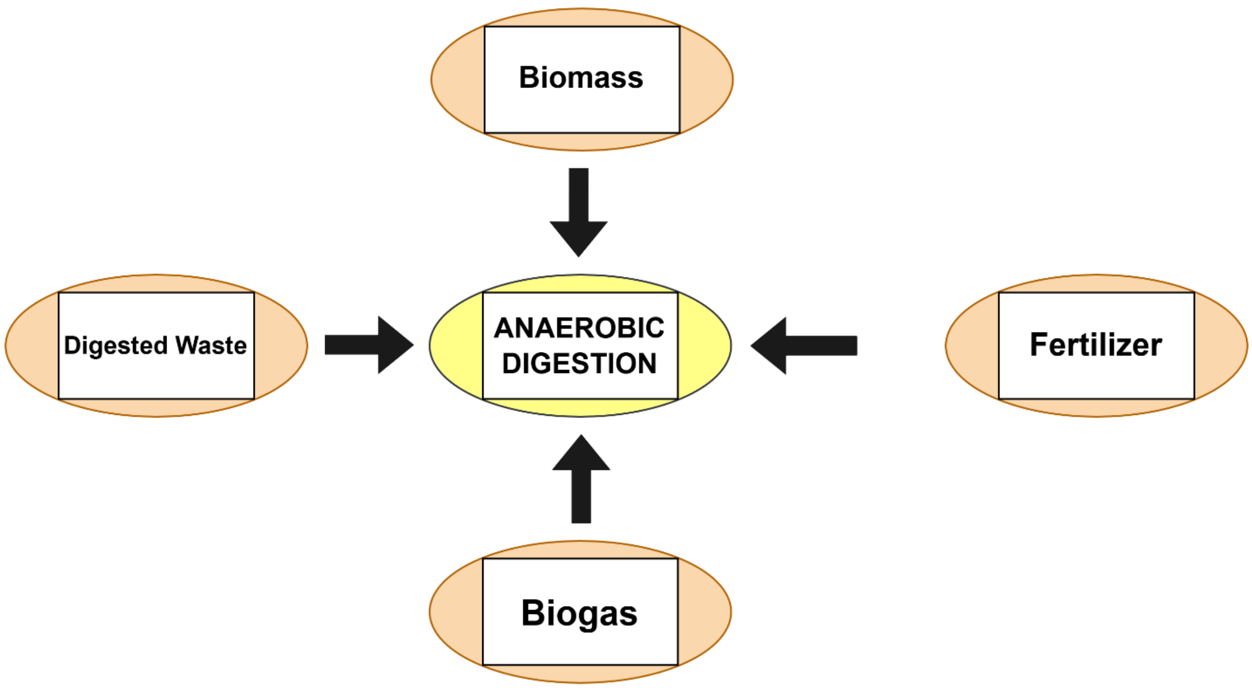
expel the excess liquid till the plunger level reaches 10 ml. Measure the volume of liquid, which need to be among 3-4ml, indicating that about 30-40% of the fuel has been absorbed, as a result inferring that the ultimate 60-65% is methane. • If the flame fails to burn adequately and the methane reading exceeds 50% (indicated by way of much less than 5ml of liquid), it shows the presence of nitrogen or any other gasoline. The composition of biogas is located to include the subsequent components: Methane (50-65%), Carbon dioxide (30-40%), Nitrogen (2-3%), and Water vapor (0.5%).

CHAPTER 3
EXPERIMENTAL INVESTIGATIONS/METHODOLGY



Flow Chat-1: Anaerobic Digestion

Flow Chat-2: Complete process diagram



CHAPTER 4

RESULTS and DISCUSSIONS

4.1. Volatile Fatty Acid:

VFA is described as fatty acids owned by a carbon chain that includes six or smaller carbon atoms. These acids can be produced by throwing strategies for fermentation strategies operating inside the gut. Remarkable examples of VFAs include acetate, propionate and butirate. Various titration techniques exist for the measurement of VFA, and this business appoints two unique strategies. Method 1 forces a sample of 100 ml in a beaker, filters it and measures pH in filtration. Then 20 ml of the filtrate is treated 0.1ml HCL to pH when four. The combination is then heated to a warm plate for three minutes, cooled, and the title is given with 0.01m NaOH to replace the pH from 4 to 7, which is registered with HCL and NAOH. The composite VFA content of milligrams/L acetic acid is calculated using the system: (NAOH volume) 87.5. Method 2 makes a titration process corresponding to the VFA and the alkalinity to correspond to a cut. The pattern must be passed through the first 0.45µm membrane filter. A filtered sample of 20-50 ml has been placed in a cortex vessel, ensuring that the pH electrode tip remains immersed. The initial pH is mentioned, and the pattern is consistently title with 0.1N sulfuric acid. Additional acid is gradually distributed to pH when four.3, where the volume is not referred to with A2 [ml]. This process maintains pH when 4.0, the factor that the amount of titrant is recorded A3 [ml]. A continuous blend of samples and titrant is necessary throughout titration to reduce atmospheric changes.

4.3. COMPOSITION OF KITCHEN WASTE OF PACE ITS:

The average composition of kitchen waste was investigated on several occasions. More than half of the garbage included raw vegetables and fruit residues. The volume of eggs and raw meat, which are important sources of pathogens, were relatively low at 1.5% and 1.2%, respectively, while boiled meat was about 5% of total waste

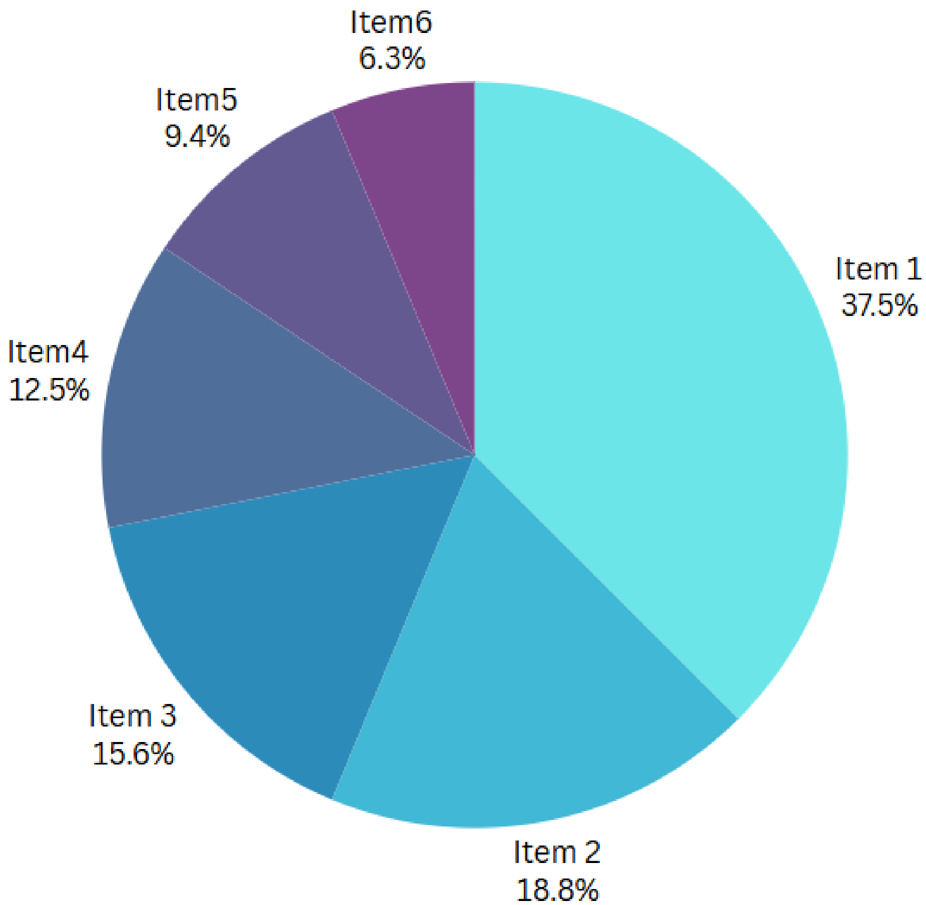


Figure 4: Composition of kitchen waste

1. Water
2. Cow Dung
3. Vegetable Waste
4. Egg Shells
5. Meat Waste
7. Rice

Figure-5: waste collection

4.5. Procedure And Start Up:

EXPERIMENT 3(N): Fresh cow dung turned into collected and punctiliously combined with water with the aid of hand earlier than being poured into a 20-liter digester. The contents from the previous test served as the inoculum, as it contained the vital microorganisms for aerobic digestion. Following inoculation, the digester changed into allowed to sit for several days, at some stage in which fuel production changed into monitored. After some days, kitchen waste was brought to evaluate its effect on gas production. EXPERIMENT 3(O): The composition of this digester is as follows: - 20-liter digester. - A aggregate of bovine manure, inoculum, and water - Cow dung: 2.5 liters - Inoculum: 3.8 liters - Water: thirteen.5 liters - pH: five.02 - Sodium hydroxide (NaOH) and sodium bicarbonate had been brought to adjust pH.

Figure-6: Preparation of modal

4.6. RESULTS:

The experiment indicates that we can produce about 10 liters of biogas every day using a 20-liter reactor (digester). According to the goals of our project, we aim to design 1000-liter reactors for each hostel, which uses kitchen waste directly as a raw material in the mess of the mess. Therefore, we conclude that under optimal conditions (such as pH, VFA, alkalinity, etc.), 1000-liter reactors can produce 650 liters of biogas daily.

Comparison of my biogas -DESTRY with traditional system:

Biogas systems use organic materials in the form of raw material, which is located in an airtight tank, where bacteria decompose the contents, resulting in biogas production, which mainly does methane and some carbon dioxide. These biogas can be used as fuel for cooking and other uses, while the remaining solid underpokes can serve as organic livestock manure. Research has shown that the use of raw materials with high calorie and nutrition value for bacteria can significantly increase methane production efficiency. This system is especially friendly to the user. A comparison table reflects the difference between traditional Bioga's system and biogas system for kitchen waste. In the latter, the kitchen produces garbage meter within 52 hours, while traditional systems, which rely on cattle, require 40 kg of raw material for equal amounts of methane.

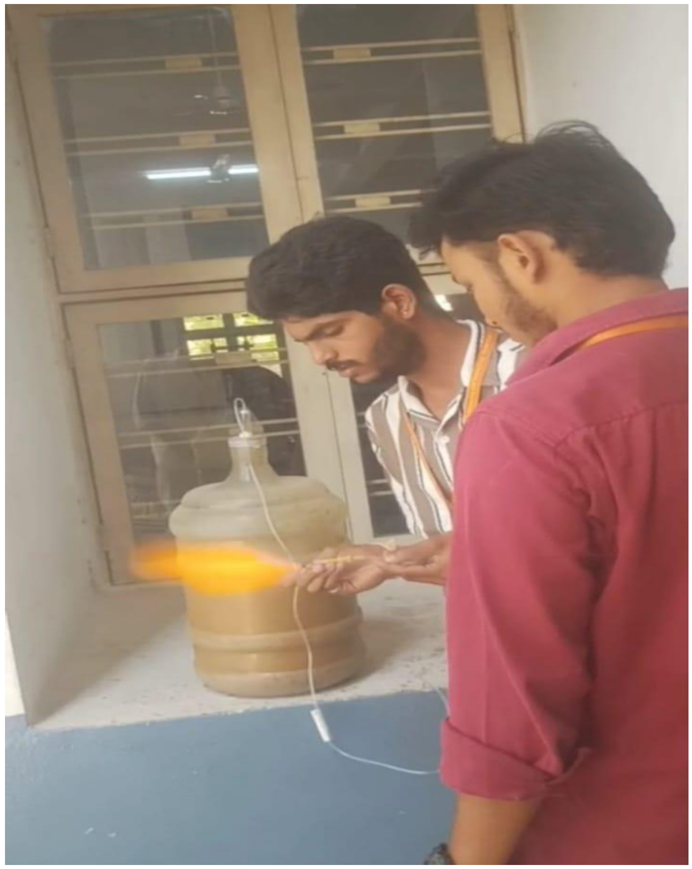


Figure-7: Result of Biogas

4.4. Discussions:

Conclusions suggest that set 2, including kitchen waste, produces more amount of gas than the other two sets. In particular, the set produces 250.69% more gas than the set 2 sets 1 and produces 67.5% more gas than the set 3. This suggests that the waste in the kitchen is more effective in gas production than cow dung, it is probably its high nutrients due to content. Therefore, the use of kitchen waste represents a more effective approach to biogas production.

The results indicate that the process of factories with bacteria reduces the pH level of the process. In this context, methanogenic bacteria, which use these fatty acids, show a slow response rate compared to others, making it a speed -limiting step in the total response. In set 2, involving kitchen waste, ph is significantly reduced, suggests rapid response; This indicates that hydrolysis and acidogenis processes occur faster because organisms use waste more efficiently than cow dung. In addition, the total fixed sets are more clearly reduced in 2.

Table 4: total solid concentration of set up.

Comparison with Conventional Bio-Gas Plants	Conventional Bio-gas Systems	Kitchen Waste Bio-gas System
Amount of feed stock	40kg +40ltrwater	1.5-2kg+water
Nature of feed stock	Cow-Dung	Starchy & sugary material
Amount and nature of slurry to be disposed	80ltr,sludge	12ltr,watery
Reaction time for full Utilization of feedstock	40days	52hours
Standard size to be installed	4,000lit	1,000lit

Figure-6: Biogas Modal

CHAPTER 5
CONCULSION

- **Skilled waste management:** This initiative shows how kitchen waste can be effectively converted to biogas, which reduces the pressure on landfill.
- **Renewable energy source:** Biogas acts as a permanent alternative for fossil fuels, increases energy security.
- **Cost -effective:** The process of converting bio -cot kitchen waste is more economical than traditional energy sources.
- **Reduces greenhouse gases:** reducing waste significantly reduces the production of methane, which reduces environmental effects**.**
- **Simple technology:** Anarobic digestive method is practical on small scale and social applications.
- **Nutritional underproduct:** The remaining solution serves as high quality organic fertilizer, which benefits soil health.
- **Scalable solution:** This system can be sewn for use in homes, restaurants and institutions.
- **Reduces LPG addiction:** Biogas can serve as an alternative to cooking LPG, which reduces the cost of fuel.
- **Encourage waste insulation:** It improves waste management practices between users.
- **Low maintenance:** When Biogas Dazester is installed, Biogas Dazester requires very little maintenance.
- **Short Peback period:** Initial investments are quickly achieved through savings on energy and fertilizer.
- **Odor and contamination decreases:** Anaerobic digestion reduces unpleasant odors compared to traditional waste composition methods.
- **The circular supports the economy:** it converts waste into valuable resources, including energy and fertilizer.
- **Education price:** This project increases awareness of permanent practice in the conversion of waste-to-energy.
- **The municipality reduces the waste load:** It reduces the load on municipal waste

management systems.

- **Favorable for urban and rural areas:** This system is suitable for different environments with proper waste collection.
- **Improves hygiene:** It reduces open waste dumping, which reduces the risk of disease.
- **Government and Political Aid:** This initiative corresponds to renewable energy and recycling policy for waste.
- **Community engagement:** It encourages community participation in environmentally friendly practice.
- **Future capacity:** With ongoing reforms in digester technology, biogas production can be more optimized for increased efficiency.

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