

Assessment of Solidwaste Generation in Akshaya College of Engineering and Technology

Dr. R. Premsudha¹, Hariskumar S², Maheswari³, Moovanthika G⁴, Regupathi raja J⁵

1.Prof and Head-Department of Civil Engineering

2,3,4,5UG Students, Department of Civil Engineering

Akshaya College of Engineering and Technology (Autonomous), Coimbatore, Tamil Nadu

Abstract: *Municipal solid waste (MSW) generation has increased due to population growth, urbanization, and changing lifestyles. Biodegradable waste such as food waste, vegetable residues, and paper waste causes environmental pollution when disposed improperly. Anaerobic digestion is an eco-friendly method that converts organic waste into biogas and nutrient-rich slurry through microbial action in the absence of oxygen. Biogas can be used as a renewable energy source, while the slurry can be used as organic fertilizer. The present study focuses on Assessment of generation of solid waste and biogas production from foodwaste with cowdung and paper mill waste. Assessment of generation of solid waste was conducted at Akshaya College of Engineering and Technology (ACET-Autonomous) Coimbatore covering an area of 16 acres (4,55,694 sq.ft). A Dheenabandhu-type biogas plant with a utilizing a combination of food waste and cow dung as feedstock under anaerobic digestion. The increasing generation of organic waste in educational institutions demands sustainable and sustainable and efficient waste management solutions*

Keywords: Biogas Production, Anaerobic Digestion, Solid Waste management, Renewable Energy, waste-To-Energy, Organic Waste, Environmental Sustainability

I. INTRODUCTION

Solidwaste management has become a major environmental concern due to rapid population growth, urbanization and increased consumption patterns .Solid waste refers to unwanted or discarded materials generated from households, institutions, agriculture and industries. In institutional environments such as Tamilnadu Agricultural University, large quantities of biodegradable waste are produced daily from hostels, canteens, farms and dairy units. Improper disposal of such waste can lead to environmental pollution, greenhouse gas emissions and health hazards. Therefore, sustainable waste management techniques are essential to reduce waste accumulation and promote resource recovery .Converting organic waste into useful energy through biological processes is one of the most effective solutions for managing biodegradable solid waste.

Biogas is a renewable and eco-friendly source of energy produced through the breakdown of organic matter in the absence of oxygen. It primarily consists of methane (CH₄) ,carbon dioxide (CO₂) and trace gases. Biogas technology plays a vital role in converting organic waste into clean energy while reducing environmental pollution. the use of biogas systems in institutions and rural areas helps in minimizing dependence's on conventional fossil fuels and promotes sustainable development. In campus like Tamilnadu Agricultural University. Biogas plants utilize waste such as food residues,cow-dung, paper waste and agricultural by products to generate fuel for cooking and other applications. Additionally the by product of biogas production known as slurry, serves as a nutrient rich organic fertilizer, enhancing soil fertility

1.1 Anaerobic Digestion Process

Anaerobic Digestion is a biological process in which microorganisms breakdown organic waste in the absence of oxygen(O₂).It uses materials like food waste,cow-dung,paper sludge and agricultural residues .this process takes place



inside a closed container called a digester. it produces biogas (mainly Methane (CH₃) and Carbon dioxide (CO₂)) and slurry (a nutrient rich fertilizer) it is an eco-friendly method of waste management and energy production.

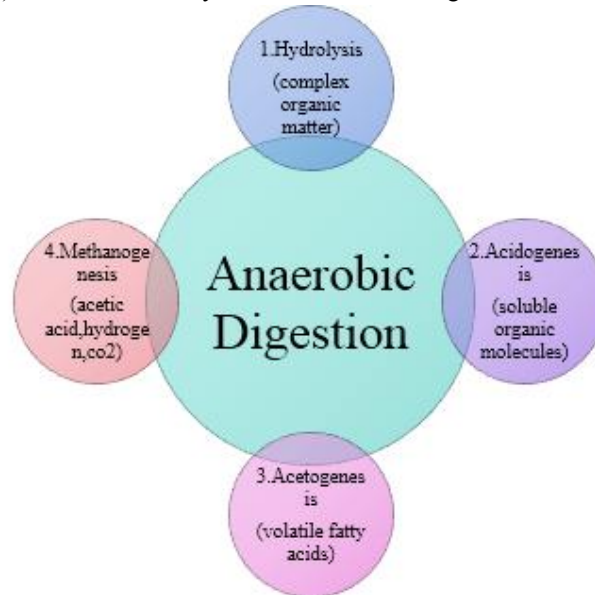


Fig 1. Anaerobic Digestion Process

1.2 Objectives of the study

1. To study the working principle of the existing biogas plant in Tamilnadu Agricultural University.
2. To collect and analyze the different types of biodegradable waste such as food waste ,cow-dung and paper waste used as feed stock.
3. To investigate biogas production using selected organic waste materials.
4. To measure the quantity of biogas produced under different feeding conditions.
5. To study the effect of waste composition on biogas yield through experimental observation.
6. To analyze the properties and usage of slurry obtained after digestion.
7. To identify operational issues during experimentation and suggest improvements.
8. To assess the overall performance of the biogas plant through practical investigation.

II. LITERATURE REVIEW

Author(s) & Year	Study Type	Feedstock / Substrate	System / Conditions	Key Findings
Gyadi et al., 2024	Review	Food waste, manure	pH, temperature, C/N ratio	Biogas yield depends on optimized parameters
Triviño-Pineda et al., 2024	Meta-analysis	Organic solid waste	42–69% MSW organic	High energy potential (5–7 kWh/m ³)
Kasinath et al., 2021	Review	Organic waste	Pre-treatment methods	Methane yield improves with optimization
Alam et al., 2022	Experimental	Food waste	37°C (mesophilic)	Stable digestion; ~2079 mL biogas
Karthik et al., 2023	Experimental	Kitchen waste	pH ~7, 37°C	High methane from starchy waste
Karne et al., 2024	Experimental	Food waste (rice,	24–28°C	High yield (554 L/kg)



		chapati)		
Ahmed et al., 2019	Experimental	Cow dung slurry	27–31°C, catalyst	Improved gas yield with catalyst
Hussaro et al., 2017	Co-digestion	Food + veg + chicken dung	pH ~6.8, ~30°C	72% methane; better C/N ratio
Manonmani et al., 2017	Co-digestion	Cow dung + food waste	40 days digestion	Increased yield with continuous feeding
Padmavathy et al., 2024	Co-digestion	Vegetable waste + cow dung	2:1 ratio, 35°C	66% methane; improved stability
Wembe et al., 2023	Experimental	Hyacinth + manure	40 days	Higher yield in mixed substrates
Pilarski et al., 2025	Review	Multi-feedstock	Advanced digestion systems	Up to 98% efficiency
Oh et al., 2018	Experimental	Food waste + wood chips	35°C	Improved fermentation efficiency
Shehata et al., 2024	Experimental	Cooked food waste	~21°C	Higher methane yield from cooked food
Jameel et al., 2024	Review	Food waste	10–20 days digestion	Temperature affects methane onset
Mezgebo et al., 2019	Experimental	Biomass (food waste)	13 days	32.9 kg/day biogas production

III. METHODOLOGY

3.1 Description of Akshaya College of Engineering and Technology

The initial phase of the study was carried out at Akshaya College of Engineering and Technology in Kinathukadavu. The campus consists of academic blocks, hostels, and mess/canteen facilities, which generate a considerable amount of organic waste on a daily basis. Akshaya College of Engineering and Technology is located in kinathukadavu, Coimbatore. The campus extends over an area of 16 acres with a total built-up area of approximately 4,55,694 sq.ft, consisting of academic buildings, laboratories, administrative block, hostels, and other facilities. Due to large campus population, a considerable amount of solid waste is generated daily. The college produces around 500 kg of food (wet) waste from canteens and hostels, and about 560 kg of dry waste such as paper, plastic, and packaging materials from academic and administrative activities. To manage biodegradable waste, the campus is equipped with a Dheenabandhu type biogas plant having a capacity of 17,650 litres. This system processes organic waste through anaerobic digestion, producing biogas that can be used as a renewable energy source for cooking or other applications within the campus.





Fig No.2. Map view of ACET

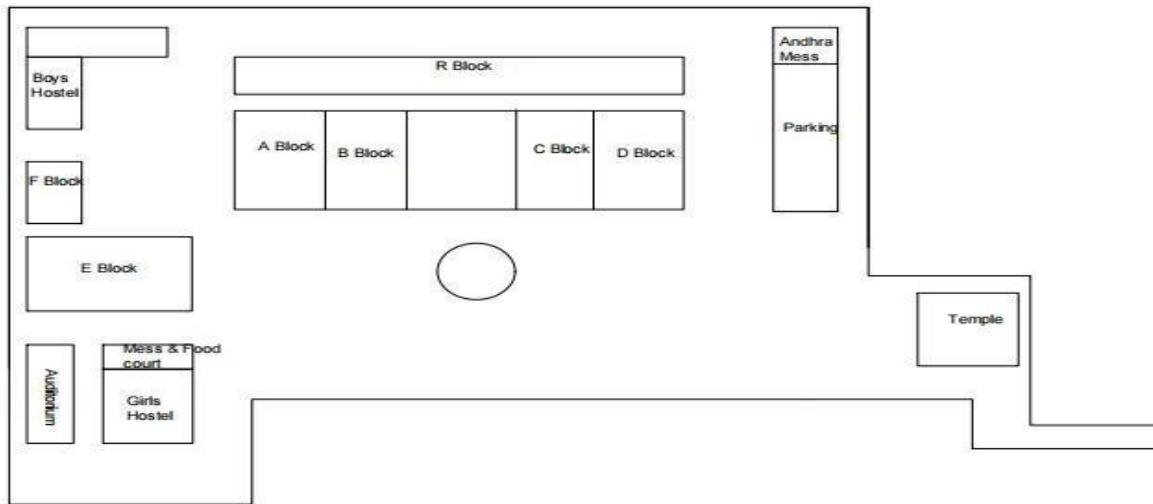


Figure : 3. ACET Campus

Table No.1 ACET Campus Block Description:

Block	No. of. class rooms	No. of. Staff rooms	Library	No. of. Labs	No.f. Restrooms			Open yard
					Boys	Girls	Staff	
A	6	1	1	1	-	2	-	1
B	1	-	-	10	-	-	-	
C	8	-	-	1	-	-	-	
D	3	2	-	2	-	-	-	
M	6	10	-	2	2	-	3	-
E	16	6	-	12	2	2	2	-
F	-	-	-	3	-	-	-	1
R								
Boys Hostel	102	1	-	-	7	-	1	1
Girls Hostel	63	1	-	-	-	4	1	1



Mess	-	1	-	-	-	-	-	-
Andhra Mess	-	-	-	-	-	-	-	-
Food Court	-	-	-	-	-	-	-	-
Gym	-	-	-	-	-	-	-	-

3.2 Data Collection of Building Blocks

The detailed survey of the entire college campus to understand the infrastructure and waste generation sources. All major blocks such as academic buildings (A, B, C, D, E, F, M, R), hostels (boys and girls), mess, food court, and other facilities are considered. Data collected includes number of classrooms, laboratories, staff rooms, restrooms, and the population using each block. This is essential because waste generation is directly related to the number of users and activities carried out in each location. For example, academic blocks mainly generate dry waste, whereas hostels and mess generate large quantities of wet (organic) waste. Proper data collection ensures accurate estimation of total waste generation and helps in designing an efficient waste management system.

3.3 Identification and Quantification of Solid Waste

After data collection, the next step involves identifying and quantifying the solid waste generated from each block. Waste is categorized into two main types: Each source is analyzed individually to determine the quantity of waste generated per day (in kg). The study shows that the majority of wet waste is generated from hostels and mess facilities, while dry waste is mainly from classrooms and offices. Dry Waste: paper, plastic, packaging materials, dust, etc. Wet Waste: food waste, vegetable peels, leftover food, organic matter. Main Block is located at East side of the plot area. It consists of various blocks such as: A-Block is located at North side of the plot area. B-Block is located at North side of the plot area. C-Block is located at south side of the plot area. D-Block is located at south side of the plot area.

Table No. 2 Quantity of Solid waste generation at Main Block

Block		A	B	C	D	M
Class Room	DW (kg)	5	0.5	7.25	2.5	5
	WW (kg)	-	-	-	-	-
Staff Room	DW (kg)	1	-	-	3	8
	WW (kg)	-	-	-	-	-
Labs	DW (kg)	0.5	7	0.5	1	2
	WW (kg)	-	-	-	-	-
Library	DW (kg)	0.5	-	-	-	-
	WW (kg)	-	-	-	-	-
Boys	DW (kg)	-	-	-	-	-
	WW (kg)	-	-	-	-	-
Girls	DW (kg)	-	-	-	-	-
	WW (kg)	2	-	-	-	2
Staffs	DW (kg)	-	-	-	-	-
	WW (kg)	-	-	-	-	3
Open Yard	DW (kg)	1	1	1	1	1
	WW (kg)	-	-	-	-	-



Table No.3 Quantity of Solid waste generation at E-Block

Block	Class Rooms		Staff Rooms		Labs		Restrooms						Open Yard	
	DW	WW	DW	WW	DW	WW	Boys		Girls		Staff		DW	WW
							DW	WW	DW	WW	DW	WW		
E	10	-	3	-	8	-	-	-	-	2	-	1	-	-

Table No. 4 Quantity of Solid waste generation at R-Block

Block	Class Rooms		Staff Rooms		Labs		Restrooms						Open Yard	
	DW	WW	DW	WW	DW	WW	Boys		Girls		Staff		DW	WW
							DW	WW	DW	WW	DW	WW		
R	10	-	3	-	8	-	-	-	-	2	-	1	-	-

Table No. 5 Quantity of Solid waste generation at Boys Hostel

Block	Rooms		Staff Rooms		Labs		Restrooms						Open Yard	
	DW	WW	DW	WW	DW	WW	Boys		Girls		Staff		DW	WW
							DW	WW	DW	WW	DW	WW		
Boys Hostel	20	-	1	-	-	-	-	2	-	-	-	0.5	5	-

Table No. 6 Quantity of Solid waste generation at Girls Hostel

Block	Rooms		Staff Rooms		Labs		Restrooms						Open Yard	
	DW	WW	DW	WW	DW	WW	Boys		Girls		Staff		DW	WW
							DW	WW	DW	WW	DW	WW		
Girls Hostel 1	10	15	3	2	-	-	-	-	5	15	1	1	7	-

Table No.7 Quantity of Solid waste generation at Mess

Block	Dinning Hall		Staff Hall		Labs		Restrooms						Open Yard	
	DW	WW	DW	WW	DW	WW	Boys		Girls		Staff		DW	WW
							DW	WW	DW	WW	DW	WW		
Mess	5	25	1	2	-	-	-	-	-	-	-	-	-	-

Table No.8 Quantity of Solid waste generation at Andhra Mess

Block	Dinning Hall		Staff Hall		Labs		Restrooms						Open Yard	
	DW	WW	DW	WW	DW	WW	Boys		Girls		Staff		DW	WW
							DW	WW	DW	WW	DW	WW		
Andhra mess	2	5	-	-	-	-	-	-	-	-	-	-	-	-



Table No.9.Quantity of Solid waste generation at Food Court

Bloc k	Hall		Staff Rooms		Labs		Restrooms						Open Yard	
	DW	WW	DW	WW	DW	WW	Boys		Girls		Staff		DW	WW
							DW	WW	DW	WW	DW	WW		
Food Court	10	5	-	-	-	-	-	-	-	-	-	-	-	-

Table No.10 Quantity of Solid waste generation at Gym

Bloc k	Hall		Staff Rooms		Labs		Restrooms						Open Yard	
	DW	WW	DW	WW	DW	WW	Boys		Girls		Staff		DW	WW
							DW	WW	DW	WW	DW	WW		
Gym	2	-	-	-	-	-	-	-	-	-	-	-	-	-

3.12. BIO-METHANATION UNIT

3.12.1 In Akshaya College of Engineering and Technology(ACET)

In Akshaya College of Engineering and Technology(ACET) Dheenabandhu type fixed dome biogas plant with a capacity of approximately 17,650 liters. This type of digester is constructed underground using brick or concrete and does not have any moving parts.

- Inlet Chamber-The inlet chamber is used to feed the slurry into the digester. The mixture of FW, CD or PS, and water is added through this section.
- Digester-The digester is the main chamber where anaerobic digestion occurs. Microorganisms break down organic matter and produce biogas in the absence of oxygen.
- Outlet Chamber-The outlet chamber removes the digested slurry. As new slurry is added, the old slurry is pushed out.



Fig No. 4 & 5 Inlet chamber Digestion chamber and Gas holder ACET Campus





Fig No. 6.Outlet Chamber ACET Campus

IV. RESULT AND DISCUSSION

The experimental study was structured to evaluate the performance of a Dheenabandhu type fixed dome biomethanation unit for the conversion of organic waste into renewable energy. While preliminary substrate characterization was initiated at Akshaya College of Engineering and Technology,

4.1.1 Environmental and Institutional Impact

This biomethanation approach serves as a sustainable solution for institutional waste management, particularly for college campuses. The system effectively reduces the volume of organic waste while generating biogas suitable for cooking applications. Furthermore, the digested slurry collected at the end of the process is nutrient-rich, containing essential elements like nitrogen, making it a high-quality organic fertilizer that promotes sustainable agricultural practices. Overall, the study confirms that a waste-to-energy approach using a Dheenabandhu plant is technically feasible, cost-efficient, and eco-friendly.

4.2. INITIAL CHARACTERISTICS of SUBSTRATE

The initial characteristics of the substrates used in the study were analyzed to understand their suitability for anaerobic digestion and biogas production. The selected wastes include FW, CD, and PS, which were tested for parameters such as pH, moisture content, TS (TS), VS (VS), nitrogen content, total organic carbon (TOC), and C/N ratio. The results indicate that CD has a higher nitrogen content, which supports microbial growth, while FW contains higher VS, indicating good biodegradability. PS shows a higher carbon content and C/N ratio due to its fibrous nature, which may slow down the digestion process. These initial characteristics play an important role in determining the efficiency of biogas production, as a balanced C/N ratio and suitable No. pH are essential for effective anaerobic digestion. The values obtained are presented in the Table 4.1. below.

Table No. 11. Chemical composition of CD

S.No	Parameter	Value
1.	pH	6.8
2.	Moisture Content (%)	85
3.	EC (mS/cm)	4.6
4.	TS (%)	69.67
5.	TDS (mg/L)	5.32
6.	VS (%)	52.5
7.	VFA (mg/L)	285
8.	Nitrogen (%)	2.8
9.	TOC (%)	53.4
10.	C/N Ratio	19.07



Table No.12 Chemical composition of FW

S.No	Parameter	Value
1.	pH	5.9
2.	Moisture Content (%)	80
3.	EC (mS/cm)	13.8
4.	TS (%)	93.56
5.	TDS (mg/L)	8.12
6.	VS (%)	86.3
7.	VFA (mg/L)	356
8.	Nitrogen (%)	1.6
9.	TOC (%)	39.7
10.	C/N Ratio	24.81

5.1 SUMMARY

The present study was carried out to investigate the efficiency of anaerobic digestion for biogas production using biodegradable waste materials such as FW, CD, and PS. The study was initiated at Akshaya College of Engineering and Technology at Kinathukadavu, where preliminary work including literature review, problem identification, and substrate selection was performed. Due to limitations in experimental facilities and insufficient availability of organic waste,

5.2 SCOPE FOR FUTURE STUDY

The following suggestions are recommended for further study:

- Substrate Analysis: Detailed analysis of substrates can be carried out by studying additional parameters such as lignin, cellulose, and hemicellulose content to better understand degradation characteristics.
- Biogas Production Optimization: The efficiency of biogas production can be improved by optimizing operating parameters such as Temperature, pH, Hydraulic Retention Time (HRT), and Organic Loading Rate (OLR).
- Co-digestion Studies: Further studies can be conducted by incorporating other biodegradable wastes such as agricultural residues, vegetable market waste, and industrial organic waste along with FW, CD, and PS.
- Kinetic Modeling: Advanced kinetic models can be applied and compared with the Modified Gompertz model to improve prediction accuracy of biogas production.
- Pilot Plant Study: A pilot-scale biogas plant can be implemented using FW generated from institutional hostels or canteens to evaluate large-scale feasibility of the process.
- Biogas Upgradation: Further research can be carried out on purification and upgrading of biogas to biomethane for use as vehicle fuel or for injection into gas grids.
- Slurry Utilization: Detailed studies can be conducted on the use of digested slurry as an organic fertilizer, including its effect on soil properties and crop yield.
- Continuous Digestion System: Instead of batch process, continuous feeding systems can be studied to improve efficiency and ensure steady gas production.

REFERENCES

- [1]. Abanades, S., (2022). A conceptual review of sustainable electrical power generation from biogas. *Energy Science & Engineering*, 10(2), 630–655.
- [2]. Achinas, S., Achinas, V., & Euverink, G. J. (2017). A Technological Overview of Biogas Production from Animal Manure. *Engineering*, 3(3), 299-307.



- [3]. Ahring, BK 2003, 'Perspectives for anaerobic digestion', *Advances in Biochemical Engineering/Biotechnology*, vol. 81, pp. 1-30.
- [4]. Al Mamun, M. R., & Torii, S. (2017). Enhancement of methane concentration by removing contaminants from biogas. *Renewable Energy*, 6, 31-41.
- [5]. Angelidaki, I & Sanders, W 2004, 'Assessment of the anaerobic biodegradability of macropollutants', *Applied Microbiology and Biotechnology*, vol. 63, pp. 143-152.
- [6]. Angelidaki, I & Sanders, W 2004, 'Assessment of anaerobic digestion process', *Applied Microbiology and Biotechnology*, vol. 59, pp. 130-139.
- [7]. Angelidaki, I., & Ellegaard, L. (2003). Codigestion of manure and organic wastes in centralized biogas plants. *Applied Biochemistry and Biotechnology*, 109, 95-105.
- [8]. Appels, L, Baeyens, J, Degève, J & Dewil, R 2008, 'Principles and potential of anaerobic digestion', *Progress in Energy and Combustion Science*, vol. 34, pp. 755-781.
- [9]. Awasthi, M. K., (2017). Evaluation of biogas production from food waste and sewage sludge. *Bioresource Technology*, 238, 139-145.
- [10]. Awasthi, MK, Pandey, AK & Bundela, PS 2014, 'Co-composting of organic fraction of MSW', *Waste Management*, vol. 34, pp. 437-445.
- [11]. Banks, CJ.,2011, 'Anaerobic digestion of source segregated waste', *Waste Management*, vol. 31, pp. 798-803.
- [12]. Banks, CJ, Chesshire, M, Heaven, S & Arnold, R 2011, 'Anaerobic digestion of source-segregated domestic food waste', *Waste Management*, vol. 31, pp. 798-803.
- [13]. Bhatia, L.,(2023). Food waste utilization for reducing carbon footprints towards sustainable and cleaner environment: a review. *Int. J. Environ. Res. Public Health*, 20(3), 2318.
- [14]. Bolzonella, D, Innocenti, L, Pavan, P, Traverso, P & Cecchi, F 2003, 'Semi-dry anaerobic digestion of organic fraction of municipal solid waste', *Bioresource Technology*, vol. 88, pp. 43-50.
- [15]. Bond, T., & Templeton, M. R. (2011). History and conflict of codigestion of food waste and sewage sludge. *Energy Policy*, 39(6), 3420-3430.
- [16]. Bouallagui, H 2005, 'Mesophilic biogas production from fruit waste', *Process Biochemistry*, vol. 40, pp. 989-995.
- [17]. Bouallagui, H, Haouari, O, Touhami, Y & Hamdi, M 2005, 'Mesophilic biogas production from fruit and vegetable waste', *Process Biochemistry*, vol. 40, pp. 989-995.
- [18]. Bouallagui, H, Torrijos, M, Godon, JJ, Moletta, R, Cheikh, RB, Touhami, Y, Delgenes, JP & Hamdi, M 2004, 'Two-phase anaerobic digestion of fruit and vegetable wastes', *Biochemical Engineering Journal*, vol. 21, pp. 193-197.
- [19]. Brown, D., & Li, Y. (2013). Solid state anaerobic digestion of lignocellulosic biomass for biogas production. *Bioresource Technology*, 127, 275-280.
- [20]. Budiyo, Widiyasa, IN, Johari, S & Sunarso 2010, 'The kinetic of biogas production rate from cattle manure', *International Journal of Chemical and Biological Engineering*, vol. 3, no. 1, pp. 39-44.

