# Use of Lab Scale Reactor for Performance Evaluation of Anaerobic Digestion Through Cane Grass and Buffalo Pats

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The aim of present research is to check performance of cane grass with buffalo pats and its slurry in anaerobic digester. Lab scale based reactors were modeled to evaluate the biogas production potential of organic-waste. The reactors are made up of synthetic cans. After several changes in the components, these models are used for biogas production. The study found the production of biogas was 0.45m3/kg for the cane grass (CG) to buffalo pats (BP) with ratio of CG:BP as 50:50 at 35oC. Similarly for the different combination ratios of CG:BP-60:40, CG:BP-70:30, CG:BP-80:20 and CG:BP-90:10 same methodology was followed. In this ratios production of biogas were found 0.50, 0.42, 0.27, 0.23 m3/kg respectively.
**Keywords:** Anaerobic, Biogas, Digestion, Grass, Reactor, Slurry.

## 1. Introduction

Anaerobic digestion (AD) is the reduction process of organic-matter in absence of oxygen. The process frequently utters its siginficane and effects (Wang et al. 1995). In the design or analysis of a waste disposal system, awareness of bio-degradability of the feed-stock material is crucial (Gupta and Lataye, 2018). Few key factors like heat, grinding, blending, substrate-cosubstrate conditions, loading-rate and pre-post treatment are very important (Rekha and Pandit, 2013). Experimental studies arebeing conducted by different researchers so as to spot suitable working situations with waste disposal. Hydro-lysis, acido-genesis and methano-genesis are 3 stages of AD (Pereira et al. 2005). Enzymes and pathogens hydro-lyzes compounds into sugars and amino-acids (Gupta and Lataye, 2019). These sugars and amino-acids are then altered into strong volatile-fatty-acids (VFA), $H_2$, $CO_2$, and acetic-acids through acido-genesis (Sosnowski et al. 2003). Lastly methano-genesis alters VFA, $H_2$, $CO_2$, and acetic-acids to methane.

## 2. Method Adopted

The present study advocates the use of lab-scale reactor (LSR) for performance evaluation of AD through cane grass (CG) and buffalo pats (BP) from lingo-cellulosic substrate-cosubstrate respectively. The feed-stock worn in the research is cane grass as a main-substrate and buffalo pats with slurry as cosubstrate. CG was co-digested with BP and slurry in LSR. The effect of temperature, CG size, CG:BP ratios were experimentally evaluated. Effect of various parameters like moisture-content (MC), total-solids (TS), volatile-solids (VS) and fixed-solids (FS) were analyzed for inlet-outlet slurry.

*A.* Equipment used:

In the present study 2 major machines are worn for the grounding of cane grass. It is represented in Fig. 1.

- Chaff-cutter - An engineered chaff cutter is used for cutting of cane grass in identical size. CG is cut uniformly into pieces in the size of 3 mm (Gupta and Lataye, 2017).
- Grinder - A wet grinder consisting of revolving drum and electric motor is used to for grinding cane grass material (Amon et al. 2007).

Fig.1: Chaff-cutter and Grinder

*B.* Reactor used:

The different feed-stock ratios of CG:BP assembled under different digesters are represented in Fig. 2. BP were collected from local buffalo shed of the town.

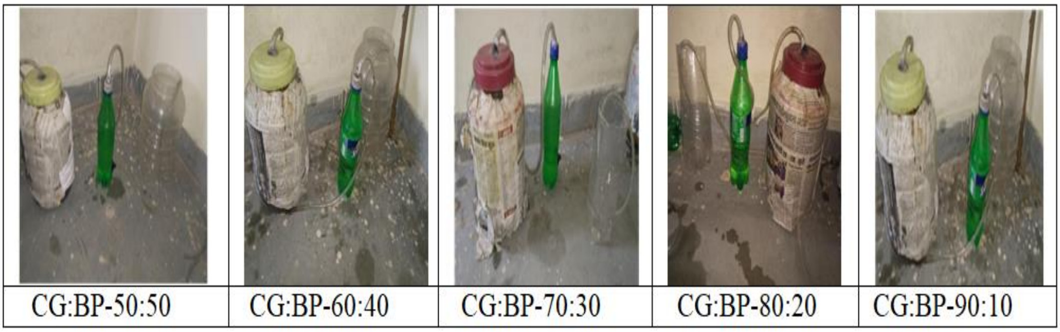


Fig.2: Different ratios of lab scale reactors of CG:BP

Working of Reactor-I,II,III,IV,V considers water displacement technique wherein 1 full water poured synthetic bottle was attached to LCR. A tube joined from synthetic water bottle is transported to bare unfilled container so as to accumulate the receiving water from the bottle in LCR (Fig. 2) (Lindorfer et al. 2008). These LCRs are monitored continuously up to 30 days at $35^0$C. The details of different feed-stock materials for CG and BP are represented in Table 1.

Table 1: Details of different feed-stock materials for CG and BP

| Reactor Type | Ratio of CG:BP | Quantity of CG | Quantity of BP |
|---|---|---|---|
| Reactor-I | 50:50 | 1 | 1 |
| Reactor-II | 60:40 | 1.2 | 0.8 |
| Reactor-III | 70:30 | 1.3 | 0.7 |
| Reactor-IV | 80:20 | 1.4 | 0.6 |
| Reactor-V | 90:10 | 1.5 | 0.5 |

After aggregation of feed-stock materials, appropriate manual mixing was conceded out by considering volume of the respective LCRs. Mixing was carefully conducted by ensuring that no containments are present in LCRs. Around 30 days observations were monitored (Uzodinma et al. 2014). All the LCRs are air-water tight so that sufficient pressure gets created to displace the water for biogas generation. Daily physical shakeup was made to make sure and safe contact between the pathogens and feed-stock for efficient biogas production. The biogas gas generated by the feed-stock i.e. (CG:BP) inside LCR was passed to the water container through tubes.

## 3. Results and Discussion

Effectiveness and competence of the process must be evaluated to acquire complete idea of ongoing AD treatment on LCRs (Dina et al. 2016). The pH, volatile-fatty-acid, total-solids and alkalinity are considered to be stable in a given process. Different characteristics have been monitored, analyzed andevaluated. For the analysis of biogas produced by AD, a total 5 LCRs were modeled. The LCRs consist of CG as a substrate with BP and slurry mixed in different proportions as co-substrate.

- Performance evaluation of LCR

After the 45 days setup, events like AD-LCR monitoring, slurry mixing of CG:BP. were executed. During the first early days, lesser biogas generation was observed. But gradually after few days, rise in biogas generation was observed owing to water displacement technique. From Fig. 3, it was observed that the production of biogas is 0.45 $m^3$/kg for CG:BP 50:50 at 35ºC. Similarly for the ratios of CG:BP as 60:40, 70:30, 80:20 and 90:10 same process was repeated. In this ratios, biogas generation rate were obtained as 0.50 $m^3$/kg, 0.42 $m^3$/kg, 0.27 $m^3$/kg, 0.23 $m^3$/kg respectively. During evaluation, it was observed that rate of biogas generation was in constantly decreasing state. It was also noticed that varied lingo-cellulosic intakes of different proportions of CG:BP affect generation rate of biogas.

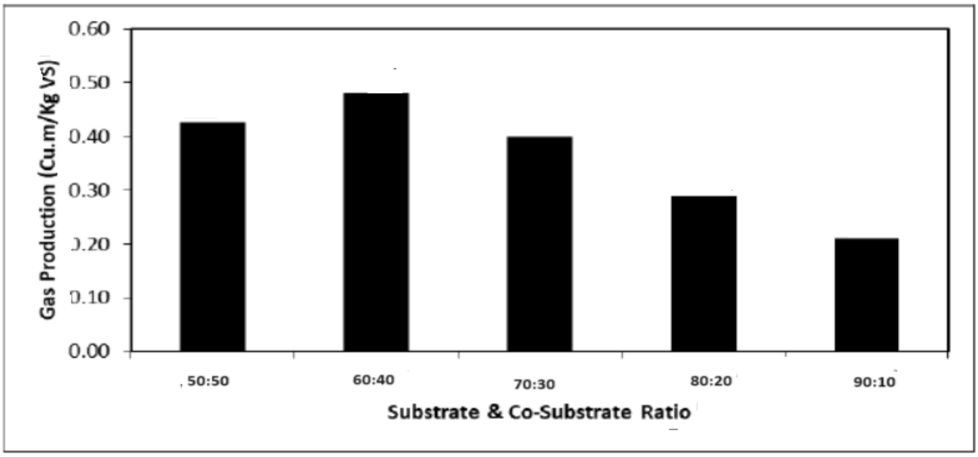


Fig. 3: Gas production for CG:BP

- Characteristics of inlet-outlet slurry

Inlet slurry has combination of CG and BP in varied ratios. In the present work, combination differs as per the proportions of CG and BP. The characteristics of the slurry like moisture-content, total-solids, volatile-solids and fixed-solids are important to study. The results are represented in Fig.4.

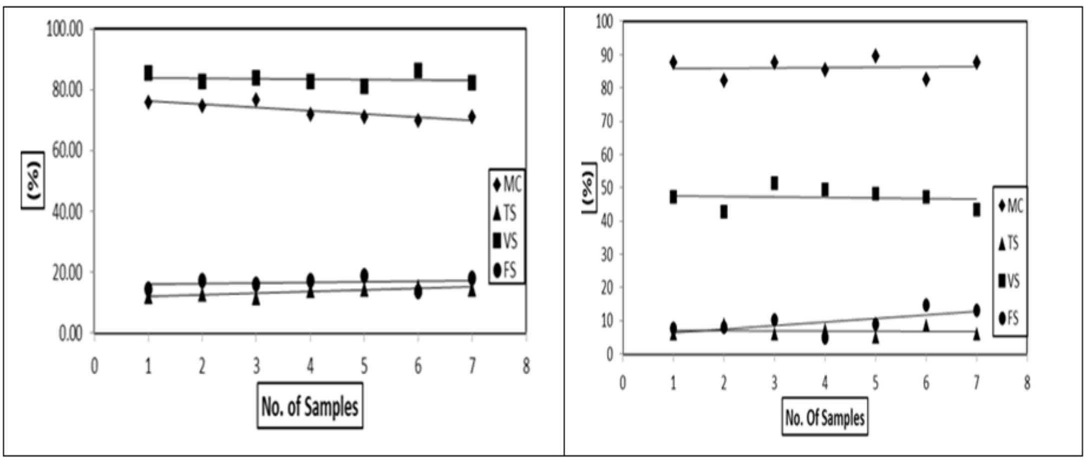


Fig. 4: Inlet-Outlet slurry characteristics of CG:BP

The Fig.4. shows variation in the characteristics of the inlet and outlet slurry. The average of the samples is taken. It was observed that inlet slurry has moisture-contents as 75.05%, total-solids as 12.52%, volatile-solids as 82.89% and fixed-solids as 16.81%. It was also observed that outlet slurry has moisture-contents as 85.92%, total-solids as 7.14%, volatile-solids as 46.95% and fixed-solids as 9.98%.

- Evaluation of volatile-solids diminution of CG-BP

Similar methodologies for evaluation of volatile-solids diminution were considered in the different proportions of LCRs of CG:BP. This evaluation of diminution is crucial and it affects biogas generation rate. It is represented in Fig. 5.

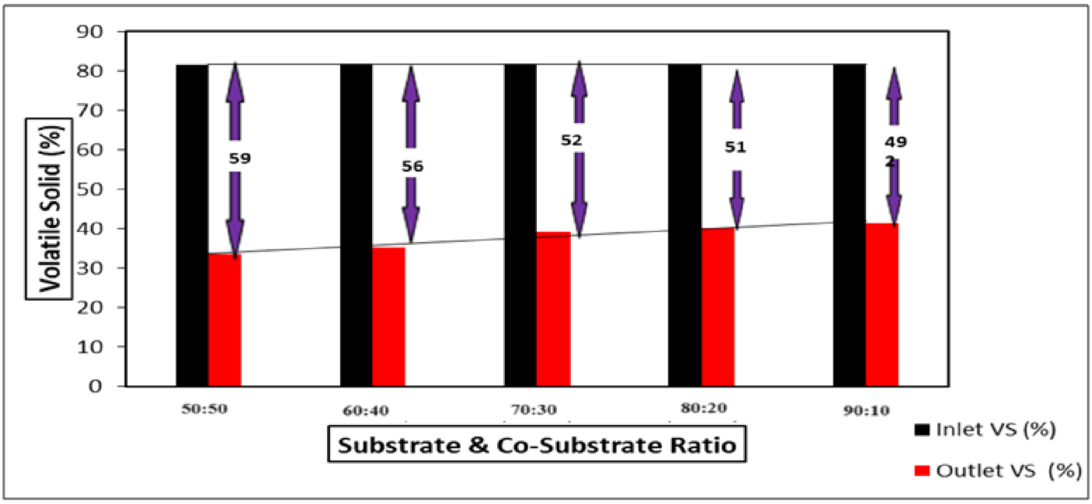


Fig.5: Volatile-solids diminution of CG:BP

The different characteristics of inlet-outlet slurry for 5 varied proportions i.e. CG:BP as 50:50, CG:BP as 60:40, CG:BP as 70:30, CG:BP as 80:20 and CG:BP as 90:10 was assessed and evaluated. The volatile-solids reduction was found 59%, 56%, 52%, 51% and 49% respectively. It was noticed that contribution of volatile-solids diminution reduced by 53.70% by increasing content from 50% to 90%. At higher proportions of CG, volatile-solids diminution dropped considerably.

## 4. Conclusion

The present research work was carried out with an idea to evaluate performance of anaerobic digestion (AD) for biogas generation through a mixture of cane grass (CG) and buffalo pats (BP) using different lab scale reactors (LCRs). The study found the production of biogas was 0.45m$^3$/kg for the CG to BP with ratio of CG:BP as 50:50 at 35$^o$C. Likewise for the different mixture proportions of CG:BP as 60:40, CG:BP as 70:30, CG:BP as 80:20 and CG:BP as 90:10 similar results were observed. In this proportions, biogas generation rate were found as 0.50 m$^3$/kg, 0.42 m$^3$/kg, 0.27 m$^3$/kg, 0.23 m$^3$/kg respectively. From the biogas generation, it can be concluded that gas production achieved at an average rate of 19% by increase in the contribution of cane grass and optimum ratio found to be CG:BP (60:40). After comparison between inlet-outlet slurries, certain deviations was noticed in outlet slurry that the moisture-contents is increased by 10.87%, total-solids are decreased by 5.38%, volatile-solids are decreased by 35.94% and fixed-solids are decreased by 6.83.

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