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CO-DIGESTION OF COW DUNG AND RICE STRAW USING GELATIN AS ADDITIVE

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Abstract *- The purpose of this study was to find the production ability of biogas from cow dung (CD) and rice straw (RS) using gelatin as an additive. In this study conical flasks made of glass were used as digesters. 450gm slurry was made maintaining a total solid content of 8%. Four different percentages of gelatin 0.2, 0.4, 0.6 and 0.8% (w/w) was used in the slurry. In a 73 days of observation time, the maximum amount of gas produced was 23351 ml/kg of CD+RS for addition of 0.8% (w/w) gelatin. With the addition of gelatin, total biogas production was found to be increased up to 73% as compared to digestion without gelatin. This study has shown that gelatin is a potential additive in production of biogas.*

Keywords: Biogas, Cow Dung, Renewable Energy, Rice Straw, Co-digestion

1. INTRODUCTION

Biogas is the source of renewable energy. It is mainly the biological breakdown of organic waste under oxygen-free conditions. From the observation of Xiaohua *et al* [1], interest of people to produce biogas is increasing because 1 m^3 of biogas can give us as much light as a 60-100 watt bulb for 6 hours, or can cook 3 meals for a family of 5-6 person, or can replace 0.7kg of petrol, or can generate 1.25 kWh of electricity.

Biogas is a non-polluting and renewable energy source. Mostly anaerobic digestion is used in producing biogas. Different animal manure and wastes are used in this process. Salam et al. [2] produced biogas from cow dung using silica gel as catalyst. 390 gm cow dung was mixed with 310 gm water maintaining 8% (wt.) total solid content. At 27-31°C, total gas production was found to be 27.3 L/kg CD without using silica gel and 30.5 L/kg CD using silica gel as catalyst. Pachaiappen et al. [3] explored the possibility of biogas production from water hyacinth blended with cow dung. At 35°C, 24% methane yield was achieved from a 50% water hyacinth + 50% CD mixture. Ukpai et al. [4] compared biogas production from cow dung, cow pea and cassava peeling. Cow dung slurry was made with 1:2 ratio of cow dung to water. For cow pea and cassava peeling the ratio was 1:5. Highest cumulative biogas yield of 124.3 L/total mass of slurry (TMS) from cow dung while 87.5 L/TMS from cow pea and 87.1 L/TMS from cassava peeling was obtained. Eze et al. [5] compared production of biogas from cow dung and commercial fruit wastes. Cow dung slurry was made with 1.5 kg cow dung and water in 1:9 (w/v) ratio. Total 0.5 kg of crushed orange, tomato, and garden egg was blended in 1:1:1 (w/w) ratio and mixed with water in 1:9 (w/v) ratio. Total 34,276 ml gas was produced from cow dung and 12,895 ml gas was produced from the fruit wastes. Cow dung was declared more efficient than fruit wastes for biogas production.

This study was conducted using rice straw, cow dung, and gelatin as an additive. The main objectives of this study was-

i. To verify the production ability of biogas from cow dung and rice straw.
ii. To find the effect of gelatin as an additive in biogas production.

The total gas production with respect to the addition of gelatin in this study acknowledges the potential of gelatin as an additive in biogas production.

2. MATERIALS AND METHOD

Cow dung and rice straw were collected from Unosottor Para, a village outside of Chittagong University of Engineering and Technology campus. Gelatin was collected from reputed scientific store. Then the total solid contents for cow dung were calculated by drying those raw materials in the oven at 105℃ until a constant weight was achieved. Five sets of experiments were conducted in parallel for different amounts of Gelatin.

2.1 Experimental Setup

Two main components of a biogas plant are – digester and gas holder. Five conical flasks made of glass were used as digesters. At first, the mixture of cow dung, rice straw, and gelatin were kept in a conical flask for the anaerobic digestion process. Then a plastic bottle containing water was connected to the conical flask with a plastic tube. Another plastic bottle was connected with the water container with a plastic tube to store the water displaced by

gas pressure in water displacement method as shown in Fig. 1. The connections were sealed to prevent interference of any other gasses or external pressure. The experimental setup of this work is shown in Fig. 2.

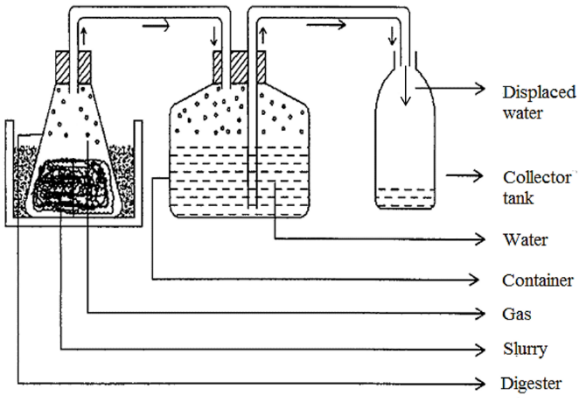

Fig. 1: Schematic of experimental setup

Fig. 2: Picture of the experimental setup

Rice straw was collected and chopped into small pieces as shown in Fig. 2 and gelatin was collected from a scientific store as shown in Fig. 4.

Fig. 3: Rice straw

2.2. Calculation of raw materials used

Moisture content was determined using the oven drying method. Two cow dung samples and two rice straw samples were placed in the oven and kept at 105°C. The process was repeated until a constant weight had been achieved. The dried sample was cooled to the room temperature and then weighed. The moisture content of cow dung (CD) and rice straw (RS) were found to be 83% and 19% respectively.

Fig. 4: Gelatin

Hasan [6] produced biogas from co-digestion of cow dung and rice straw. By analyze his result it found that the optimum ratio for highest gas production is Cow dung: Rice straw (w/w) = 10:1. In this study, ratio between cow dung (CD) and rice straw (RS) was kept 10:1.
Total Solid Content (TS) between 7.4 and 9.2% is optimum for gas production [7]. So, 8% TS in the slurry was maintained in this work.

After drying in the oven, the calculated solid content of cow dung (CD) and rice straw (RS) were 17% and 81% respectively. A 450gm liquid slurry was made which is nearly 65-70% of the total capacity of the conical flask by volume. The whole setup was kept at 27-30°C and observed gas production for 73 days.

3. RESULT AND DISCUSSION

The total production of methane gas was found to be 13526 ml/kg of CD+RS without using gelatin. Using 0.2, 0.4, 0.6, and 0.8% gelatin the total production of gas was found 17538 ml/kg, 18704 ml/kg, 19300 ml/kg, and 23350 ml/kg of CD+RS respectively.

By analyzing the data, it has been found that the total gas production with respect to the percentage of gelatin is maximum at 0.8% gelatin as shown in figure 4.
Therefore, production increases 72.63% using 0.8% gelatin which is maximum among the five different percentages of gelatin used.

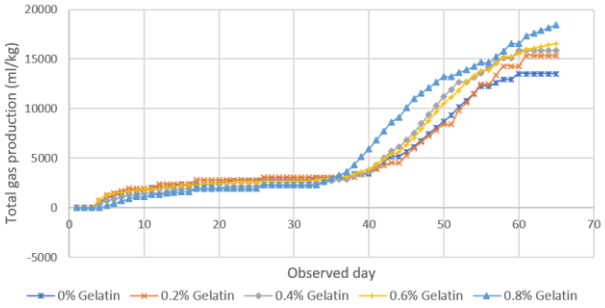

Fig. 5: Total gas production vs. observed day

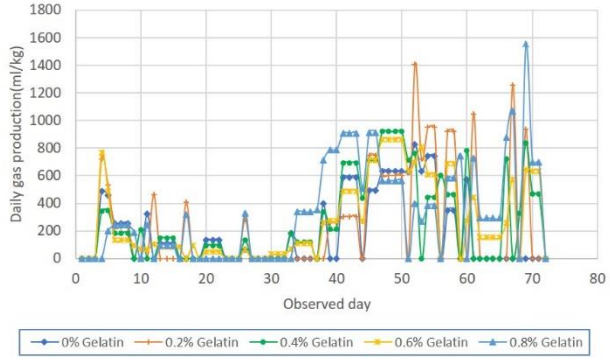

Fig. 6: Daily gas production vs. observed day

Figure 6 shows that daily gas production is much less in the beginning compared to the last 30 days.

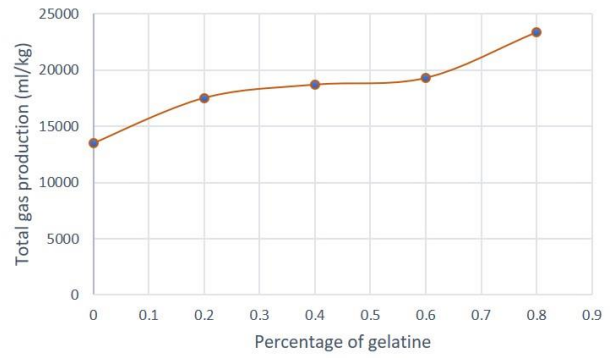

Fig. 7: Total gas production vs. percentage of gelatin(w/w)

The graph in Fig. 7 suggests that the use of gelatin increases gas production. But the graph in Fig. 5 shows that the gas production needs longer time. At the first 35 days total gas production using gelatin is less than the total gas production without gelatin. The trend of 0.8% gelatin is at the bottom of others for first 35 days but gets to top after the first 35 days.

It can be said from this experiment that mesophilic anaerobic digestion is efficient for biogas production. Analyzing the data, it can be said that biogas production from cow dung strongly depends upon the use of the additives as a catalyst. In this case, gelatin was a great success and gas production increased with the addition of gelatin up to 0.8%. It can be also said that mesophilic anaerobic digestion is feasible for practical implementation. And the temperature should be kept at 27°-30°C.

4. CONCLUSION

Use of certain inorganic, organic additives (such as Gelatin) seems to be promising for enhancing biogas production. However, their utility is limited due to the seasonal availability in different regions. Using 0% gelatin yielded 13526 ml/kg of CD+RS whereas using 0.8% gelatin yielded 23351 ml/kg of CD+RS. It clearly shows the positive effect of using gelatin as an additive with cow dung and rice straw as raw materials. Percentage of gelatin more than 0.8% (w/w) should be tried.

5. REFERENCE

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