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# BIOGAS PRODUCTION ENHANCEMENT BY USING GLYCERINE AS CO SUBSTRATE

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**ABSTRACT**

*This work reports enhancement in biogas production by using glycerine as a co-substrate with cow dung. Glycerine is a by-product in bio diesel industry, which is used to improve the biogas production as well as methane content. In this experiment the gas production is found to increase when compared to the one while using cow dung alone. From previous study it is found that when using glycerine in ratio of 4% and above (v/v) there is a significant drop in the pH of slurry due to production of volatile fatty acid which leads to decrease in gas over production. To cope with this problem a little amount of base calcium hydroxide is added to maintain pH and glycerine is added in ratio of 4% (v/v). The temperature was maintained between 34ºC to 40ºC. The pH was kept around 7. Overall gas production was increased by 10% and the methane content was also increased.*

***Keywords:* Biogas, glycerine, biodiesel, volatile fatty acid etc.**

## 1. INTRODUCTION

Biogas is simply a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Biogas is a renewable energy source and in some cases it exerts few carbon footprints also.

Biogas can be produced by anaerobic digestion with anaerobic organisms, which digest material inside a sealed system or fermentation of biodegradable materials [1].

Biogas is mainly methane ($CH_4$) and carbon dioxide ($CO_2$) and may have small amounts of hydrogen sulphide ($H_2S$), moisture and siloxanes. The gases methane, hydrogen, and carbon monoxide (CO) can be combusted or oxidized with oxygen. This energy release allows biogas to be used as a fuel; it can be used for any heating purpose, such as cooking. It can also be used in a gas engine to convert the energy in the gas into electricity and heat.

Biogas can be compressed, the same way natural gas is compressed to CNG, and used to power motor vehicles. In the UK, for example, it is estimated that about 17% of vehicle fuel will be replaced by biogas [2].

### 1.1 Crude glycerine and its conversion

Glycerol (or glycerine or 1, 2, 3-propanetriol) is a colourless, odourless, viscid and non-toxic alcohol, which melts at 17.8°C [3]. The chemical formula of glycerol is $C_3H_5(OH)_3$. Glycerol can be obtained from organic fermentation [4].

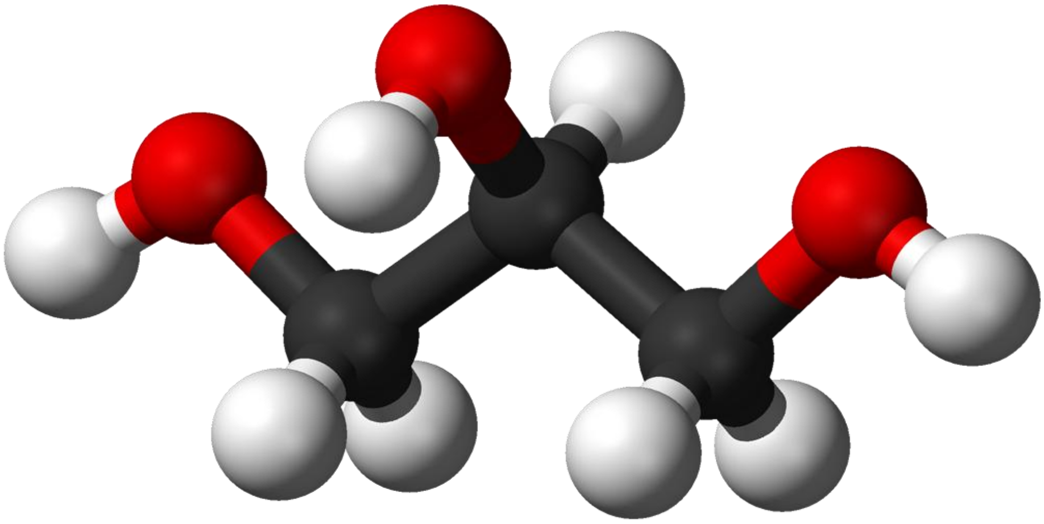

**Fig. Glycerol 3-D balls. Black ball for carbon red for oxygen and white for hydrogen[Benjah-bmm27].**

When glycerine is fed into slurry it decomposes into formate, acetate, hydrogen and carbon dioxide (as bicarbonate) which ultimately converted into $CH_4$ and thus increasing the net methane content.

The main disadvantage of the crude glycerine purification is its high cost and that is why it is out of the range of the economic feasibility of the small and medium size plants [5].

## II. MATERIALS AND METHODS

### 2.1 Cow Dung and Glycerine

Crude glycerine was obtained from a firm producing biodiesel. It was preheated before use to remove oils and fats. Fresh cow dung was collected from nearby dairy. Both are mixed in the ratio of 4% (v/v) of crude glycerine. 160 ml of glycerine is mixed in 4 litre of cow dung slurry. Some amount of base calcium hydroxide is added to maintain the pH around 7. The mixture was fed into the digester and kept for around 35 days. The gas was collected and tested in a gas analyser.

### 2.2 Temperature and pH control

A digital thermometer and a pH meter is fixed in the digester for proper reading. The temperature was kept between 34°C and 40°C. The heating is done externally so that the temperature does not fall in the night and pH was kept around 7.

### 2.3 Experimental Setup

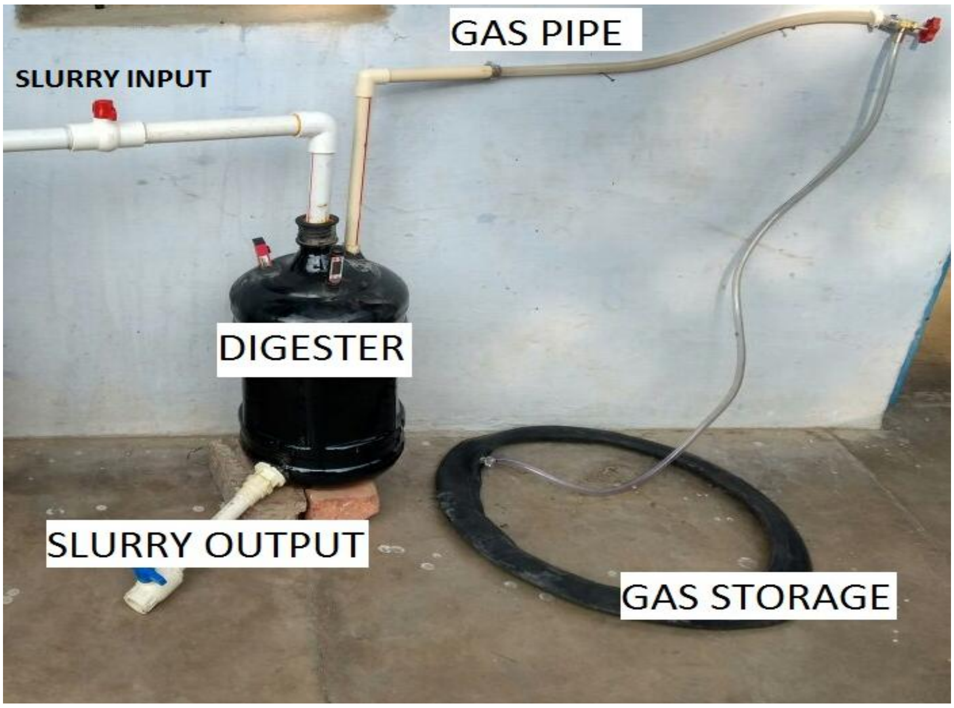


**Fig. experimental setup**

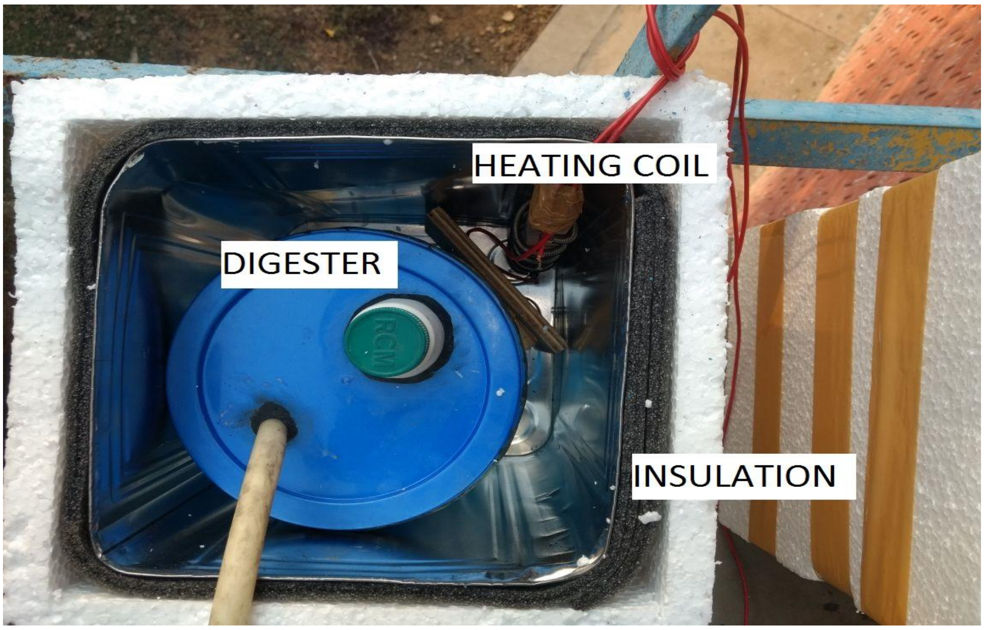


**Fig insulated digester**

The gas was collected in the tube continuously and then tested in gas analyser for different composition of gases.

### III. RESULTS AND DISCUSSION

From the results, the production of biogas with glycerine and without glycerine is shown in the figure below.

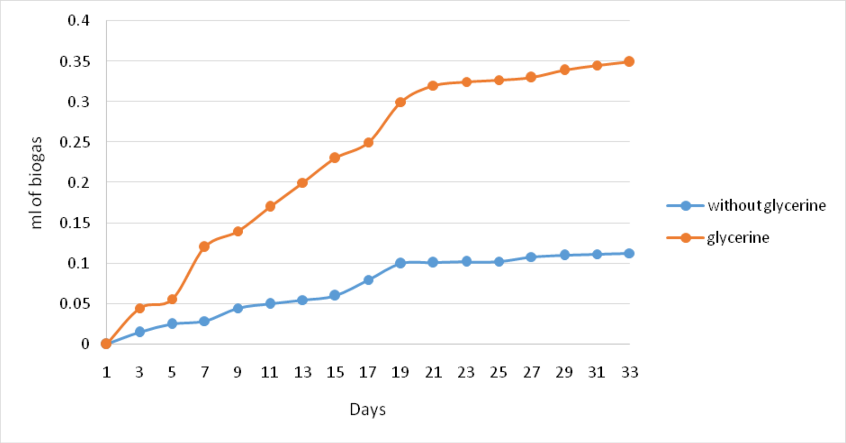


**Fig. production of biogas**

The volume of the biogas was measured for 33 days. The volume of the biogas was compared between 4% glycerine added along with cow dung and with cow dung alone. Clearly the volume obtained was more in the mixture of cow dung and glycerine. Also the methane content was more in glycerine mixture.

### IV. CONCLUSION

From the above study it is clear that after adding 4% glycerine and a small amount of base calcium hydroxide, the pH of the mixture does not go down and produces more biogas. From the previous studies it is found that with increase in the glycerine content there is a drop in pH and consequently decrease in biogas production (M. S. Fountoulakis et. al. 2009). With added base the pH remains in range and thus produces more biogas. The total biogas production and the methane content was more in the glycerine mixture as compared to the biogas produced with cow dung alone. The only limiting thing is that one should take care of the pH to prevent the mixture being acidic in nature.

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