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# Improving Biogas Electrical Power Generation Using Pig Dung-Gas Technology

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***ABSTRACT:****Biogas Electrical power production works on the principle of methane generation. Pig dung has little dry-matter and organic material content which yield large quantities of methane to produce electricity. This work observed that pig dung has best physiological and chemical parameters for methane production.This wasproved by establishing the futures of the network, designing a linear mathematical model from the established futures of pig dung, designing a Simulink model for Improving Biogas electrical power generation using pig dung and comparing results when different pig dungs are used. The result obtained when collected dung is used is 8KW of power while the result obtained when the mathematical model output dung is added to the collected dung is 8.131KW of power. By these results, it shows that as the number of pig dung increases the biogas electrical power output increases by 0.82%.when incorporated dung output from the mathematical model for improving biogas electrical power generation using pig dung.*
***KEY WORDS: -*** *Improving, power generation, pig dung*

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## I. INTRODUCTION

Biogas is a biological gas which originates from bacteria in the process of biodegradation (fermentation) of organic material (from plants, animals and sometimes human origins) under anaerobic (oxygen free) and is one of the most widely used and familiar form of biomass. It is produced by microorganisms, especially in the absence of oxygen. Biogas can also be formed at the bottom of lakes where decaying organic matter builds up under wet and anaerobic conditions [6], [7], [3].This technology can contribute to energy conservation if the economic viability and social acceptance of this technology are favorable. Our campus has a number of hostel buildings which generates large quantum of kitchen waste and sewage per day. The waste generated from kitchen and sewage from the hostels is given as feedstock to produce 600 $m^3$ of biogas per day with cow dung as byproduct. The methane gas generated from Biogas is purified and this is used for power generation [2]. The biogas digester is operated normally by producing biogas containing 58% methane at an average digester temperature of 29.8°C. The 1 $m^3$ biogas digester yielded biogas between 60 and 140 liters daily [1]. [4] Discovered that with the total swine population (around 4.3 million heads) from the farm scale of over 1,000 heads of pigs in Taiwan, the estimation shows the economic benefits of using biogas, including an annual electricity generation of $2.67 \times 10^8$ $kWh_e$ (corresponding to electricity charge savings of US$ 26.7 million), where natural gas charge savings total US$ 8.7 million, and the carbon dioxide reduction totals 180,000 tons. The 95 million animal units in the country could produce nearly 1 quad of renewable energy per year. Converting the biogas into electricity using standard micro turbines could produce 88 ± 20 billion kWh, or 2.4 ± 0.6% of annual electricity consumption in the US. Replacing coal and manure GHG emissions with the emissions from biogas would produce a net potential GHG emissions reduction of 99 ± 59 million metric tons or 3.9 ± 2.3% of the annual GHG emissions from electricity generation [5].

## II. METHODOLOGY

This research paper develops a linear mathematical model of biogas electrical power generation for Ade-Oyo community in Ibadan Oyo state with the aims to improving electricity access of the area using pig dung. This system was designed calculating the daily energy generated for biogas to establish the futures of the network understudy. The biogas electrical power mathematical model is formulated and simulation was performed using MATLAB/SIMULINK.

Assumptions made in the biogas system design:

The standard pigs dung is 1

The following parametric data was collected as shown in table 1

**Table1** Collected empirical data from Ade-Oyo at Ibadan, Oyo state

| Number of pigs | Volume of digester($m^3$) | Volume of biogas($m^3$) | Generated electric energy(Kwh/d) | Generated electric power(Kw/d) |
|---|---|---|---|---|
| 50 | 6 | 3.9 | 11.6 | 0.4 |
| 100 | 12 | 7.2 | 23.2 | 1 |
| 150 | 18 | 10.8 | 34.9 | 1.5 |
| 200 | 24 | 14.4 | 46.5 | 2 |
| 250 | 30 | 18 | 58.2 | 2.5 |
| 300 | 36 | 21.6 | 69.8 | 3 |
| 350 | 42 | 25.2 | 81.4 | 3.5 |
| 400 | 48 | 28.8 | 93.1 | 4 |
| 450 | 54 | 32.4 | 104.7 | 4.5 |
| 500 | 60 | 36 | 116.3 | 5 |
| 550 | 66 | 39.6 | 127.9 | 5.5 |
| 600 | 72 | 43.2 | 139.6 | 6 |
| 650 | 78 | 46.8 | 151.2 | 6.5 |
| 700 | 84 | 50.4 | 162.8 | 7 |
| 750 | 90 | 54 | 174.5 | 7.5 |
| 800 | 96 | 57.6 | 186.1 | 8 |

### A. Mathematical Linear Modeling of Biogas

A total of 800 pigs each with a weight of approximately 60 kg are used to generate the bio-digester. The quantity of pig dung to be used can be determined from the first and second row of the data given as shown in equations 1 and 2 shown below.

$50X + 3.9Y = 0.4$----------1

$100X + 7.2Y = 1$----------2

Where

X is the number of pig dung used to produce biogas power

Y is the volume of biogas used to produce biogas power

Then, solving equations 1 and 2 simultaneously.

$50x + 3.9Y = 0.4$----------3 x2

$100x + 7.2Y = 1$----------4x2

$-100X - 7.8Y = -0.8$----------5

$100X + 7.2Y = 1$----------6

$-0.6Y = 0.2$

$0.6y = -0.2$

$Y = -0.2/0.6$

$Y = -0.33$

T0 find the experimental pig dung X

Recall equation 1 and substitute -0.33 for Y

$50X + 3.9Y = 0.4$

$50X + 3.9 \times -0.33 = 0.4$

$50X - 1.287 = 0.4$

$50X = 1.687$

$X = 1.687/50 = 0.03374$

X is the increase in pig dung = 0.03374

To find the total pig dung to use = 1 + 0.03374 = 1.03374

### *A.* The Simulink model of Biogas

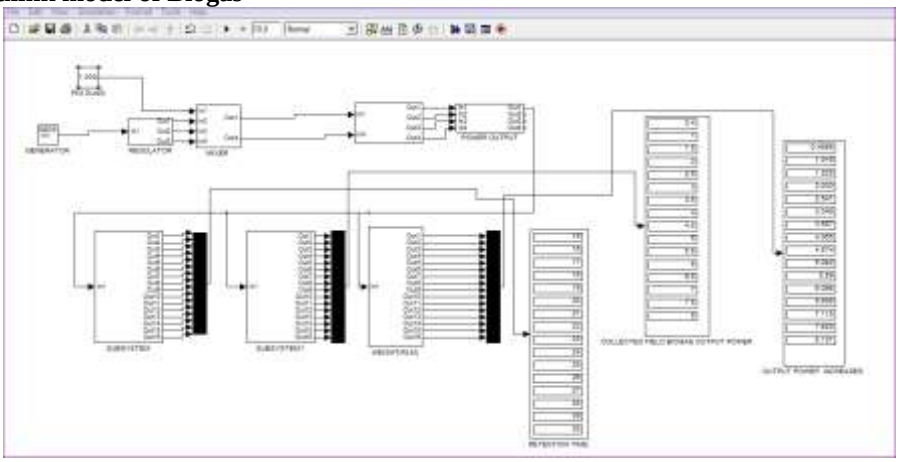

**Fig 1** designed Simulink model for improving biogas electrical power generation using pig dung

Fig 1 shows the simulated result of collected biogas electrical power and mathematical model for improving biogas electrical power generation using pig dung. The comprehensive analysis is shown in table2 and fig2

## III. RESULT ANALYSIS

**Table2 Comparing the collected biogas electrical power and the biogas electrical power when increased dung gotten from the mathematical model is incorporated**

| Number of pigs dung | Collected biogas electrical power output. | Biogas electrical power output when increased dung gotten from the mathematical model is incorporated |
|---|---|---|
| 50 | 0.4 | 0.4065 |
| 100 | 1 | 1.016 |
| 150 | 1.5 | 1.525 |
| 200 | 2 | 2.033 |
| 250 | 2.5 | 2.541 |
| 300 | 3 | 3.049 |
| 350 | 3.5 | 3.557 |
| 400 | 4 | 4.065 |
| 450 | 4.5 | 4.574 |
| 500 | 5 | 5.082 |
| 550 | 5.5 | 5.59 |
| 600 | 6 | 6.098 |
| 650 | 6.5 | 6.606 |
| 700 | 7 | 7.115 |
| 750 | 7.5 | 7.823 |
| 800 | 8 | 8.131 |

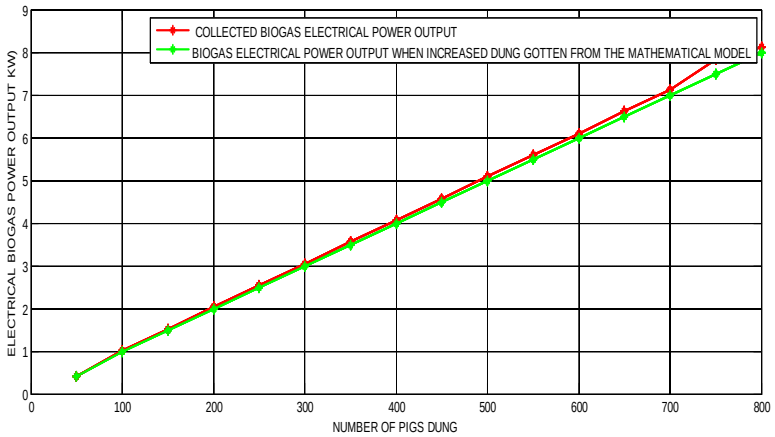


**Fig 2** comparing the collected biogas electrical power and the biogas electrical power when increased dung gotten from the mathematical model is incorporated

## IV. DISCUSSION OF RESULTS

The simulation result is presented in Fig 2. This shows that the biogas electrical power increases when dung gotten from the mathematical model is incorporated. Its shows the relationship between the Biogas electrical Power output, Biogas electrical power output when increased dung gotten from the mathematical model is incorporated and the Number of Pigs Dung. The Biogas electrical Power output after processing the dung of 50, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750 and 800 fattening pigs are 0.4KW/d, 1KW/d, 1.5KW/d, 2KW/d, 2.5KW/d, 3KW/d, 3.5KW/d, 4KW/d, 4.5KW/d, 5KW/d, 5.5KW/d, 6KW/d, 6.5KW/d, 7KW/d, 7.5KW/d, and 8KW/d respectively while the Biogas electrical power output when increased dung gotten from the mathematical model is incorporated are 0.4065KW/d, 1.016KW/d, 1.525KW/d, 2.033KW/d, 2.541KW/d, 3.049KW/d, 3.557KW/d, 4.065KW/d, 4.574KW/d, 5.082KW/d, 5.59KW/d, 6.098KW/d, 6.606KW/d, 7.115KW/d, 7.823KW/d and 8.131KW/respectively. The results indicate that there is an increase in the Power output when the number of Pig increases.

Fig 1 shows the simulated result of collected biogas electrical power and mathematical model for improving biogas electrical power generation using pig dung. The comprehensive analysis is shown in table2 and fig2

Fig 2 shows comparing the collected biogas electrical power and the biogas electrical power when increased dung gotten from the mathematical model is incorporated.

The result obtained when collected dung is used was 8KW/d of power while the result obtained when the mathematical model output dung is added to the collected dung is 8.131KW/d of power. By these results, it shows that as the number of pig dung increases the biogas electrical power output increases by 0.82%.when incorporated dung output from the mathematical model for improving biogas electrical power generation using pig dung.

## V. CONCLUSION

Pig dung has little dry-matter and organic material content which yield large quantities of methane to produce Biogas power generation in Ade-Oyo Ibadan. It was observed that there was power increased when pig dung used. The biogas electrical power mathematical model is formulated and simulation was performed using **MATLAB/SIMULINK**.

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