उन्नत भारत अभियान
UNNAT BHARAT ABHIYAN

Title: Development of Biogas Energy System for Panchayat or primary schools of village

Date: 25-11-2023

Submitted By:

Meerut Institute of Engineering and Technology, Meerut (C-46414)
NH-58, Baghpat Bypass Crossing, Meerut, Uttar Pradesh -250005

Rural Energy System

SEG Details

Dr. Swapan Suman

Principal Invigilator

Final Project Report of
Unnat Bharat Abhiyan

1. Name of the Institute (in Block Letters): MEERUT INSTITUTE OF ENGINEERING AND TECHNOLOGY, MEERUT

2. AISHE Code: C-46414

3. Title of the Project: Development of Biogas Energy System for Panchayat or primary schools of village

4. Name of Subject Expert Group (SEG): Rural Energy System

5. Name of the Regional Coordinating Institute (RCI): IIT Roorkee

6. Name of village(s) where project development activities were carried out: Gagoul

7. Project Duration (with date): 06 Months

8. Project Budget: Rs. 50,000/-

9. Technology (Development/Customization): Customization

10. Introduction of the Project:

Energy is most imperative need of human life. Energy consumption pattern indicates the social and economic development of any country. The fulfilment of energy requirement, with increase in population, has led to the energy crisis, globally. Conventional energy sources (natural gas, oil, coal) are considered as the main energy sources in the world. Generally, most remote residential-scaled systems relied on diesel generators to meet their basic energy needs. However, increasing global environmental concerns and incentives have led to the proliferation of renewable energy resources such as wind, solar photovoltaic (PV), hydro, geothermal, and biomass energy. This transition to variable energy resources requires a new trend in energy system integration, which can flexibly and reliably meet multiple energy supply objectives.

Electrification of villages is a vital step for improving the techno-economic conditions of rural areas and crucial for the country's overall development. Uninterruptible and viable power supply to every household is one of the main challenge Indian government has taken, especially in rural and remote places.

Biogas, a clean and renewable form of energy and a well substitute for primary energy sources (fossil fuels, oil, etc.). As we know that consuming of fossil fuels impose negative impact on our environment. This has resulted in an increase in CO_2 concentration in the atmosphere and overall increase in the GHG emissions with rapid depletion of these fossil fuel resources. Despite its numerous advantages, the

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potential of biogas technology could not be fully harnessed or tapped as certain constraints are also associated with it. Most common among these are: the large hydraulic retention time of 30–50 days, low gas production in winter, etc. Therefore, efforts are needed to remove its various limitations so as to popularize this technology in the rural areas. Budget analysis of biogas system is done based on the biogas installation scheme presented in Figure, the operation needs, and the price of the products and consumables. The analysis is limited only in the utilization of biogas as energy source for power generation. The analysis also considering the value of solid fertilizer resulted from the digestion sludge. Biogas typically refers to a mixture of gases produced in result of breakdown of organic matter by the process of anaerobic fermentation.

11. Project Objective(s) :

(a) Current status: Completed

(b) Achievement of the project (In details):

- Establishment digester for biogas production.
- Higher the efficiency of gas production in the winter using Solar in the digester to maintain their temperature.
- Cost of energy by using proposed system is less than 10 Rs. per kWh.

The main goal of this program to protect the environment is to place biodigesters in gram panchayat as a pilot and further duplicity to all over India as a clean, long-lasting energy source.

12. Project Outcomes:

- **Photographs of the final products.**

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a. Electricity issue can be solved in gram panchayat
b. Biogas Generation Reduces Soil and Water Pollution
c. Biogas Generation Produces Organic Fertilizer
d. Enhancement of fertile land.
e. The technology is easy to use and doesn't cost much. It supports a circular economy.

13. Description of Project (In details) (Technology, Methodology, etc.):

The biogas digester of the present study was made from a high-density polyethylene (HDPE) plastic of 1000 ltr. It has the following parts: the inlet connection (feed entrance), outlet connection (removal of digested waste), and the gas storage tube. The inlet connection was connected to the digester chamber via an inlet pipe and outlet connection made of Ø 4 inch PVC pipe.

The removable lid container will be used for the digester itself, so it needs a feed pipe, a gas outlet, a drain, and an overflow provision. The 1000 ltr gallon drums will get their tops removed, and the smaller will fit inside the larger to trap the biogas.

For the drum steady diameter drop at the bottom, we measured how far in from the lid's edge to drill the hole. We could cut some 2-inch PVC to length for eyeballed the depth.

After that we working on plastic tubing, fittings, and a valve for the biogas exit. After drilling valve hole and threading the adapter into it, run the line to another valve that will connect to the collector.

We cut the top off the drum and add another drain toward the bottom of the latter, and add another gas outlet to the bottom of the former. Finally, connect the gas storage to the feed the digester and gas storage balloon to biogas driven generator.

14. Technical details, Design/drawing of the project:

The amount of cattle manure procured for this proposed project is 275 kg (Supposed) and it will be mixed with water in the ratio 1:1 (275 kg of cattle manure is mixed with 275litres of water in order to achieve good slurry and maintain the working volume of the bio- digester at 1000 litres). The mixture will fed into the digester and homogenized using a stirrer. The inlet of the digester was covered tightly and padded with rubber seal to ensure that the anaerobic condition was maintained. The experiment was carried out for 30 days under room temperature. The utilization of produced biogas as an efficient clean energy source depends on its methane concentration. The electrical energy can be extracted from biogas energy, it is first converted into heat energy through biogas engine and, this heat energy is used to drive a turbine to get the electrical energy.

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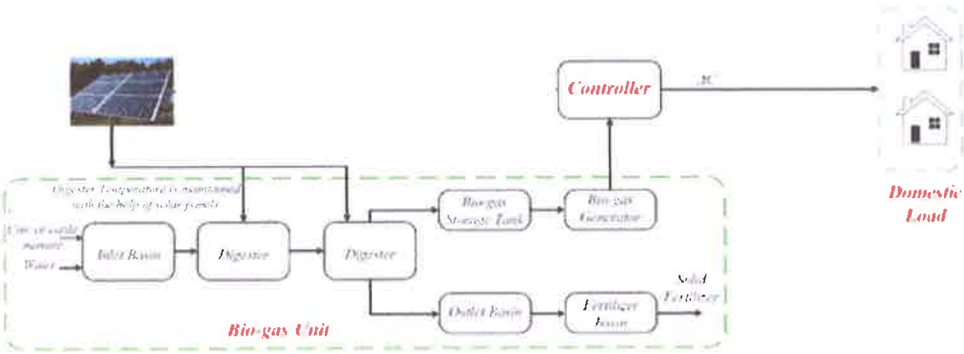

15. Cost analysis of the equipment: NA

16. Details of the Manufacturer: NA

17. Impact of this project in the adopted village(s)/centre, etc. (Minimum 100 words):

The production of biogas is a particularly successful endeavor in rural regions. This is due to the fact that biogas is generated via the decomposition of organic waste, which is abundant in rural areas. Farmers keep domestic animals, and the organic waste they create is a byproduct of their farming.

- It has improved the health of family through reduction household & nearby waste.
- Cattle rearing become inevitable and trying to make the same profitable.
- Slurry is used as a major fertilizer.
- More attention is paid to agriculture.
- Reduced the rate of chemical fertilizers considerably.

18. Number of Families/peoples benefited: 1300

19. Photos with captions of the projectactivities (Maximum of 6 photographs of high resolution):

(a) Setup of biogas system at Gagoul Village

(b) Biogas driven generator connection

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(c) **(d)**

(c, d) Students working on biogas installation with skilled labor

(e) **(f)**

(e, f) Biogas digester preparation by the student

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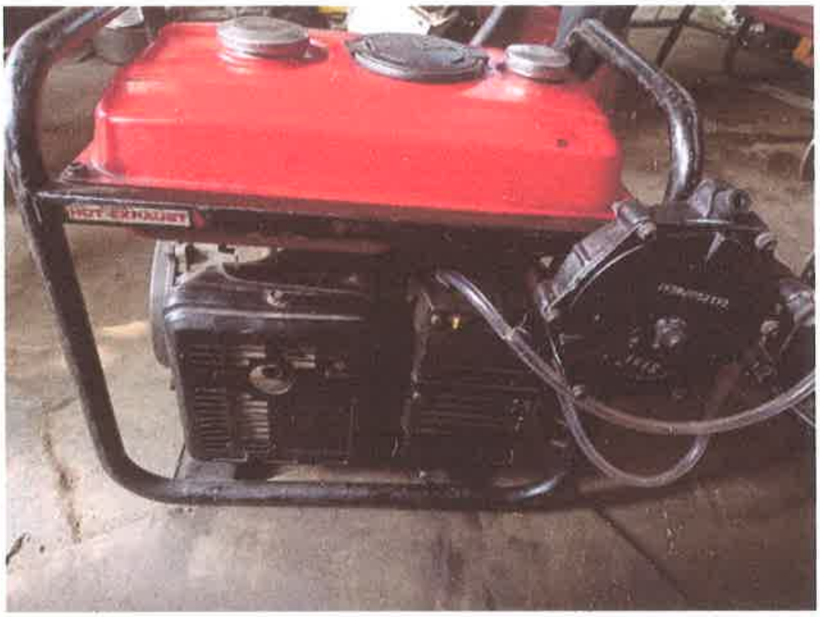

(g) Biogas driven generator

20. Description of each photo ina maximum of 25 word:

Figure (a) Setup of biogas system at gram panchayat of Gagoul Village

Figure (b) Connections of gas pipes and wire fitting on biogas driven generator

Figure (c, d) Students working on biogas installation with skilled labor at Gagoul Village

Figure (e, f) Biogas digester preparation & fitting by the students

Figure (g) Biogas driven generator for electricity generation

21. Link of feedback videos of villagers (If any): NA

22. Other relevant information (Minimum 100 words):

Energy calculation of biogas setup

For cattle maximum gas production per kg = 0.03 m3

Total gas =Total dung in kg x 0.03

Calculation for 275 kg dung if we are successful to collect than,

Total gas=0.03 x 275 = 8.25 m3

If, 1m3 =19 Mega joules;

So, 8.25 x19= 156.75 MJ

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To convert it to kWh >> 156.75/3.6 = 43.54 kWh

Conversion to electrical energy

[Note: when we convert it to electrical energy 65% of energy lost as Heat & other mechanical losses as utilized by electrical generator.]

So, (43.54 x 35)/100 = 15.24 kWh is available as electrical energy from 275 kg of cow/cattle dung Consumption.

[By using bio-gas system only we can supply minimum demand of 2kWh for 12 hours]

From outlet basin, we get the organic fertilizer as residue in form of slurry. It has a high nutrient content and act as an ideal fertilizer. Among these all setup, we prepare a fertilizer basin. Through which we will prepare a high quality of organic fertilizer.

After biogas generation, we will obtain the solid fertilizer from the digester at outlet basin approximately of 20 kg per day as per literature [Arini Wresta et al. / Energy Procedia 68 (2015) 122 – 131].

Fertilizer cost = Rs. 10 per kg (as per sales marketing in India)

It means, generation of fertilizer = 30×20 = 600 kg per month;

Selling cost = 10×600 = Rs.6000 per month = Rs.72,000 per year

23. Comments from the SEG: NA

24. Comments from National Coordinating Institute (NCI): NA

25. Clarification from Participating Institute (PI): NA

Dr. Swapan Suman

[PI Name, Signature with stamp]

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