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Biogas production to promote renewable energy - A case study on Bhimtal Area

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ABSTRACT

As we are forwarding ahead we are continuously overusing our nonconventional sources of energy that is a serious concern. Now there is a time to focus on renewable energy at society level as the government has already taken a no. of steps to promote renewable energy .The main focus of this paper is to tie our hands with government to promote this free of cost energy to save our limited resources and make our society clean and green. In this paper we are proposing an alternative for LPG and a solution for waste management.

Keywords: *Biogas, Renewable energy, Waste management*

Introduction

India is an agricultural hub with million hectare of farming land and a number of dairy animals which shows the potential of renewable energy resources. As we are one of the developing country we have to do a lot for lining us in the category of developed countries. For this change, energy plays an important role. As the consumption of nonrenewable sources of energy is increasing and about to end in next 20 to 30 years the whole world has started to think about the resources which are free of cost. The leaders of the entire world also promised to reduce their energy consumption and promote renewable energy. However, with the second largest population, we are lacking in the production of energy as there is a gap between demand and supply. As an agricultural country, Biogas is a clean, non-polluting, smoke and soot free source of renewable energy. It contains 55 to 70 per cent methane which is inflammable. Biogas is produced from cattle dung, human excreta and organic matter in a "Biogas Plant" commonly known as "gobar gas plant" through a process called "digestion". The manorial value of the dung is also enhanced by this process. It helps simultaneously in obtaining both cooking fuel and enriched manure from cattle dung. It has also improved village / urban sanitation. One tone cattle dung by about 100 adult animals produces about 50 cu.m. biogas per day (@ 20 Kg per cum.). This gas can be utilized for thermal as well as power generation besides producing rich manure as a bye product. The gas generated can also be purified and compressed further to produce bio-CNG, which can find application in commercial purposes.[1-3]

Methodology

This proposal aims to provide a better solution to the current waste management. We are interested to set up two types of biogas plants one as conventional animal biogas plant and other as for kitchen residue. The proper implementation of a biogas digester would solve the problem while also taking the load of the local power problem by providing the community with another energy source in the form of biogas. They would be able to use the biogas for a number of things. The other product made from the bio-digesters is fustigation water. This water when implemented into the local irrigation systems and farming areas would benefit the crops and agricultural yield that the area produces. At the last we will have a no. of products like biogas for cooking/power generation, vermin compost as organic fertilizer, liquid organic fertilizer (garbage enzyme). We will earn carbon credits from world energy forum. The concept of a biogas settler is to treat the waste products entering into it to create a usable gas and a safe product to be used for fertilization. The design of a biogas settler is similar to that of a septic tank, however the design incorporates the ability of biogas to be harnessed and stored. The by-products of the fertilization and biogas are possible through a process called anaerobic digestion. The airtight chamber develops sludge at its bottom and with the lack of oxygen in the chamber a chemical reaction takes place that creates a methane rich biogas that is able to be used in household gas appliances such as stoves and lamps. With the lack of oxygen in the chamber, and as the influent may take 60-80 days to pass through the system, most harmful pathogens are destroyed and the effluent liquid and slurry are able to be used for fertilization of the surrounding farmland, reducing the waste and increasing the sanitation of the area.

The use of a biogas settler is ideal in this situation as the initial cost of the unit is relatively low, it requires little maintenance, has no energy consumption as opposed to many similar design that may be affected by flood, the biogas settler will not be affected by its location in such a wet area. The advantages of the settler far outweigh its negatives, one of which being the removal of the sludge; approximately every 5 years the sludge will accumulate to a level at which it will need to be removed and whilst many of the harmful pathogens have been removed by this stage, it is required to be done by skilled personnel. This sludge will usually then is placed in a drying bed before it is used for fertilization. Large retention times on the influent and warmer temperatures of the chamber are ideal in the treatment of the effluent to increase the effectiveness of the removal of harmful products, resulting in by-products higher nutrients and more suitable for uses as fertilization. Ideally the hydraulic retention time (HRT) would be close to 100 days and chamber temperature would be close to 55 °C to ensure pathogens are destroyed. By placing the chamber below ground, the temperature can be regulated much more easily with the chemical reactions inside creating its own heat within the chamber. An expert design is then required to ensure the HRT which is as large as possible whilst still producing a consistent amount of biogas for the colony's demands. Once biogas is initiated, the pressure level within the main chamber is increased, for this reason a compensation tank is needed which is connected to the lower of the main chamber. As pressure increases, the sludge is then forced through a pipe into the compensation chamber, thus reducing the absolute pressure in the main chamber and preventing fractures in the frame. This compensation tank is then open to atmosphere as the sludge stored within it is practically harmless and can be placed within the drying beds. The benefits of a biogas plant seem endless- low construction costs, low running costs and a clean source of energy. However the system can have some downsides, such as gas loss if chamber suffers a fracture and the dependence on the community to participate in the use and production of the biogas plant.[4-6]

Sample Calculations

1) For kitchen residue
*For 5 kg solid waste
(Including waste food, crop residue, dry leaves) with 20-30 liter organic waste water can generate 1CUM biogas.
*One CUM biogas = .43kg LPG

We will get 100 kg waste material daily for 290 working days (29000kg/working days).

We can generate 20 CUM biogas/day that can generate 8.6 kg LPG per day.

We can generate 2494 kg LPG per year. The cost of 19.2 kg LPG cylinder is Rs. 932, so the total cost is Rs.121058.

** Biogas Calculation for animal waste:
Daily Biogas = (volatile solids (kg/year) × 0.4 × 1.1(m^3 biogas/kg volatile solid) × 0.7)/365

For 50 m^3 biogas plant the amount of waste material is 1000 kg/day. As one CUM biogas=0.43 kg LPG then we can produce 21.50kg LPG per day. Yearly we can produce 7847 kg LPG so the total cost is 3,80,906. These calculations are based only on the data collected by us (Ofoefule *et al.*, 2010)

Calculation of Carbon Credits (Thamilselvan *et al.*, 2015)

By filling one ton of CO_2 in cylinder, we can avoid its release in atmosphere, then 12 euro (INR 780) (1euro=65 Rs.) is offered by CCC. As methane is 21 times more polluting than CO_2, we can claim 252 Euros (INR 15000) for one ton. By this we can save pollution, but also add income source to project.

Total production of biogas is 24050 m^3 as Mass =density * volume, so Density of methane is 1.15kg/ m^3 and total mass of 1m^3 biogas is 1.15 kg. For 24050 m^3 it is 27657 kg. 1.15 kg has 30% CO_2 and 70% methane Mass of CO_2 is 8297 kg. Mass of methane is 19359 kg. One carbon credit is equal to one ton carbon. We have 8.29 carbon credits. As methane is 21 times more warmth than carbon So for 19359 kg we have 406 carbon credits. (1 methane credit=21 carbon credits One ton methane=21 ton carbon).

Environmental and social impact

With anaerobic digestion, a renewable source of energy is captured, which has an important climatic twin effect. The use of renewable energy reduces the CO_2-emissions through a reduction of the demand for fossil fuels. At the same time, by capturing uncontrolled methane emissions, the second most important greenhouse gas is reduced. We will earn carbon credits from world energy forum. We are planning to open a center of renewable energy in our campus to promote this conventional sources of energy (solar energy, wind energy, water energy and biogas energy). We can also setup a biogas development and Training center inside our campus. Our objective is to promote the recycling/utilization of waste material of our University. By collecting and processing all kinds of wastes separately a significant contribution can be made to realize these objectives:

- To replace LPG cylinders with biogas for cooking purpose in our University.
- To set up a biogas plant using the waste material of university to promote renewable energy.
- To provide enriched vermicompost to the farmers.
- To generate income.
- To set an example as the first private university in Uttarakhand to set up such a large plant to promote renewable sources.

Conclusion

Currently we are using animal waste to make vermicompost. In our proposed plan we are interested to utilize this waste at several levels. We are interested in producing biogas using biogas plant. The remaining slurry is used to produce vermincompost using bio agents. We can also use our waste material of rotten fruits and vegetables in making "garbage enzymes". These are the product of fermentation of vegetable/fruit waste in a mixture of water and brown sugar after a period of 3 months. These can be used as fertilizer, insecticide, plant hormone and anti- odor agents after dilution.

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