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Economic Feasibility Of Substituting LPG With Biogas For MANIT Hostels

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Abstract: In this paper, the economic feasibility of substituting LPG with biogas for an Indian University hostel has been discussed. The University hostels daily generate huge amount of biomass in the form of kitchen waste. This kitchen waste can be utilized to produce biogas, which can be further used in the hostel mess as an alternate to LPG. Economic factors for the suitable bio-digester design and the feasibility of its replacement in the long run have been studied in this paper.
Keywords: Anaerobic-digestion, Biogas, Economic Feasibility, Kitchen waste.

1. Introduction

The associated harmful environmental and health effects with the use of traditional fossil fuels have enhanced the growing interest in the search for alternate cleaner source of energy globally. Biogas generation has simply been seen as a by-product of anaerobic digestion of organic waste[1]. The renewable and sustainable energy resources are best substitute to the conventional fuels and energy sources[2]. Biogas, a clean and renewable form of energy could very well substitute (especially in the rural sector) conventional sources of energy such as fossil fuels, oil, etc., which are causing ecological – environmental problems and at the same time depleting at a faster rate[3]. Biogas contains 50 - 70% methane and 30 - 50% carbon dioxide along with small amounts of other gases and typically has a calorific value[4] of 21 - 24 MJ/m^3. Biomass is one potential source of renewable energy and the conversion of plant material into a suitable form of energy, usually electricity or as a fuel for an internal combustion engine[5]. Solid wastes can be collected, and treated in a non-polluting, environmentally feasible cost effective process to produce biogas[6].

Kitchen waste is organic material having high calorific value and nutritive value to microbes. It means higher efficiency and size of reactor and cost of biogas production is reduced. This study was performed to find out the feasibility of installation of a biogas plant in the college hostel.

2. Material And Methodology

Biomass Estimation: There are in all 7 Hostels in MANIT. Each contributes to a huge amount of hostel mess waste. This waste constitutes of vegetable waste, cooked food, meat, dairy waste etc. Around 35-40 kg mess waste is obtained from every hostel. Biomass was collected from the waste material produced at the hostel mess of the MANIT hostels. The economic analysis has been performed on hostel H-6.

Structure of Bio-gas plant: A large area is available behind the hostel mess for installation of bio-digester plants. For the hostel mess, batch type or continuous digesters can be used. In the batch type digester organic waste stays in the tank for some time and is then replaced after gas production. In the continuous digester new slurry is fed every day. The continuous type is more efficient with a higher gas production rate per digester volume. In our case it would also be more feasible because waste accrues every day.

The bio-tech portable plant has been shown in figure 1. This figure shows the water jacket type and the ordinary type bio-digester. The water jacket bio-digester can be used in hostels.

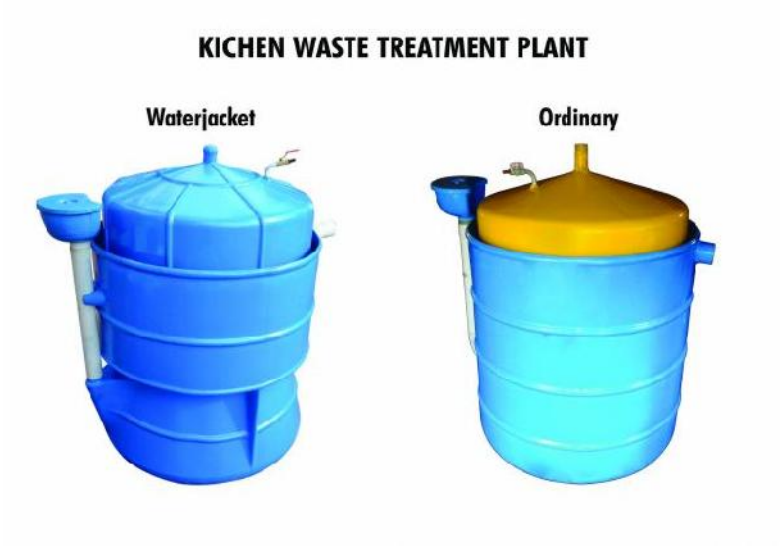

Figure 1 – Setup of the bio-digester

Determining the size of digester:

The size of the digester (Vd) was determined by the retention time and the daily substrate input in m^3. The following formula can be used in order to calculate the appropriate volume: Vd = Sd x RT [7]
The daily substrate input is calculated (Input Feed + Water in 1:1 ratio)
According to the technical details given by the Bio-Tech India:
Maximum Treatable Waste per day= 40kg
Organic Waste Water in Liters required= 80-100L
Size of Plant= 12cum
Biogas production 0.45-0.65 m3/kg of kitchen waste
Production of gas per day = 20-25cum

3. Discussion

LPG Consumption in the Hostels: In hostel they use approximate two 19 kg LPG cylinder per day i.e., 38 liters/day LPG consumption.

Specifications:

Price of 19 kg cylinder- Rs.1536.50/-

1 m^3 of biogas is equivalent to 0.45Kg (450g) of LPG

The Hostel mess runs for 9 months in a year.

Table 1 – Specifications of the Bio-gas Plant

Input /Feed	40 Kg of kitchen waste per day	
Application	Bio gas for cooking at Hostel Mess , Slurry as manure for gardening	
Daily biogas	Generation of biogas per day (Avg)	20 m^3
	LPG Equivalent of biogas per day	9 Kg
	Savings through LPG per day (@ Rs80.87/Kg)	Rs.727.83
	Savings through manure per day	Rs.20
	Total returns per day	**Rs.747.83**
Annual biogas and manure	Generation of biogas per year	5400 m^3
	LPG Equivalent of biogas per year	2430 Kg (127 Cylinders)
	Total returns per year	**Rs. 2,01,915**

Approximate Cost of 12cum Biogas Plant = 3-4 Lacs

Payback period= 1-2 years

4. Conclusion

Economic feasibility of installation of kitchen waste Bio-digester for the hostel mess has been assessed and was found to be technically and economically viable solution. System payback is 1-2 years with annual returns of Rs.201915. By the installation of Bio-digester we can reduce the demand for LPG thereby saving fossil fuels. The installation of digesters is a better solution for disposal of kitchen waste which also reduces the burden on the waste processing by Municipalities / Corporations. The slurry produced by the biogas plants can be used as good fertilizer for the plantation in MANIT.

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