JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

TO STUDY THE ESTIMATION OF BIOGAS REQUIREMENT FOR THE MECHANIZED HOUSEHOLDS ACTIVITIES IN CHHATTISGARH, INDIA

Shailendra Kumar
Assistant Professor, Department of Agricultural Engineering, BNPG College, Rath, Hamirpur (UP) India.

Abstract

Excess biogas from cooking is analysed with different size of biogas plans in Chhattisgarh Plains for suitability of different domestic operations. Maximum excess gas found in 6 cum size (0.89 m^3 /day) followed by in the 4 cum size of plant (0.73 m3 /day). Total time required running of 5hp engine (Grinding /flouring and for pumping water) is about 35 minutes and biogas required to operate 35 minutes is1.29 cum /day. Biogas required for cooking is1.75 cum / day. The requirement of gas for domestic as well for fodder and water by operating 5 hp biogas engine, at least about 3 cum biogas plant is needed. Assumptions are taken as the family members are ten in the family and number of cattle is eight.

Keywords: *Biogas, Mechanized household, IC engine, Renewable energy*

Introduction:

Demand of Fossil fuels is increasing day by day to fulfill basic needs of population at high rate. Therefore, an alternative source of energy is essential which is cheap, clean and sustainable for our society. Biogas is one of the best alternative renewable sources of energy, which can be easily explored from the dung, animal excreta and other agricultural and kitchen's wastes. Biogas is an eco-friendly source of renewable energy which is obtained by anaerobic digestion of biomass (Kumar *et.al*, 2015)

Animal rearing practices are essential component of life where there is strong interdependent between cow and man in rural India. Cow generates energy not only in the form of nutrients such as milk but also provides bullock energy and dung. It is dung which is source of renewable energy in the form of biogas, dung cake (Kumar *et al*., 2016).

It is estimated that 60 per cent of the world's population live in rural areas of developing countries and rely on agriculture for their livelihood. About one billion people rely on residue as their principal cooking fuel. In many areas, particularly in Asia, the commercialization of bio-residues is a source of modest income. At the same time it is a burden for poor people. Most often the utilization of bio-residue is associated with a very low efficiency and therefore, it has a high level of smoke emissions and a negative impact on health. Cattle dung is the main raw material used for biogas generation (Kumar and Singh. 2019). Use of Biogas in Chhattisgarh is limited to only cooking purpose. It is matter of interest to know the working status of biogas plants under different districts. If the plant does not perform satisfactory it should be treated as national loss. Because, huge number of biogas plants are installed annually, in the villages under government subsidy program, by various agencies (Kumar, 2008).

In Chhattisgarh the installation of Biogas plants are carried out by the Chhattisgarh State Renewable Energy Development Agency (CREDA) under the Department of Energy, Govt. of Chhattisgarh from 25th may 2001 (Kumar *et al.*, 2014)

Present Study and analysis were carried out to know the excess quantity of biogas in the installed biogas plants to fulfill the requirement to operate IC engine and other house activities in the selected districts of Chhattisgarh Plains.

Review and literature

Jawark *et al.* (1987) reported that biogas could also be used to power engines, in a dual fuel mix with petrol.

KVIC, (1993) was reported that maximum gas production occurs during the first four weeks, before tapering off; therefore a plant should be designed for a retention period that exploits this feature. KVIC further stated that the biogas can also be used to power engines, in a dual fuel mix with petrol and diesel and can aid in pumped irrigation system.

Bhatiya (1990) carried a case study on biogas engines. He expressed that biogas engines can be popularized, but Govt. policy of giving subsidy in electricity, kerosene, and diesel etc. makes farmer's mind to prefer these sources of energy and hence they dislike adopting non-conventional sources (biogas engines).

Methods and materials

The study was carried out during 2007-2008 in Chhattisgarh plains of selected area of Chhattisgarh state. Chhattisgarh plains carrying eleven districts, a multistage and multiphase sampling technique was used. From each district, a few blocks were randomly selected and from each selected blocks few villages were selected. From each selected village, observations were taken from each available biogas plants using questionnaire from the respondents. Further, observations for other characters were measured from each biogas plants in the villages. The data were collected with the help of questionnaire from the respondents of biogas plants selected by multi stage simple random sampling and observations were recorded at the site of plants.

Results

The availability of excess biogas, to run dual engine, after fulfilling the cooking need was assessed with different sizes of biogas plants and presented in Table 1 and detailed calculation given in Table 2.

Table 1 Excess Gas availability in the different sizes of biogas plants to run dual engines

S.N.	Plant's Capacity, m^3	Av. gas produced, m^3 / day	Av. gas consumed, m^3 / day	Excess gas availability , m^3 / day
1	2	1.92	1.46	0.45
2	3	2.51	1.95	0.57
3	4	2.52	1.78	0.73
4	6	3.67	2.78	0.89
5	8	3.80	3.20	0.60

It is revealed from the Table 1 that small biogas engine can be run for short time for light house hold activities. The gas availability in family size biogas plants was found less than 1 cum to run dual engines, after cooking /domestic use. Maximum excess gas found in 6 cum size (0.89 m^3 /day) followed by in the 4 cum size of plant (0.73 m3 /day), as 0. 425 m^3 gas is required to run 1 hp / h for a dual engine (Rai, 1997), therefore a 2hp-h dual engine could be run per day with existing 4 and 6 cum size of biogas plants under present feeding condition. The 3 cum plants are also sufficient to run a small engine for one hour and supply gas for domestic use if dung feeding is increased up to the desired level and increased from present level 63 % to 100 %.

Table 2 Calculation of biogas required for different household activities

Assumptions

Family size	= 10 members
No. Of cattle in Bain	= 8
Average body weight/ cattle	= 350 kg
Feed require per cattle	=14 kg per day
Chaff-cutter capacity (5 hp biogas engine operated)	= 600 kg / h
Water required / cattle / day	= 100 liter
Water required /human / day	= 150 liter
Capacity of grinder	= 80 kg /h
Concentrate required / cattle	= 2.5 kg
Flour required / human / day	= 0.5 kg
Total head	= 40 m
Pumping efficiency	= 80 %

Dia. Burner 4",

	Gas consumption of 5 hp engine	=16.5 cuff/hr or
	(Rai, 1997.)	= 0.4672 cum / h
	Mechanized activities	
	i) Chaff-cutting	
	ii) Grinding / flouring	
	iii) Water Pumping	
	iv) Cooking	
	Feed requirement for 8 cattle	= 14 x 8
		= 112 kg
1	Total time required to run chaff-cutter	= 112 / 600
		= 11.2 minutes
	Total water requirement / day	= 8x 100 + 10 x150
		= 2300 liter

$$WHP = \frac{\text{Total head x discharge}}{4500} \times Ef = \frac{40\text{x discharge x } 0.8}{4500}$$

	Discharge	= 448 liter / minute
2	5hp Gas engine required time for pumping water	= 2300 / 448
		= 5.13 minutes
	Total concentrate required/day.	= 20 kg
	Total quantity of wheat for grinding for human / day	= 5 kg.
3	Total time for grinding	= (50 / 80) x 60
		= 18.75 minutes
	Therefore,	
	Total time required running of 5hp engine	= 11.2 + 5.13 + 18.75
	(Grinding /flouring and for pumping water)	= 35 minutes (rounded)
	For running of 5 hp engine gas required	= 0.425x5
	(Rai, 1997.)	= 2.125 cum/hr
A	Total Gas required for running of 5 hp engine	**= 2.125 x (35/60)**
	(Grinding /flouring and for pumping water)	**=1.29 cum /day**
	Ave. time required for cooking and heating (Table 4.4.1)	= 3.75 hr / day
B	Gas required for cooking and heating	**= 3.75x.4672**
		= 1.75 cum / day

Total Gas required (A+ B)	**= 1.29 + 1.75**
(Grinding /flouring, pumping water cooking and heating)	**= 3.04**
	= 3 Cum / day, Rounded

Therefore, to meet the requirement of gas for domestic as well for fodder and water by operating 5 hp biogas engine, at least about **3 cum** biogas plant is needed.

References

Anonymous, 1993. KVIC Report: *Khadi and Village Industries Commission and its Non-Conventional Energy Programmes , Bombay, India.*

Bhatiya, R. 1990. Diffusion of renewable energy technologies in developing countries: A case study of biogas engines in India. *World Development. Vol. 18 (4): 575-590.*

Jawark, H.H., Lane, N.W. and Rallis, C.J. 1987. Biogas / Petrol dual fueling of SI Engine for rural. *Third world use. Biomas. 13: 87-103.*

Kumar Shailendra 2008. *Techno-Economic Study of Biogas Plants In The Chhattisgarh plain*. M.Tech. *Unpublished thesis, IGKV, Raipur, (Chhattisgarh) India*.

Kumar Shailendra, B. P. Mishra, S. K. Patel, B. K. Yaduvanshi, F.G. Sayyad and M. S. Khardiwar (2014). A block and capacity wise status of biogas plants of Chhattisgarh Plains in India. *International Journal of Multidiscipinary and Current Research, jan. 2014, pp-18-21.*

Kumar Shailendra, B. P. Mishra, M. S. Khardiwar, S. K. Patel and F.G. Sayyad, 2015. Economic evaluation of different Size of Biogas Plants in Chhattisgarh (India). *Current World Environment, An International Research Journal of Environmental Science, ISSN: 0973-4929, Online ISSN: 2320-8031, .Vol. 10(1), pp. 184-188 (2015)*

Kumar Shailendra, B. P. Mishra, M. S. Khardiwar, S. K. Patel, B. K.Yaduvanshi and B. P. Solanki, 2016. Biogas Plants in Chattisgarh (India): A Case Study. *Current World Environment, An International Research Journal of Environmental Science, ISSN: 0973-4929, Online ISSN: 2320-8031, .Vol. 11(2), pp. 599-603 (2016).*

Kumar Shailendra and Singh Neelam Kumar, 2019. Estimation of Biogas loss in Non-working plants and finding association between biogas plants and dung availability in Chhattisgarh, India. *CWE, Vol. 14, No. (3), 2019, pg, 458-462.*

Rai, G. D. 1997. *Non-Conventional Energy Sources*. Khanna Publishers Pvt. Ltd. New Delhi, India: pp 311-435.