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Prospect and Application of Biogas Technology for Rural Communities of India

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ABSTRACT: Energy is a vital input for the better quality of life and economic growth. With the progress of mankind, energy requirements have increased to a great extent. India's overall energy production is considerably less than its overall energy consumption. In this aspect renewable energy has been identified as a suitable alternative to the fossil based energy. Renewable energy system provides an opportunity for mitigation of greenhouse gas emission and reducing global warming. Renewable energy can be harnessed in the form of solar energy, wind energy, ocean energy, hydro energy and biomass energy. Anaerobic digestion process has been found to be one of the major conversion technologies for biomass to energy. The current availability of biomass in India is estimated to be about 500 million metric tons per year (MNRE, India). Since India is an agricultural based country and about 69 % of Indian population resides in rural areas, biomass to energy conversion i.e. biogas technology can play an important role for fulfilling the energy demand of rural India. In this paper an attempt has been made to study the aspects of biogas technology in the rural communities of India.

KEYWORDS: . Renewable energy, biogas technology, rural communities

I.INTRODUCTION

Until the 18th century almost all energy used by man was supplied locally from traditional energy sources . Before man has started using petroleum, coal was the major source of energy. At present, petroleum and natural gas provide more than 55% of the total world energy demand. The world's petroleum resources are expected to last only for next 30 - 40 years and about 200 years for coal. There is a need to save energy, our largest potential, and to replace fossil fuels soon. As the substitute of the fossil fuels, the uses of various new and renewable sources of energy are getting more and more importance all over the world. The most obvious renewable source of energy is the sun itself and the best solar energy-converting machine available is the green plant**.**India has 17% of the world's population, and just 0.8% of the world's known oil and natural gas resources. India produces only about 25 % of the total annual requirement of oil. Huge amount of money is spent for importing oil and natural gas. 80% of the population is living in rural areas of India. The share of commercial energy is only 20% as compared to 49% for the urban areas .The household sector accounts for nearly 75% of rural energy consumption. Within this sector, cooking is the largest energy consuming end use, accounting for almost 90% of household energy. Biofuels (fuel Wood, crop residues and cow dung) meet 85–90% of the domestic energy demand and 75% of all rural energy demand. In this paper an attempt has been made to study the prospect of utilization of biogas as a cooking fuel in the rural communities of India.

II. MATERIALS AND METHODS

Biogas is a mixture of gases of methane and CO_2 with trace amount of H_2S and others produced by anaerobic digestion(in absence of air) of organic wastes. Different group of bacteria are responsible to convert organic wastes to biogas.60% methane, 40% Carbon di-oxideTrace amount—H_2 , H_2S, AmmoniaCarbon di-oxide and other impuritiesare removed to enrich methane for burning to produce heat.

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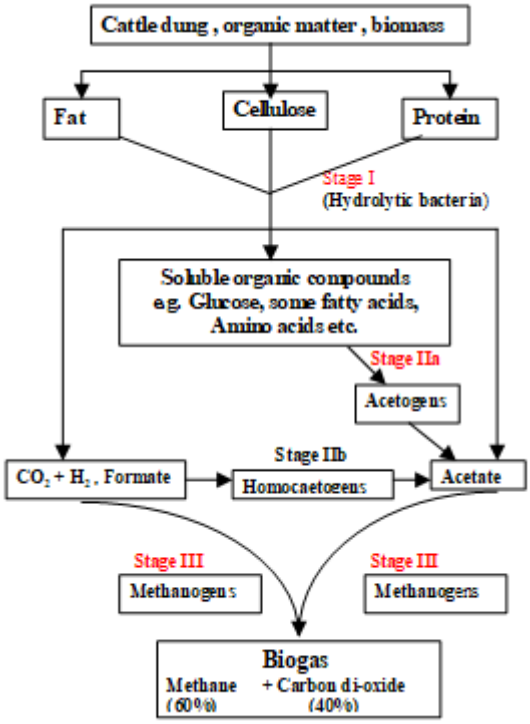

Fig. 1: Three stages of methane production from organic residue

Biogas Plant Design

The biogas plants presently found working in the rural households of India can be broadly divided into two categories:

i) Floating gas holder type (e.g. KVIC model. Pragati model etc.)
ii) Fixed- dome type (e.g. Deenbandhu model, Janata mode etc.)

Floating gas holder type:

It consists of a deep well-shaped underground digester connected by inlet & outlet pipes. A mild steel gas storage drum, inverted over the slurry goes ups & downs around a central guide pipe corresponding to the accumulation and withdrawal of gas.

Fixed- dome type:

The digester and gas holder are part of a composite unit made of bricks & Cement masonry. It has cylindrical (Janata model) or hemispherical (Deenbandhu model) digester with dome shaped roof and large outlet tank.

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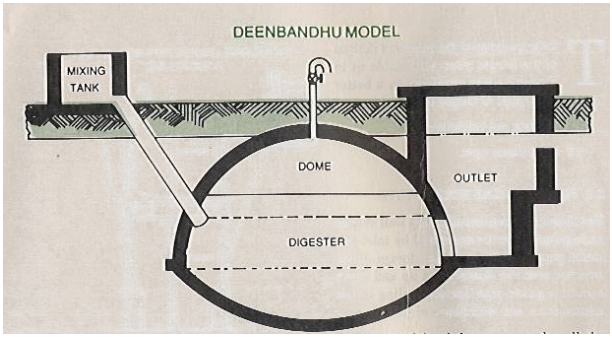

Operation and maintenance

Daily Routine

Weekly Routine

Monthly Routine

Half yearly/yearly routine

Daily Routine

(a) About 25 Kg cowdung / m^3 . So digester capacity x 25 = daily requireent of cowdung for biogas
(b) KVIC model, half rotation clockwise & anticlockwise 2-3 ties, immediately after feeding
(c) As far as possible, the main gate valve is opened only when gas is required. In any case, it should be made as a practice to close the gate valve at night, when no more gas is required. Next day the valve is opened when gas is to start

Weekly Routines

(a) The burners and lamps are cleaned
(b) The water remover/water trap may be checked
(c) Stirring is to be done inside the digester to break scum

In case of KVIC, the dry matter that must have been collected in the gap between the digester wall and gas holder may be removed manually.

Monthly Routine

(a) Gate valve and gas pipe line be tested for leakage
(b) If the manure pit by the side of the gas plant is full, the outlet slurry may be diverted to the next pit

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V. RESULT AND DISCUSSION

Factor influencing the biogas production:

Factors	Optimum Conditions (Bhattacharyya *et al.*,1993)
Carbon/ Nitrogen ratio	30:1 is the ideal ratio. But it may be vary from 20:1 to 40:1 depending on the substrate.
Solid concentration	10-20% Total Solid Concentration of the Substrate for Semi-Continuous types of digester.
Temperature	35^0C (less than 15^0C is not favorable for gas generation)
Retention Period	30 to 55 days.(it varies from place to place depending on temperature in winter season)
p^H	6.6 –8.2 (7.2 p^H is the optimum for gas generation)
Toxic substances	Fungicide, Insecticide, Pesticide, heavy metals, Detergents, Phenyl, etc are harmful for gas generating bacteria.
Mixing	1: 1 ratio should be maintained for mixing fresh cow-dung with water to get TS 10% and to prevent the digester from scum formation.

Biogas Plant Design

The biogas plants presently found working in the rural households of India can be broadly divided into two categories:

iii) Floating gas holder type (e.g. KVIC model. Pragati model etc.)
iv) Fixed- dome type (e.g. Deenbandhu model, Janata mode etc.)

Floating gas holder type:

It consists of a deep well-shaped underground digester connected by inlet & outlet pipes. A mild steel gas storage drum, inverted over the slurry goes ups & downs around a central guide pipe corresponding to the accumulation and withdrawal of gas.

Fixed- dome type

The digester and gas holder are part of a composite unit made of bricks & Cement masonry. It has cylindrical (Janata model) or hemispherical (Deenbandhu model) digester with dome shaped roof and large outlet tank**.**

Size for household biogas plant:

Size CUM	Cattle required no.	Daily requirement of wet dung (kgs)	Cooking for no. of persons
1	2-3	25	3-4
2	4-6	50	5-8
3	7-9	75	8-12
4	10-12	100	12-16

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VI.CONCLUSION

Thus it is seen that biogas is an excellent cooking fuel for the rural communities of India as the raw materials required are readily availableBased on the findings of this study, it can be concluded that the biogas digester is simple but effective option to save cost on cooking fuel.. Any excess gas generated should be sold to the neighbourhood. One time installation of the biogas plant will lead to saving of money spent on other fuels. Organic fertilizers can be made from the slurry generated after the biogas production process. Use of clean fuel, proper waste disposal system for cow dung and theprevention of deforestation for firewood are the main benefits to the environment from the plant.

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