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HARNESSING BIOGAS PRODUCTION IN THE TEA PLANTATION SECTOR

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The present energy generating systems are largely dependent on local resources like wood, straw or dung for burning; water power for generating electricity; wind energy for the operation of wind mills. However, such local resources cannot meet the entire requirements of the common man. The need, therefore, for alternative energy supplies become a major factor in the successful implementation of developmental plans. In this regard an ideal energy source is one that is local in origin and can produce energy useful for this purpose depending mostly, if not entirely, on local materials and labour. From this point of view, the development of biogas technology holds the key to the prosperity of a reasonably satisfactory life for the masses. Biogas is a great energy potential and offers tremendous scope for further improvement and development. It is called biogas as it is produced out of biological material. The by-products formed from the generation of biogas themselves are of immense utility value. There is thus a great scope for exploiting this source of energy in the tea plantation sector.

What is "Bio Gas"?

This is an inflammable gas produced during anaerobic bacterial fermentation of organic materials in a tightly sealed chamber. This contains approximately 60% of methane (CH_4), 35% of carbon dioxide (CO_2) and small quantities of hydrogen sulphide (H_2S), nitrogen (N_2), hydrogen (H_2) and also traces of moisture.

Usually biogas is produced by adding animal wastes such as cowdung, pig dung, poultry droppings and urine by mixing them with plant materials or crop wastes such as grasses, weeds, fallen leaves, straw and aquatic plants or algae into an air tight digesting chamber where bacterial fermentation takes place. Water is also added from time to time with the above components through an inlet.

When the above components are allowed to undergo anaerobic fermentation for nearly a month, the mixture of gases collectively termed as 'Biogas' is liberated into a gas collecting dome or gas holder. Animal wastes and plant materials are added daily or weekly with stirring and the digested slurry is withdrawn through an outlet. This slurry is rich in nitrogen and used as fertilizer. The gas collected into the gas dome can be withdrawn through a gas outlet and stored or directly used as a fuel (see Fig. 1).

The addition of urea or calcium carbonate ($CaCO_3$) with the other ingredients to the biogas digester has been found to increase the proportion of methane as well as the rate of gas production.

Biogas Technology in the Tea Plantation Sector

The tea sector has a large resident work force. This work force is badly affected by the energy crisis due to the shortage of firewood. It is mostly due to a lack of firewood that the plantation labour is forced to take away the valuable prunings from the tea that is pruned periodically. Most of the plantation labour do some form of cultivation for which they need manure. However, they cannot always afford to buy artificial fertilizer. The labour mostly uses cow dung as their main source of fertilizer as some of them own these animals. It will thus be seen that an integrated system that links the benefits that could be derived from biogas technology to the needs of the plantation labour would be a profitable undertaking.

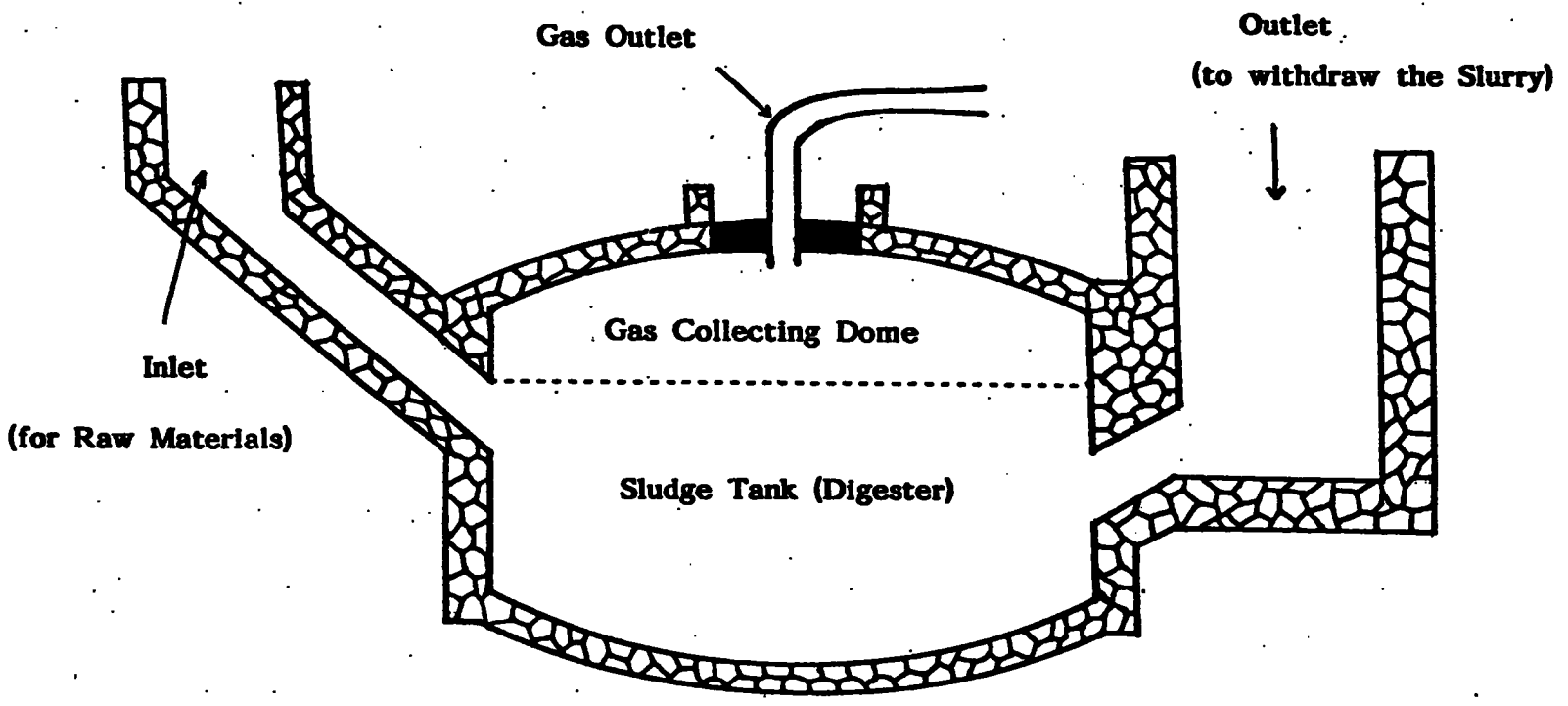

Fig. 1 - Diagram of the Chinese type biogas generator

The tea sector has a fairly well developed dairy industry with reasonable extents of grass lands to feed the dairy. The animal waste obtained from 4 or 5 cows could be put to good use if some biogas generators/digesters are centrally located among the dwellings of the labour. In such a well co-ordinated scheme the labour would get cheap fuel for cooking and lighting purposes. This is because the principal source of biogas energy, methane, is a high quality energy source. Biogas is a clean high grade fuel that is soot free and will not dirty the pots and pans used in cooking. The biogas can also be used for lighting as it gives the same light intensity as a 60 watt electric bulb.

The effluent and sludge that is left after digestion is high quality manure in which nutrient elements of the plant and animal residues are conserved and can be profitably applied to the farm crops of the labour. During the process of composting of plant residues and animal waste, ammonia is lost over the period of *aerobic* decomposition of 3 months, thus reducing the nitrogen content and decreasing the nutrient efficiency of the end product. However, during the process of *anaerobic* decomposition of organic waste, the nutritive value of the residue is conserved.

There are two types of biogas digesters commonly installed in many countries, including the Chinese and the Indian type of digesters. Even though both models are similar in most features, the Indian type has a movable gas dome while the Chinese type has a fixed brick-work dome. In Sri Lanka the Chinese type biogas generators are popular due to their simplicity in construction and low cost of installation. This type of generator can be constructed within two weeks with locally available raw material such as cement, sand, bricks, metal, etc (Fig. 1).

Advantages of biogas digesters

1. Large amount of methane gas is produced which is a cheap and of higher calorific value fuel. It can be stored at ambient temperature.

2. The thick liquid sludge which is left over in the digester is an excellent manure with lower C/N ratio and is odourless and also a good soil conditioner.

3. Weed seeds and pathogen which could spread through the waste materials of animals are destroyed or greatly reduced during anaerobic fermentation and thus re-infestation is prevented.

4. Solves the problem of waste disposal in a sanitary manner.

5. Nitrogen loss that occurs during aerobic decomposition is prevented and the period of fermentation is also reduced so that more waste materials could be decomposed within short periods.

6. Helps in conserving energy sources such as wood and gives self sufficiency to the poorer sectors of the society.

Table 1 compares the benefits obtained from compost manure and from biogas.

TABLE 1 - Comparative yearly benefits from compost manure and biogas plant digested manure

(from 4-5 cows or 45 kg of fresh dung per day)

	Method	Fuel obtained	Effective heat value	Manure
1.	Composted in manure pit	Nil	Nil	7 cartloads
2.	Digested in biogas plant	620 m^3	1.87 million K.cal.	10 cart-loads

The gas production from various animal wastes is presented in Table 2.

TABLE 2 - Gas production per unit dry weight of animal wastes

Type of waste	Gas produced (m^3/kg)
Cow dung	0.19 - 0.29
Pig manure	3.74 - 4.99
Chicken waste	0.37 - 0.82
Conventional sewage	0.37 - 0.56
Straw	0.37 - 0.39
Green vegetables and crop wastes	0.37 - 0.39

Table 3 gives comparative fuel value of different major fuels.

TABLE 3 - Fuel value of biogas and other major fuels

Fuel (per kg)	Calorific value (B.T.U)
Firewood	3182 - 3864
Kerosene oil	8844
High speed diesel	8836
Biogas	5909 - 6818
Methane	9782

BIBLIOGRAPHY

ANON. (1980). Biogas. Pamphlet, Industrial Development Board, Sri Lanka, pp. 10.

ANON. (1980). Ferrocement Biogas Holder. Booklet No. 3, International Ferrocement Information Centre, Thailand, Publication No. 18/80, pp. 47.

KARUNAIRAJAN, R.D. (1980). The biogas way to modern rural life. Booklet, pp. 23.

LAURA, R.D. and IDNANI, M.A. (1971). Increased production of biogas from cowdung by adding other agricultural waste materials. *J. Sci. Fd. Agric.* **22**, 164-167.