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Biogas as a Alternate Source Of Energy And Creating Awareness Among Rural People

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ABSTRACT: *This paper deals with the use of biogas as a alternate source of energy and creating awareness among rural people. Biogas refer to a gas made from anaerobic digestion of agricultural and animal waste. The gas is useful as a fuel substitute for firewood, dung,agricultural residues,petrol and electricity. Biogas, a clean and renewable form of energy could very well substitute (especially in the rural sector) for conventional sources of energy (fossil fuels, oil, etc.) which are causing ecological–environmental problems biogas digester involves anaerobic fermentation process in which different groups of bacteria act upon complex organic materials in the absence of air to produce biogas.*

Keywords: *Alternate Source, Biogas, Methane, Waste, Biogas plant.*

I. INTRODUCTION

Biogas is a gas whose primary elements are methane (CH_4) and carbon dioxide (CO_2) and may have small amount of hydrogen sulphide (H_2S), Moisture and siloxanes. It is a mixture of methane (CH_4), 50 to 70% carbon dioxide (CO_2), 30 to 40% hydrogen (H_2), 5 to 10% nitrogren (N_2) and 1 to 2% hydrogen sulphide (H_2S).Water vapour (0.3%). biogas is about 20% lighter than air and has an ignition temperature in the range of 650 to 750°C. It is a colourless and odourless gas that burns with 60% efficiency in a conventional biogas stove. It is a product of the natural decomposition of any organic substance of animal or plant. It refers to a gas produced by the biological breakdown of organic matter in the absence of oxygen organic waste such as dead plant and animal material, animal dung and kitchen waste can be converted into a gaseous fuel called biogas. The main source for production of biogas are cattle dung, night soil, poultry or piggery dropping, agricultural residues animals manure, wood waste from forestry and industry, residues from food and paper industries, municipal green wastes, sewage sludge dedicated energy crops such as short rotation (3 to 15 years) grasses, sugar crops (sugarcane, beet), starch crops (corn, wheat) and oil crops (soy, sunflower, palm oil), kitchen waste, household waste, green waste, human waste. The components of biogas – methane and carbon dioxide- act as greenhouse gases that harm the environment if released unburned into the atmosphere. The production of biogas in biogas plants prevents uncontrolled emission of methane into the atmosphere and, by generating renewable energy in the form of biogas, reduces the use of fossil fuel.

II. BIOMASS CONVERSION PROCESS

Biomass conversion process is divided into three categories, such as:
(i) Direct combustion
(ii) Thermo chemical conversion
(iii) Biochemical conversion

2.1 Direct combustion

Process of burning in presence of oxygen to produce heat and by products is called combustion complete combustion to ashes is called is incineration. The process of combustion is applicable to solid, liquid and gaseous fuel. Such as wood dung, vegetable waste can be dried and burnt to provide heat or converted into low calorific value gas by "pyrolysis".

2.1.1 Pyrolysis process

In this process organic material to gases solid and liquids by heating to 500 ^{0}C to 900 ^{0}C in the absence of oxygen product of wood pyrolysis are methanol, charcoal and acidic acid all forms of organic materials including such as rubber and plastic can be converted to a fuel gas which contains CO ,CH_4, other hydrocarbons (C_nH_m) CO_2 and N_2.

2.2 Thermo chemical conversion

Thermo chemical conversion process converts the biomass and its residues to fuel, chemical and power using gasification and pyrolysis technologies.

2.3 Biochemical conversion

Biochemical conversion by micro-organisms converting biomass to biofuels are slow processes taking place at low temp.The principal conversion process is fermentation. fermentation is a processs of decomposition of organic matter by micro-organism. e.g- decomposition of suger to form ehanol and carbondioxide by yeast and ethanol forming acetic acid in making vinegar.

2.3.1 Gassification

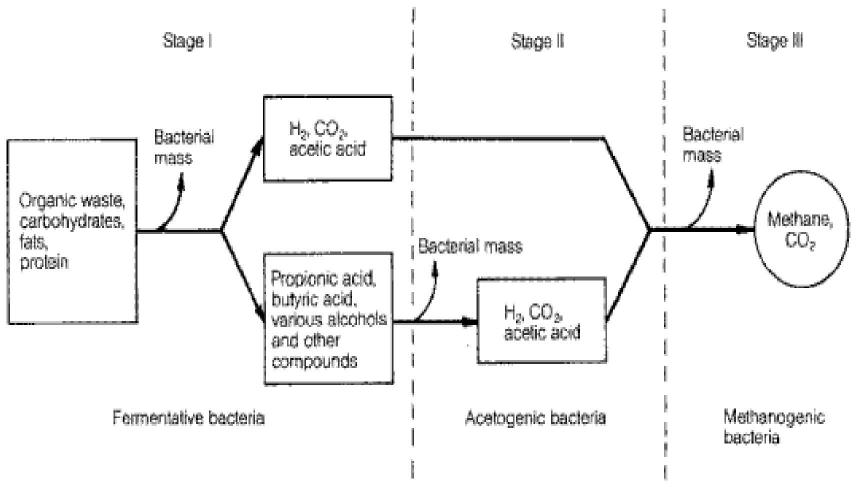
Heating biomass with about one-third of the oxygen necessary for complete combustion produces a mixture of carbon dioxide and hydrogen known as syngas. Paralysis heating biomass in the absence of oxygen produce a liquid pyrolysis oil both syngas and pyrolysis oil can be used as fuels both can also be chemically converted to other valuable fuels and chemicals. ," Gobar Gas" mainly because cow dung has been the material for its production. It is not only the excreta of the cattle, but also the piggery waste as well as poultry droppings are very effectively used for biogas generation. A few other material through which biogas can be generated are algae, crop residues. Biogas is produced by digestion, pyrolysis or hydro gasification. Digestion is a biological process that occurs in the absence of oxygen and in the presence of anaerobic organisms at ambient pressures and temperatures of 35-70 C. The container in which this digestion takes place is known as the digester.

2.4 Anaerobic digestion

Biogas technology is concerned to micro organisms. These are living creatures which are microscopic in size and are invisible to unaided eyes. There are different types of micro organisms. They are called bacteria, fungi, virus etc. Bacteria again can be classified into two types' beneficial bacteria and harmful bacteria. Bacteria can be divided into two major groups based on their oxygen requirement. Those which grow in presence of oxygen are called aerobic while the others grow in absence of gaseous oxygen are called anaerobic. When organic matter undergoes fermentation (process of chemical change in organic matter brought about by living organisms) through anaerobic digestion, gas is generated. This gas is known as bio-gas. Biogas is generated through fermentation or bio-digestion of various wastes by a variety of anaerobic and facultative-organisms. Facultative bacteria are capable of growing both in presence and absence of air or oxygen.

III. STEPS IN BIOGAS PRODUCTION

Biogas microbes consist of a large group of complex and differently acting microbe species, notable the methane-producing bacteria. The whole biogas-process can be divided into three steps: hydrolysis, acidification, and methane formation. Three types of bacteria are involved



3.1 Hydrolysis

In the first step (hydrolysis), the organic matter is enzymolyzed externally by extracellular enzymes (cellulose, amylase, protease and lipase) of microorganisms. Bacteria decompose the long chains of the complex carbohydrates, proteins and lipids into shorter parts. For example, polysaccharides are converted into monosaccharide. Proteins are split into peptides and amino acids.

3.2 Acidification

Acid-producing bacteria, involved in the second step, convert the intermediates of fermenting bacteria into acetic acid (CH_3COOH), hydrogen (H_2) and carbon dioxide (CO_2). These bacteria are facultatively anaerobic and can grow under acid conditions. To produce acetic acid, they need oxygen and carbon. For this, they use the oxygen solved in the solution or bounded-oxygen. Hereby, the acid-producing bacteria create an anaerobic condition which is essential for the methane producing microorganisms. Moreover, they reduce the compounds with a low molecular weight into alcohols, organic acids, amino acids, carbon dioxide, hydrogen sulphide and traces of methane. From a chemical standpoint, this process is partially endergonic (i.e. only possible with energy input), since bacteria alone are not capable of sustaining that type of reaction. Acid-producing bacteria, involved in the second step, convert the intermediates of fermenting bacteria into acetic acid (CH_3COOH), hydrogen (H_2) and carbon dioxide (CO_2).These bacteria are facultative anaerobic and can grow under acid conditions. To produce acetic acid, they need oxygen and carbon. For this, they use the oxygen solved in the solution or bound oxygen. Hereby, the acid producing bacteria create an anaerobic condition which is essential for the methane producing microorganisms. Moreover, they reduce the compounds with a low molecular weight into alcohols, organic acids, amino acids, carbon dioxide, hydrogen sulphide and traces of methane.

3.3 Methane formation

Methane-producing bacteria, involved in the third step, decompose compounds with a low molecular weight. For example, they utilize hydrogen, carbon dioxide and acetic acid to form methane and carbon dioxide. Under natural conditions, methane producing microorganisms occur to the extent that anaerobic conditions are provided, e.g. under water (for example in marine sediments), in ruminant stomach sand in marshes. They are obligatory anaerobic and very sensitive to environmental changes. In contrast to the acidogenic and acetogenic bacteria, the methanogenic bacteria belong to the archaebacter genus, i.e. to a group of bacteria with a very heterogeneous morphology and a number of common biochemical and molecular-biological properties that distinguish them from all other bacterial general. The main difference lies in the makeup of the bacteria's cell walls.

3.3.1 Symbiosis of bacteria

Methane and acid-producing bacteria act in a symbiotically manner. On the one hand, acid producing bacteria create an atmosphere with ideal parameters for methane-producing bacteria (anaerobic conditions, compounds with a low molecular weight). On the other hand, methane-producing microorganisms use the intermediates of the acid producing bacteria.[2] Without consuming them, toxic conditions for the acid-producing microorganisms would develop. In practical fermentation processes the metabolic actions of various bacteria all act in concert. No single bacteria are able to produce fermentation products alone.

IV. PARAMETERS AND PROCESS OPTIMIZATION

The metabolic activity involved in microbiological methanation is dependent on the following factors:

(i). Substrate temperature
(ii). Available nutrients
(iii). Retention time (flow-through time)
(iv). pH level
(v). Nitrogen inhibition and C/N ratio
(vi). Substrat solid content and agitation

Each of the various types of bacteria responsible for the three stages of the methanogenesisis affected differently by the above parameters. Since interactive effects between the various determining factors exist, no precise quantitative data on gas production as a function of the above factors are available. Thus, discussion of the various factors is limited to their qualitative effects on the process of fermentation.

V. CASE STUDY: FLOATING-DRUM & FIXED-DOME TYPE PLANT

5.1 Floating-drum plants

Floating-drum plants consist of an underground digester and a moving gas-holder. The gas-holder floats either directly on the fermentation slurry or in a water jacket of its own. The gas is collected in the gas drum, which rises or moves down, according to the amount of gas stored. The gas drum is prevented from tilting by a guiding frame. If the drum floats in a water jacket, it cannot get stuck, even in substrate with high solid content.

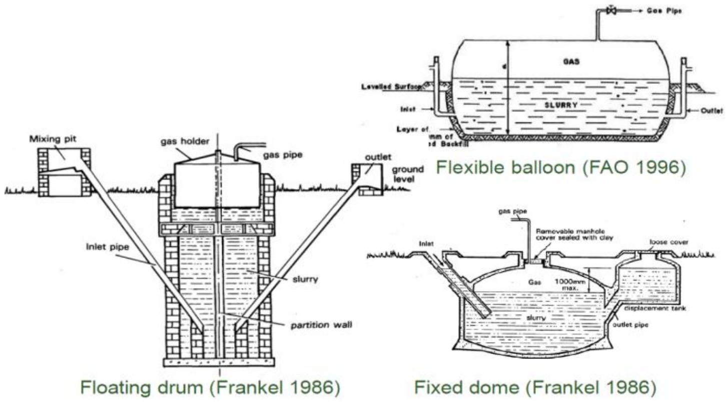


Figure 1: Basic diagram of Floating Drum, Flexible balloon and Fixed dome

5.2 The Drum

In the past, floating-drum plants were mainly built in India. A floating-drum plant consists of a cylindrical or dome-shaped digester and a moving, floating gas-holder, or drum. The gas-holder floats either directly in the fermenting slurry or in a separate water jacket. The drum in which the biogas collects has an internal and/or external guide frame that provides stability and keeps the drum upright. If biogas is produced, the drum moves up, if gas is consumed, the gas-holder sinks back.

Figure 2: Basic Structure of the Drum

Floating-drum plants are used chiefly for digesting animal and human feces on a continuous-feed mode of operation, i.e. with daily input. They are used most frequently by small- to middle-sized farms (digester size: 5-15m^3) or in institutions and larger agro-industrial estates (digester size: 20-100m^3).

5.3 Fixed-dome Plants

A fixed-dome plant consists of a digester with a fixed, non-movable gas holder, which sits on top of the digester. When gas production starts, the slurry is displaced into the compensation tank. Gas pressure increases with the volume of gas stored and the height difference between the slurry level in the digester and the slurry level in the compensation tank. The costs of a fixed-dome biogas plant are relatively low. It is simple as no moving parts exist. There are also no rusting steel parts and hence a long life of the plant (20 years or more) can be expected. The plant is constructed underground, protecting it from physical damage and saving space. While the underground digester is protected from low temperatures at night and during cold seasons, sunshine and warm seasons take longer to heat up the digester. No day/night fluctuations of temperature in the digester positively influence the bacteriological processes. The construction of fixed dome plants is labor-intensive, thus creating local employment. Fixed-dome plants are not easy to build. They should only be built where construction can be supervised by experienced biogas technicians. Otherwise plants may not be gas-tight (porosity and cracks). The basic elements of a fixed dome plant (here the Nicarao Design) are shown in the figure below.

VI. CONCLUSION

Biogas as a alternate source of energy because it is a very cheap gas .it is a renewable source of energy. Waste includes all items that people no longer have any use for, which they either intend to get rid of or have already discarded. Additionally, wastes are such items which people are require to discard, for example by lay because of their hazardous properties. Many items can be considered as waste e.g., household rubbish, sewage sludge, wastes from manufacturing activities, packaging items, discarded cars, old televisions, garden waste, old paint containers etc. Thus all our daily activities can give rise to a large variety of different wastes arising from different sources.Biowaste refers to livestock manures, the biodegradable part of municipal wastes including food and garden wastes, treated sewage sludge, organic industrial wastes such as paper and textiles and compost. They are a major contributor to greenhouse gas emissions and pollution of waters courses if not managed properly. Biowaste can be degraded anaerobically in a biogas digester to produce biogas and other gases. One excellent source of energy is Biogas. This is produced when bacteria decompose organic material such as garbage and sewage, especially in the absence of oxygen. Biogas is a mixture of about 60 percent methane and 40 percent Carbon dioxide. Methane is the main component of natural gas. It is relatively clean burning, colorless, and odorless. This gas can be captured and burned for cooking and heating. This is already being done on a large scale in some countries of the world. Farms that produce a lot of manure, such as hog and dairy farms, can use biogas generators to produce methane.

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