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DEVELOPMENT OF RURAL AREA BY RENEWABLE ENERGY USING BIOGAS PLANT

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ABSTRACT

Renewable energy, often referred to as clean energy, comes from natural sources or processes that are constantly replenished. For example, sunlight or wind keep shining and blowing, even if their availability depends on time and weather. While renewable energy is often thought of as a new technology, harnessing nature's power has long been used for heating, transportation, lighting, and more. Wind has powered boats to sail the seas and windmills to grind grain. The sun has provided warmth during the day and helped kindle fires to last into the evening. But over the past 500 years or so, humans increasingly turned to cheaper, dirtier energy sources such as coal and frocked gas.

INTRODUCTION

Biogas is the mixture of gases produced by the breakdown of organic matter in the absence of oxygen (an aerobically), primarily consisting of methane and carbon dioxide. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Biogas is a renewable energy source. In India, it is also known as "Gobar Gas". Biogas is produced by anaerobic digestion with methanogen or anaerobic organisms, which digest material inside a closed system, or fermentation of biodegradable materials.[1] This closed system is called an anaerobic digester, biodigester or a bioreactor. Biogas is primarily methane (CH) and carbon dioxide) and may have small amounts of hydrogen sulfide (H_2S), moisture and siloxanes. The gases methane, hydrogen, and carbon monoxide (CO) can be combusted or oxidized with oxygen. This energy release allows biogas to be used as a fuel; it can be used for any heating purpose, such as cooking. It can also be used in a gas engine to convert the energy in the gas into electricity and heat. A biogas plant is the name often given to an anaerobic digester that treats farm wastes or energy crops. It can be produced using anaerobic digesters (air-tight tanks with different configurations). These plants can be fed with energy crops such as maize silage or biodegradable wastes including sewage sludge and food waste. During the process, the micro-organisms transform biomass waste into biogas (mainly methane and carbon dioxide) and digestate. Higher quantities of biogas can be produced when the wastewater is co-digested with other residuals from the dairy industry, sugar industry, or brewery industry. For example, while mixing 90% of wastewater from beer factory with 10% cow whey, the production of biogas was increased by 2.5 times compared to the biogas produced by wastewater from the brewery only.

1.1 PROBLEM STATEMENT

It. can be said that man's activities basically depend on energy. This dependence may be direct and visible aa in the case of heating for food preparation or indirect and invisible as in the case of production of corn. The evalution of civilisation in terms of the invention of tools and weaponary, the development of agriculture and

husbandary and the acquisition of other aids to living is just another fact of how much, in what form and in which way man has used energy.

1.2 Problem Motivation

Although the conversion of agriculture waste – cattle dung and crop residues – to biogas and digested slurry is an established and well-proven technology in India, it has been under-used, probably because until recently, firewood was easily available and chemical fertilizer was relatively affordable to most of the farmers in India.

II. LITERATURE SURVEY

2.1 Biogas production from different waste

2.1.1 Introduction

Increase in energy demand and the issues about current non-renewable energy resources led researchers to investigate alternative energy sources during the last two decades. Renewable energy resources draw attention all over the world because they are sustainable, improve the environmental quality and provide new job opportunities in rural areas. Anaerobic digestion (AD) is historically one of the oldest processing technologies used by mankind. Until the 1970s, it was commonly used only in the wastewater treatment plants waste management. The anaerobic digestion is a biological degradation of organic matter by bacteriological flora in anaerobic mode. One such resource is the waste organic matter that is generated in the kitchens and one of the natural agencies which will play an important role in this utilisation is the tiny part of the huge world of tiny microbes. Anaerobic digestion has been considered as waste-toenergy technology, and is widely used in the treatment of different organic wastes, for example: organic fraction of municipal solid waste, sewage sludge, food waste, fish waste, animal manure, etc. Biogas is a clean renewable energy produced from organic wastes using anaerobic digestion as a method. The products of the digestion are biogas and residue. Biogas is a mixture of methane (CH4) with percentage over than 65% and carbon dioxide (CO2). CH4 is the highest component of natural gas. Methane is the main combustible gas in biogas. The biogas is useful as a fuel substitute for firewood, dung, agricultural residues, petrol, diesel, and electricity, depending on the nature of the task, and local supply conditions and constraints, thus supplying energy for cooking and lighting. Biogas systems also provide a residue organic waste, after anaerobic digestion that has superior nutrient qualities over the usual organic fertilizer, cattle dung, as it is in the form of Ammonia. These days, air pollution and global warming are the dominant anxiety grow in the environment of human. This issue could be attributed to the enormous evolution of greenhouse gases (GHG) like carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and other gases which have been produce from an extensive combustion of fossil fuels concurrently with increasing world population [1-3]. It is well known that GHG act as an important factor for global warming. In global warming the heat reflected from the earth surface to increases temperature of ambient temperature. These global warming major contribution of CO2 (60%) and less effect of CH4 (15%) [2,4-6]. Biogas is an environmentally friendly energy source which is mostly comprised of methane (CH4) (55-60%) and carbon dioxide CO2) (35-40%). Moreover, biogas contains a low quantity of other gasses such as ammonia (NH3), hydrogen sulphide (H2S), hydrogen (H2), oxygen (O2), nitrogen (N2) and carbon monoxide (CO) [7-8]. Therefore, reducing emission of CH4 and CO2 from biogas is significant for stabilizing environment temperature and overcome climate problems. Meanwhile it should be noted that CH4 is also a neat fuel. For instance, the higher calorific value of a purified biogas (consist about 97% methane). Biogas can be purified and it is used as a natural gas or

vehicle fuel. Of course, it is prerequisite to upgrade the biogas through removing carbon dioxide to enhance the calorific values. Therefore, separation of CO2 from CH4 is very important to purifying biogas. Various ways to separate CO2 and obtain purified CH4 from biogas. These purification methods like water wash absorption, adsorption, cryogenic fractionation, and membrane separation. In developing countries, biogas is provided to a finite extend from small quantity in pastoral areas. This gas is used mainly for cooking and heating purpose. Regard less to this low utilization of biogas on rural areas, biogas production and use with modern technology could be a liberal of promises option to make use of kitchen waste and wet organic waste available everywhere at negligible costs. Regular operation is more difficult to achieve than its costly initial installation. The technical reasons are mainly from both their owners and the digesters themselves, such as lessknowledge design standards of digester and cold fermentation technology. The farmer's poor knowledge to use digesters. In many cases, lacking of technical knowledge and non-technical reasons, including the loss of interest by users, are the main causes that lead to the failure of sustaining biogas digester running in rural areas, which is usually laborious and messy and offsets the convenience offered by biogas use. In fact, the nature of non-technical barriers is economic reasons. Farmers can only accept biogas digesters that have positive economic benefits to them.

2.1.2 Energy scenario in India

The demand for energy in India, in tandem with the economic growth and the resulting prosperity of the country has increased substantially in the recent years. In such a scenario, it is essential to meet the demand for all energy sources not only to meet the growth objectives but also to sustain the growth achieved till date. Primary energy consumed in the country has increased more than four times in the period from 1971 to 2009. This rising dependence on petroleum products and the growing share of imports in the domestic oil consumption. Despite the dependence on crude oil, domestic production has remained low and has, in fact, stagnated in the recent years. This has led to a rise in dependence on imports of crude oil to meet the domestic demand.

2.1.3 Biogas Applications

1. For cooking and heating.
2. As an illuminatant for domestic and street lighting.
3. for running tube well and water pump.
4. With minor modifications, conventional internal combustion engines, diesel and petrol engine both run on biogas.

2.1.4 Renewable Energy

Utilization of renewable energy resources not only generates useful energy but also aids in climate change mitigation. Energy development in Nepal has always been slow and the current generation only covers one third of the total demand. Although multiple renewable energy resources are available, due to the low economy all the types of energy systems cannot be developed together. The government seems to be perplexed in choosing the best among the alternatives as all the alternatives seems to be important and feasible. It becomes very important to prioritize them based on the peoples' need, resource availability, technical capability and environmental friendliness.

3. Biogas Plant:

3.1. Terminologies Used In Biogas Plant:

1. Bio-Gas

   It is a gaseous mixture containing about 60 percent methane, a high value fuel, about 10 percent carbon-dioxide and traces of other gases, such as ammonia and hydrogen sulphide, obtained from anaerobic fermentation of bio- mass.

2. Bio-Mass

   This refers to bio-degradable material. Cow dung is one of the most important and widely used bio-mass for the production of bio-gas.

3. Anaerobic Fermentation

   A biological conversion process carried out by micro-organisms which convert bio-mass, in the absence of oxygen, to methane.

4. Inlet Slurry

   It is a mixture of bio-mass and water in the right proportion which is fed to the digester.

5. Digester

   This is also known as fermentation tank and is generally embedded partly or fully in the ground. It is usually cylindrical in shape and made of bricks. It holds the slurry within it for digestion for a recommended retention period.

4. Process of Biogas Plant

Anaerobic Digestion

It is also referred to as biomethanization, is a natural process that takes place in absence of air (oxygen). It involves biochemical decomposition of complex organic material by various biochemical processes with release of energy rich biogas and production of nutrious effluents.

Microbiology of Biogas Production:

The process of biogas formation basically runs in four microbiological steps which are temporally parallel (see Figure 1). For a smooth process the individual degradation phases have to be optimally balanced to the requirements of the bacteria involved (e.g. pH-value, temperature).

1. Hydrolysis

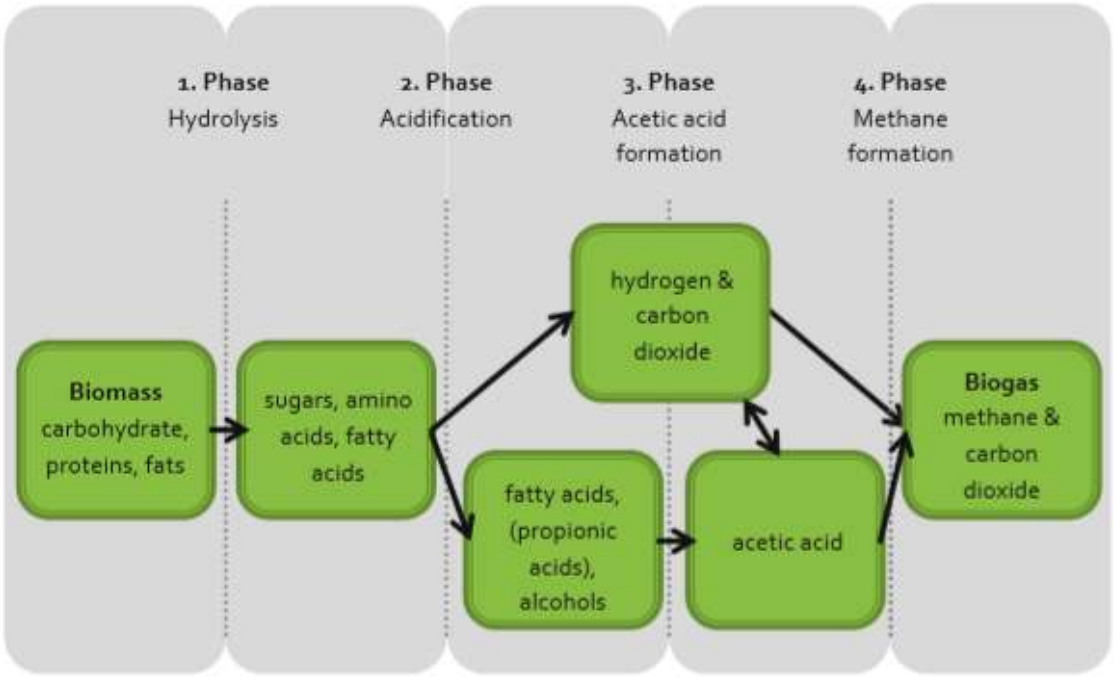
   In the first step the "hydrolysis", the substrate, which is composed of complex compounds (like carbohydrates, proteins and fats), will be cleaved by exo-enzymes in more simple organic compounds (e.g. amino acids, sugars, fatty acids).

2. Acidification

The intermediates formed are further broken down in the second step, the so-called "acidification" through acid-forming bacteria to short-chain fatty acids (acetic, propionic and butyric acid) and carbon dioxide and hydrogen and small amounts of lactic acid and alcohols.

3. Acetic Acid Formation

In the third phase, the so-called "acetic acid formation", the products of acidification will be implemented mainly to acetic acid, hydrogen and carbon dioxide. The acetic acid is formed from organic acids. When this process step is disturbed, an enrichment of acids will occur, because only the methanogens can degrade the acetic acids.



4. Methane Formation

In the last step of biogas generation, the so-called "methane formation", bacteria produce biogas over two pathways; from acetic acid and hydrogen and carbon dioxide.

III. Advantages of Biogas

1. Biogas is Eco-Friendly

Biogas is a renewable, as well as a clean, source of energy. Gas generated through biodigestion is non-polluting; it actually reduces greenhouse emissions (i.e. reduces the greenhouse effect). No combustion takes place in the process, meaning there is zero emission of greenhouse gasses to the atmosphere; therefore, using gas from waste as a form of energy is actually a great way to combat global warming.

Unsurprisingly, concern for the environment is a major reason why the use of biogas has become more widespread. Biogas plants significantly curb the greenhouse effect: the plants lower methane emissions by capturing this harmful gas and using it as fuel. Biogas generation helps cut reliance on the use of fossil fuels, such as oil and coal.

Another biogas advantage is that, unlike other types of renewable energies, the process is natural, not requiring energy for the generation process. In addition, the raw materials used in the production of biogas are renewable, as trees and crops will continue to grow. Manure, food scraps, and crop residue are raw materials that will always be available, which makes it a highly sustainable option.

1) **2. Biogas Generation Reduces Soil and Water Pollution**

Overflowing landfills don't only spread foul smells- they also allow toxic liquids to drain into underground water sources. Consequently, yet another advantage of biogas is that biogas generation may improve water quality. Moreover, anaerobic digestion deactivates pathogens and parasites; thus, it's also quite effective in reducing the incidence of waterborne diseases. Similarly, waste collection, and management, significantly improve in areas with biogas plants. This, in turn, leads to improvements in the environment, sanitation, and hygiene.

2) **3. Biogas Generation Produces Organic Fertilizer**

The by-product of the biogas generation process is enriched organic (digestate), which is a perfect supplement to, or substitute for, chemical fertilizers. The fertilizer discharge from the digester can accelerate plant growth and resilience to diseases, whereas commercial fertilizers contain chemicals that have toxic effects and can cause food poisoning, among other things.

3) **4. It's A Simple and Low-Cost Technology That Encourages A Circular Economy**

The technology used to produce biogas is quite cheap. It is easy to set up and needs little investment when on a small scale. Small biodigesters can be used right at home, utilizing kitchen waste and animal manure. A household system pays for itself after a while, and the materials used for generation are absolutely free. The gas manifested can be used directly for cooking and generation of electricity. This is what allows the cost of biogas production to be relatively low.

Farms can make use of biogas plants and waste products produced by their livestock every day. The waste products of one cow can provide enough energy to power a lightbulb for an entire day.

In large plants, biogas can also be compressed to achieve the quality of natural gas, and utilized to power automobiles. Building such plants requires relatively low capital investment, and creates green jobs. For instance, in India, 10 million jobs were created, mostly in rural areas, in plants and in organic waste collection.

4) **5. Healthy Cooking Alternative For Developing Areas**

Biogas generators save women and children from the daunting task of firewood collection. As a result, more time is left over for cooking and clean. More importantly, cooking on a gas stove, instead of over an open fire, prevents the family from being exposed to smoke in the kitchen. This helps prevent deadly respiratory diseases. Sadly, 4.3 million people a year die prematurely from illness attributable to the household air pollution caused by the inefficient use of solid fuels for cooking.

IV. Disadvantages of Biogas

5) 1. Few Technological Advancements

An unfortunate disadvantage of biogas today is that the systems used in the production of biogas are not efficient. There are no new technologies yet to simplify the process and make it abundant and low cost. This means large scale production to supply for a large population is still not possible. Although the biogas plants available today are able to meet some energy needs, many governments are not willing to invest in the sector.

6) 2. Contains Impurities

After refinement and compression, biogas still contains impurities. If the generated bio-fuel was utilized to power automobiles, it can corrode the metal parts of the engine. This corrosion would lead to increased maintenance costs. The gaseous mix is much more suitable for kitchen stoves, water boilers, and lamps.

7) 3. Effect of Temperature on Biogas Production

Like other renewable energy sources (e.g. solar, wind) biogas generation is also affected by the weather. The optimal temperature bacteria need to digest waste is around 37°C. In cold climates, digesters require heat energy to maintain a constant biogas supply.

8) 4. Less Suitable For Dense Metropolitan Areas

Another biogas disadvantage is that industrial biogas plants only makes sense where raw materials are in plentiful supply (food waste, manure). For this reason, biogas generation is much more suitable for rural and suburban areas.

V. CONCLUSION

This project help the people to contribute towards the biogas plant and understand it as better source of energy.People can be an entrepreneur and earn good revenue by staying in his own village by installing biogas plants. Wecan encourage farmers and people in our village to collect cattle dung and agriculture residue daily from their farms and households and use the same as feedstock in biogas units. We can explain them the benefits of biogas. The production and use of biogas for domestic purpose can drastically reduce the depletion of natural sources like forest which is the traditional source of energy for cooking. It removes dependence on forest and enhances greeneries leading to improve environment.It can be replace LPG cylinder also which is not affordable for poor farmer. Also there are many government subsidy likeUnder MNRE the biogas and manure management programme(NBMMP), the central government provides subsidy to users installing biogas plants. For a one cubic meter plant the subsidy amount is Rs 5,500. For larger plants the subsidy is Rs 9,000.

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