THE SIGNIFICANCE OF BIOGAS PLANTS IN NIGERIA'S ENERGY STRATEGY

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ABSTRACT

In the face of dwindling power generation that has bedeviled the nation since independence, the need to generate low cost and constant electricity cannot be overemphasized. Due to the epileptic power supply to the national grid, it has become absolutely important to explore other cheap sources of power to meet our urban and rural energy need. This will in no small measure support our national grid and reduce rural-urban drift. The complete dependence on gas generated by the Nigeria National Petroleum Co-operation to power our turbines at our gas plants often exposes the country to power outage due to high cost of maintenance and vandalism. Applying biogas technology to generate power can help the country develop its energy sector more rapidly as the raw material needed to feed the biogas plants are just mere waste such as agricultural and domestic waste. The focus of this paper is on the use of biogas to generate electricity and the production of domestic cooking gas across the rural and urban settlements in the country. The country stands the chance of meeting her vision 20-20-20 which is anchored on constant electricity if this is critically studied by the Ministry of Power and other related agencies of government in charge of our National Gas Plan.

Keywords - National grid, biogas technology, rural-urban drift, vision 20-20-20.

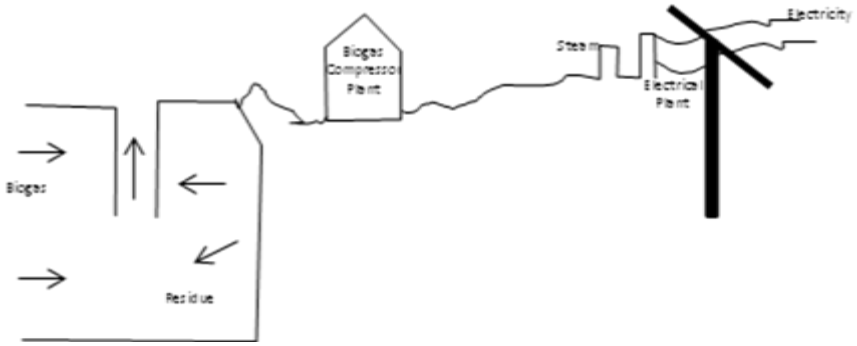
INTRODUCTION

In our today's world where the demand for energy is growing by the day, the need for exploring and exploiting new sources of energy which are renewable as well as environmental friendly cannot be overemphasized. Biogas technology offers an attractive platform to utilize certain categories of biomass for meeting rural energy needs if it is properly harnessed. In our rural areas, various cellulosic biomasses (cattle dung, agricultural waste) are available which can be utilized in the production of biogas.

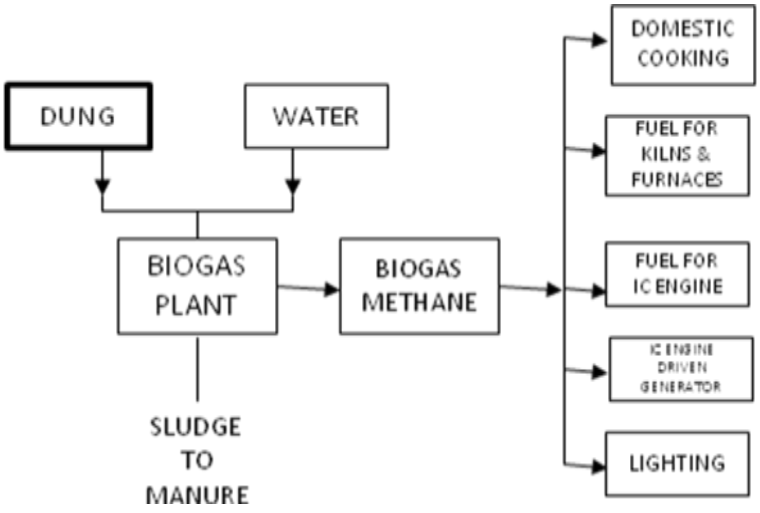
Biogas is a made from anaerobic digestion of agricultural and animal waste. The gas is about 20% lighter than air and has an ignition temperature in the range of 650^0C to 750^0C. It is odourless, colourless and burns with a brilliant blue flame similar to that of LPG gas. Its caloric value is about 20MJ/m^3 and burns with about 55% efficiency in a conventional biogas stove. The gas is mixture of methane, carbon IV oxide, hydrogen, nitrogen, hydrogen sulphide and water vapour. Biogas is a useful substitute for firewood, petrol, diesel and electricity depending on the nature of the task and its availability. Biogas can be used to power vehicles. There is a biogas powered train in Sweden running between Linkeopung and Vaestervick which is powered with gas generated from cow waste and sewage. Biogas has no particulate emissions and generates one-fifth as much nitrous oxide as diesel.

COLLECTING AND USING BIOGAS

Biogas can be collected from landfills sites by drilling gas wells. Historically, it was just flamed, but now more and more landfills are being drilled and the biogas collected is used for power generation and domestic cooking gas in most developed and developing nations of the world. Some sites have even built dedicated Anaerobic Digesters to generate larger quantities of methane-rich biogas more quickly and to reduce the volume of waste to be buried in the site.



Biogas production is often achieved using biogas plant, which is a system that digests organic matter to produce gas. Biogas technology is often used on farms with the primary goal of controlling waste pollution. Dairy farms for example, may have significant problems with waste polluting surface and underground water sources. Biogas technology allow farmers to address this problem with the beneficial side effect of creating a new power source which can help meet the electricity need of the farm. Biogas electricity and energy for heating can be produced locally with biogas technology system in our farms, for example, a farmer with 500 cows could install a system that would generate sufficient electricity to power the entire diary system. Larger scale systems in some countries collect manure from multiple farms and perform the digestion process centrally in a large plant. There are three main types of biogas technology digesters; covered lagoon, complete mix, and plug-flow. All these types digest manure to produce biogas. They differ in their efficiency, the concentration of solids they can handle, and their suitability to different climatic conditions and applications. Biogas plants are built in various sizes having capacity of $0.5m^3$/day to $650m^3$/day capacity depending on the availability of raw material. The biogas plant is designed to suit particular type of waste to be used in feeding the plant. The energy route of biogas is as shown below;



The biogas produced by the biogas plant is used as;

1. Domestic cooking gas.
2. Fuel for driving Internal Combustion engines for pumps.
3. Fuel for Internal Combustion engine driven generating plants for supplying electrical energy.

TECHNIQUES FOR ENHANCING BIOGAS PRODUCTION

The different techniques used in enhancing biogas production can be grouped into the following categories;

i. Use of additives
ii. Recycling of slurry and slurry filtrate
iii. Variation in operational parameters like temperature, hydraulic retention time (HRT) and particle size of the substrate
iv. Use of fixed film/biofilters

Additives are introduced to increase the production of biogas by stimulating the microbial activity using various biological and chemical substances under different operating conditions. Biological additives include plants, weeds, crop residues, and microbial cultures which are naturally available in our surroundings. The suitability of an additive is largely dependent on the type of substrate. Powdered leaves of some plants and legumes like Gulmohar, Leucacena leucocephala, Acacia auriculiformis, Dalbergia sisoo and Eucalyptus tereticonius have been found to stimulate biogas production between 18% and 40% (SPOBD, China, 1979, Chowdhry et al, 1994). Crop residues like maize stalks, rice straw, cotton stalks, wheat straw and water hyacinth each enriched with partially digested cattle dung enhanced gas production in the range of 10-80% (El Shinnawi et al; 1998; Somayaji and Khanna, 1994). Strains of some bacteria and fungi have also been found to enhance gas production by stimulating the activity of particular enzymes. Cellulolytic strains of bacteria like actinomycetes have been found to improve biogas production in the range of 8.4-44% from cattle dung (Tirumale and Nand, 1994, Attar et al, 1998).

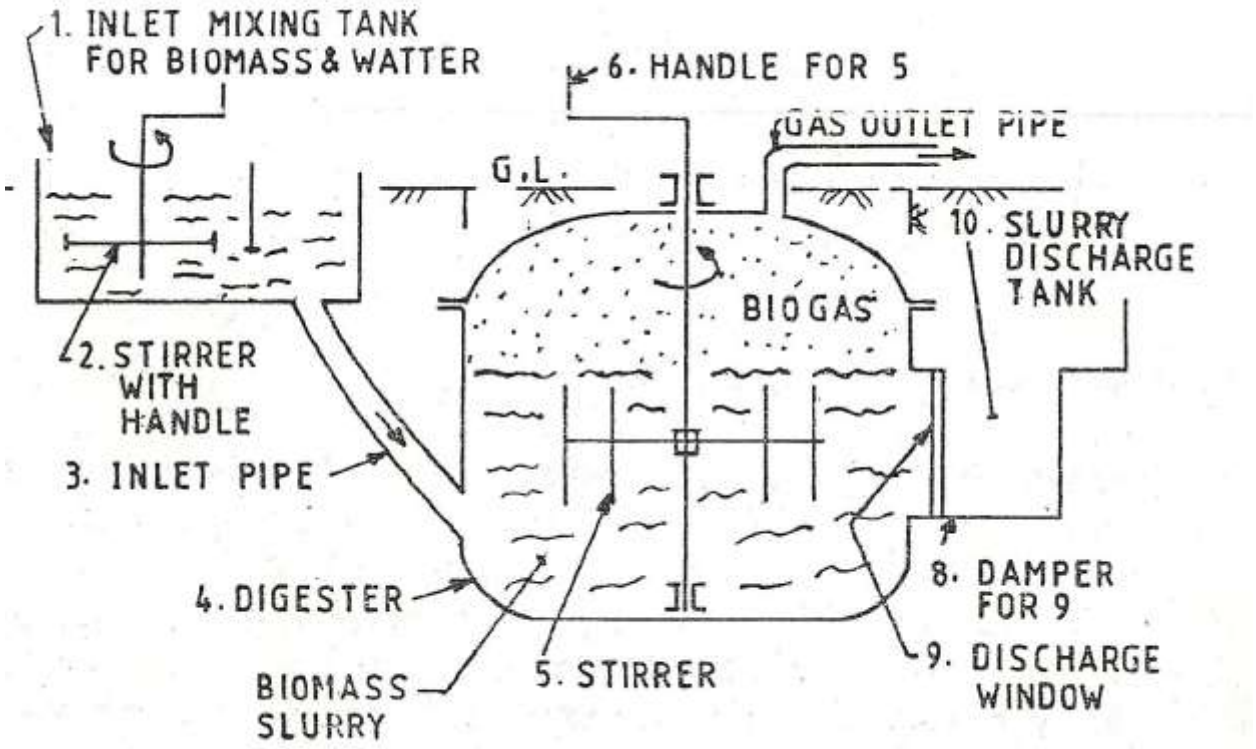
TYPES OF BIOGAS PLANT

Biogas plants are built in several sizes and configurations. Small size biogas plant can deliver 0.5m^3/day and larger sizes can deliver 2500m^3/day. Biogas plants are classified into the following main types;

i. Continuous type or batch type
ii. Dome type

The fixed-dome type biogas plant otherwise known as the Chinese Model will be preferable for use in Nigeria in meeting rural energy needs because its operation and maintenance is relatively simple. Also, it does not need large volume of digester to accommodate large volume of the batch hence its initial cost is lower than the continuous type.

The diagram below illustrates a schematic of the fixed dome type biogas plant (Chinese Model).



The inlet tank receives the feed biomass and waste or liquid waste. The stirrer with the handle is used for stirring the mixture to form slurry which is fed into the digester via the inlet pipe. The stirrer mixes the slurry in the digester. The biogas produced is collected in the upper half of the digester tank. The upper dome is fixed type; hence this type of biogas plant is called the Fixed Dome type biogas plant. After the production of biogas, the slurry is discharged by the opening damper. The fixed dome type biogas plant has been adopted on a large scale in China; hence it is sometimes called Chinese design.

NIGERIA'S CAPACITY TO GENERATE BIOGAS

The raw material needed to feed the plants for the production of biogas is found everywhere in the country especially in the northern part where agricultural activities is mostly practiced. These include; poultry waste, piggery waste, cow dung, maize and wheat straw, slaughter house waste, human excreta, tree leaves, waste cabbage etc. In northern Nigeria, the rearing of cattle is a major agricultural activity bringing in high income in the region. This activity is often accompanied with environmental pollution as a result of the dung generated by these animals. The dung can be put into use by using it to generate biogas. 50,000 cattle can deliver up to 20,000m^3/day (CO_2 free) of biogas which can serve a large community size (Gobar gas, India). In the southern part of the country, aquatic biomass can be used to generate biogas. These include; water hyacinth, algae and ocean kelp. The high vegetative cover of this region can also be taken advantage of in generating biogas. Hyacinth are plants of lily family with narrow channeled leaves and spikes of fragrant bell shaped flowers in white, yellow, blue, and purple. It grows on rivers, lakes and canals. Estimated potential of biomass energy from oceans is about 10.0 x 10^6MW and its present use is negligibly small. Cassava peelings which is a major waste generated from the processing of cassava to flour can be used with some additives to produce biogas. Nigeria has enormous potential to generate energy through this cheap and environmental friendly source.

THE WORLD'S USUAGE OF BIOGAS

The United Nations Development Programme (UNDP) 1997 Report, Energy After Rio: Prospect and Challenges, identified community biogas plants as one of the most useful decentralized sources of energy supply. Unlike the centralized energy supply technologies, such as power plants based on hydroelectricity, coal, oil or natural gas, that have hitherto been the only choices open to rural communities, biogas does not require big capital to set up, and do not pose environmental problem that excite public opposition. Instead, in most cases, they offer solutions to existing environmental problems, and many other benefits. China began mass adoption of biogas in 1975 under the slogan "biogas for every household". Within the first few years, 1.6 million digesters were constructed annually, and by 1992, about 5 million family sized plants were operating. In India, a too-rapid implementation policy in the early 1990s exceeded the capacity of India's research and development organizations to produce reliable designs and to optimize digester efficiency. The situation has improved since, especially with the introduction of a low-cost polyethylene tubular digester. Now, everyone in India installing a biogas plant has the right to an allowance paid by the central government. In a report, Biogas in India: A Sustainable Energy Success Story, the authors identified women and children as a major beneficiaries of biogas in India, where every year, 200,000 families turn away from the traditional fire place and have a biogas plant installed to provide energy for cooking and lighting. By 2000, more than 2 million biogas plants have been built in India and almost 200,000 permanent jobs created.

In Vietnam, as in other developing countries- Colombia, Ethiopia, Tanzania, Cambodia and Bangladesh- the polyethylene tubular digester was promoted to reduce production cost by using local materials and simplifying installation and operation. The resulting low-cost

digester has been well received by poor farmers, especially where they participate fully in the necessary maintenance and repair work. Within ten years, more than 20,000 polyethylene digesters were installed and mainly paid by farmers. In Sri Lanka, biomass accounts for 45% of the country's energy needs, with petroleum and hydroelectricity supplying 41% and 14% respectively. Sri Lanka's economy is still largely based on agriculture. Nepal's biogas programme is internationally regarded as a model for successful use of alternative energy for rural Third World. Nepal has overtaken China and India in the number of biogas plants per capita. Each of its 125 000 functional digesters prevents five tones of carbon (IV) oxide equivalent from being pumped into the atmosphere every year. This "saved" greenhouse gas is what rich countries are buying to offset their own emissions.

CONCLUSION AND RECOMMENDATION

A critical analysis of literature reveals that there is a strong possibility of meeting our rural energy needs if we can adopt biogas technology in Nigeria. The use of biogas technology will not only help us to generate biogas for lighting and cooking, it will also help in the treatment of waste which constitute a major environmental hazard and the slurry from the biogas plants can serve as fertilizer for farmers. The search for alternative source of energy such as biogas should be intensified so that ecological disasters like deforestation, desertification and erosion can be reduced. Utilization of biogas technology can no longer be doubted. For the effectiveness of this process, the following recommendations are made;

a. There should be an institutional framework for renewable energy education in Nigeria to come up with policies geared towards increasing the adoption rate of biogas technology.
b. Appropriate legal framework should also be adopted.
c. Increase in government spending to develop technical capacity for running and maintaining biogas digesters. For example, in China, a training course is organized for farmers from time to time to popularize biogas technology and after completing the course, participants would be given a professional technical grade certificate that is recognized by the state.
d. Government at all levels should take active part in all biogas projects and intensify funding of researches to enhance the production of biogas as it is being practice in Nepal and India just to mention but a few.

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