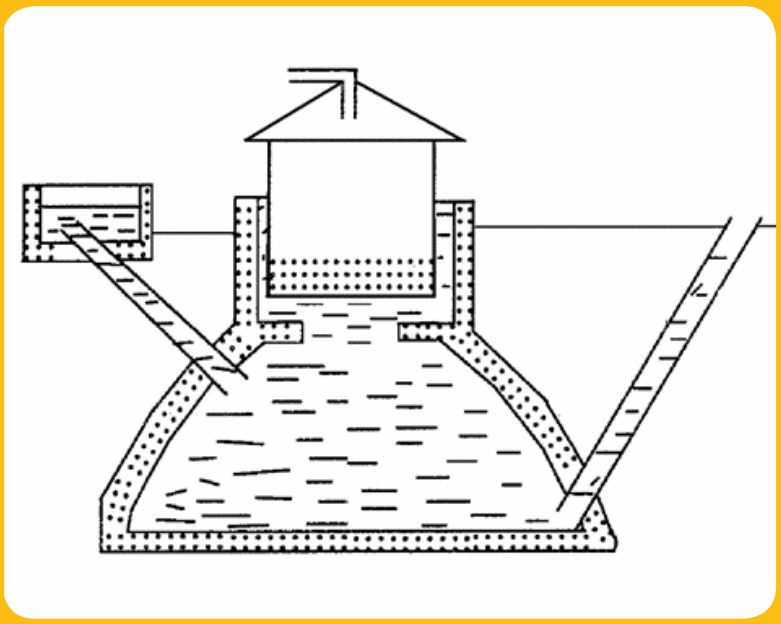
REPUBLIC OF KENYA

KALRO
Kenya Agricultural & Livestock Research Organization

NAVCDP
NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

MANAGEMENT OF SLURRY MANURE FOR BIOGAS PRODUCTION



INTRODUCTION

- Biogas is a mixture of gasses produced by methanogenic bacteria while acting upon biodegradable materials under an anaerobic condition.
- Biogas is odorless and colorless and burns with clear blue flame similar to that of LPG gas
- Gas production takes place in an oxygen-free (anaerobic) environment with an average temperature of about 35 – 40°C. The ambient temperatures should remain over 15°C
- About 25 to 30 % of organic matter is converted into biogas while the rest becomes available in the digestate or bio-slurry form.

BIOGAS PRODUCTION

- Biogas can be generated by a wide range of organic materials; cattle dung is best suited for small installations. Digestion process is robust and the material is abundantly available.
- Biogas at household level should be able to provide at least 0.8 to 1 m^3 biogas daily. To generate this amount of biogas, the household should have 20 to 30 kg of fresh dung available on a daily basis.

COMPOSITION OF BIOGAS

Gases	Formula	Percentage
Methane	CH_4	50-70
Carbon dioxide	CO_2	25-35
Hydrogen	H_2	5-10
Nitrogen	N_2	1-2
Hydrogen sulphide	H_2S	Traces
Water vapour	H_2O	0.3

IMPORTANCE OF BIOGAS

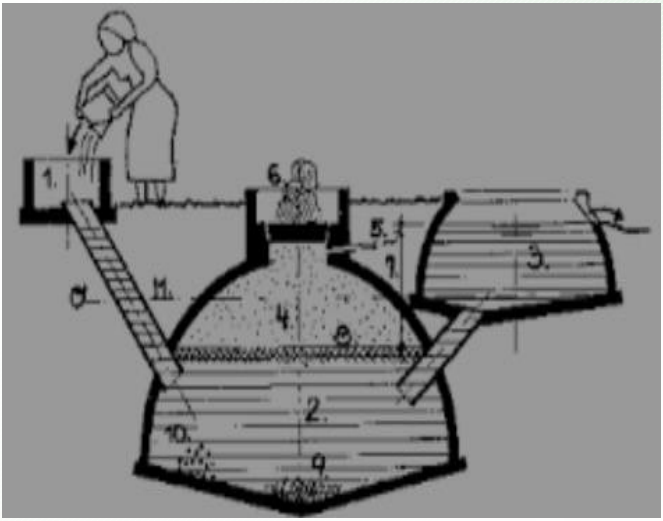
- High calorific value
- Clean fuel
- No residue produced
- No smoke produced
- Non polluting
- Economical
- Can be supplied through pipelines
- Burns readily – has a convenient ignition temperature

TYPES OF BIODIGESTERS

- **Fixed Dome Biogas Plant-** It consists of a digester with a fixed, non-movable gas holder, which sits on top of the digester.

  Estimated cost of construction of fixed dome biogas

- Depending on digester's size,
    - $6m^3$ =KShs 83,710
    - $8m^3$ = KSHs. 100,070
    - $10m^3$= KShs. 110,710
    - $12m^3$= KSHs. 125260
- Excluding site survey of KSHs. 2,500, excavation cost of KSHs. 1,000 to KSHs. 1,500 per m3 and KSHs. 5,000 for extra piping and other contingencies



Key
1-6 Bio slurry
1- Inlet pipe
2- Bioslurry
3- Discharge outlet
4- Biogas chambers
5- Biogas/seal
6- Biogas valve

- **Floating drum biogas digester** - Floating drum biogas plants consist of a digester and a moving gasholder. The gasholder floats either direct on the fermentation slurry or in a water jacket of its own

- **Polythene tube digester**-It consist of a long cylinder made of PVC. The bag digester was developed to solve the problems experienced with bricks and metal digesters.

Requirements to install a tube digester

- 2 polythene tubes of 0.2 mm thickness (Gauge 1000), 90-120 cm diameter and 8- 10 m length (for digester)
- Polythene tube of 0.2 mm thickness (Gauge 1000), 90-120 cm diameter and about 3-4 m length (for gas reservoir)
- A PVC pipe of 1.2 cm diameter and one metre long for tapping the gas from the digester
- Two pieces of PVC pipe of 10-15 cm diameter and one metre length to serve as inlet and outlet pipes
- A plastic gas pipe of 1.2 cm diameter and as long as the distance to the point of gas use
- 3 PVC "T" pieces each attached to a 1.2-cm diameter, 30-cm long pipe (for gas storage and water trap)
- Rubber straps to tie all the joints to make them airtight

Balloon biogas plant

HOUSEHOLD ENERGY CONSUMPTION FOR LOW-INCOME HOUSEHOLDS

- The average annual household fuel wood consumption for these households in Africa is ≈12 kg/day/household. Depending on traditional/conventional cooking stoves, three-stone fires or open fire
- About 1,500 - 2,400 L/day of biogas is considered sufficient to supply cooking requirements for a family of five.

Uses of biogas

Biogas can be used among others for:

- Domestic fuel (cooking, heating, lighting)
- For street lighting

Gas cooking

- Generation of electricity

Biogas for electricity

BENEFITS OF BIOGAS AS A SOURCE OF ENERGY

- Biogas improves health of rural low-income households by providing a cleaner cooking fuel and a waste handling solution thus avoiding health problems.
- Bio-slurry/digestate when used as a fertilizer enhances physical, chemical, and biological attributes of the soil and increases crop productivity when applied to the land.
- Economic benefits from bio-digester installations include job creation in the biogas sector, funds that can be made through carbon credits and reduced costs from imported chemical fertilizers and fossil fuels.
- Reduction in workload from women and children associated with collecting fuel wood or cow dung and also the availability of clean household energy.
- Reduction in greenhouse gas (GHG) emissions by displacing the burning of fuel wood and paraffin in inefficient cooking stoves with biogas.

CHALLENGES LIMITING ADOPTION OF BIOGAS TECHNOLOGY

- ***Lack of a renewable energy policy*:** Policy should guide the stakeholders and suppliers to maintain quality of product and services.
- ***Unfavorable climate (too cold or too dry)*:** Areas where the temperature sometimes goes below 10 °C are not suitable for biogas production unless the digester is protected against temperature variations
- ***High cost of installation*:** One of the major barriers for the widespread dissemination of domestic biogas technology is the high installation, operating and maintenance (IOM) costs, which puts it out of financial reach of many rural households
- ***Lack of technical knowledge*:** Lack of knowledge about the construction, operation and maintenance of biogas systems is often cited as a reason for non-adoption of biogas in some countries in Africa. Poor IOM capacity of the users has led to poor performance and even abandonment of bio- digesters.

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Design and layout by Emma. Nyaola

KALRO/NAVCDP Pamphlet No.010/2024