Small Scale Anaerobic Digestion: A Case Study

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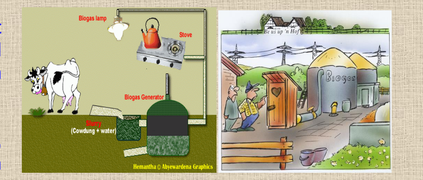
INTRODUCTION

Definition

Biogas is clean environment friendly fuel that can be obtained by anaerobic digestion of animal residues and domestic and farm wastes. It is an important renewable energy resource .

Composition

Biogas generally comprise of 55-65 % methane, 35-45 % carbon dioxide, 0.5-1.0 % hydrogen sulfide and traces of water vapor .



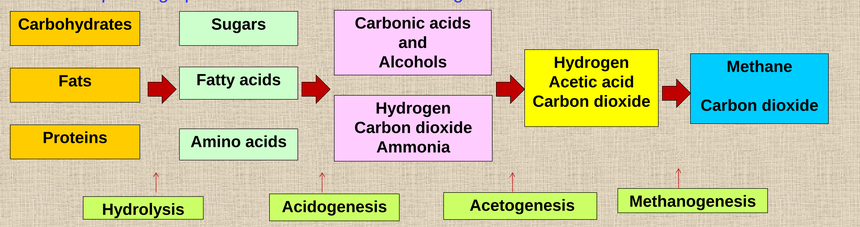
Properties

[assumed 58% CH4 and 42% CO2, saturated with water vapour at 30°C and standard pressure (1 bar)] http://biogas.wikispaces.com/Biogas+Burners

Particulars	Usual	Range
Caloric value	21.5 MJ/l	20.10 – 25.90
Effective molecular weight	27.35	24.00 – 29.00
Density	1.0994 kg/m^3	0.96 – 1.17
Specific gravity	0.94	0.82 – 1.00
Viscosity	1.297 x 10^{-5} kg/sec/m	
Optimum air to fuel ratio	5.5: 1 (15 % biogas)	
Flammability	9 % - 17 % biogas in air	
Burning velocity	0.25 m/sec in air	

Biogas production process (Anaerobic digestion)

It is a multiple-stage process in which some main stages are-



The quantity, rate and composition of biogas generated depends on

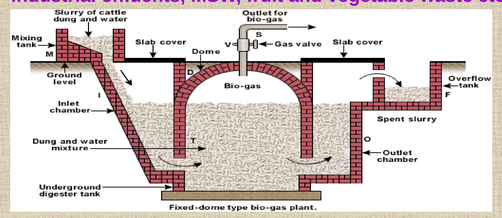
- Temperature (35-37 C Mesophilic condition)
- Bacterial population
- C/N ratio (optimum between 25:1 to 30:1)
- pH (optimally pH between 6.8-7.2)
- Solid content (feed material should have approx. 10:1)
- Should not have toxic material/ harmful material to bacteria in digester
- HRT (Hydraulic Retention Time – 30, 40, 55 days)
- Loading rate and mixing

Overview of commercially viable technologies

Family size biogas plants (1 to 10 m^3) – KVIC, Deenbandhu, Janta, Pragati, Flexi etc.

Large scale biogas plants (10 to 140 m^3) – KVIC

Large scale plants above 1000 m^3 – UASB, Modified UASB, BIMA Digester (suitable for industrial effluents, MSW, fruit and vegetable waste etc.)



Detailed structural design of fixed dome biogas plant

CASE STUDY OF BIOGAS PRODUCTION @ AONIATI SATRA

Location: Aoniati Satra, North Guwahati, City: Guwahati, State: Assam, Country: India Pin:+91 781039

Type of Digester: Deenbandhu model Dimension: 3 m^3

Inlet tank

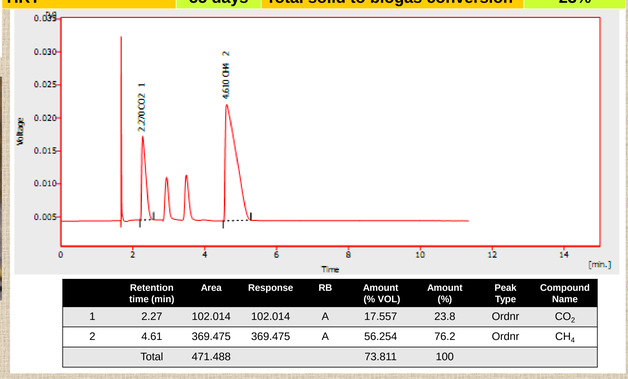
Digester

Outlet tank

GENERAL INFORMATION

Total cows	12	Feeding per day	60 Kgs
Total solid (Cowdung:water/1:1)	8.43%	Average biogas burning duration (Summer and Winter)	8 hrs daily
Average summer temperature	30-32 °C	No. of users	12
Average winter temperature	10-12 °C	Total solid of Slurry (can be reutilized for biogas production)	6.5%
HRT	55 days	Total solid to biogas conversion	23%

Biogas flame



	Retention time (min)	Area	Response	RB	Amount (% VOL)	Amount (%)	Peak Type	Compound Name
1	2.27	102.014	102.014	A	17.557	23.8	Ordnr	CO_2
2	4.61	369.475	369.475	A	56.254	76.2	Ordnr	CH_4
	Total	471.488			73.811	100		

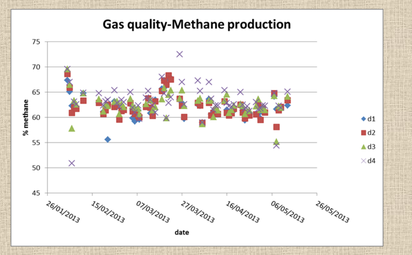
Gas chromatogarph analysis of the Biogas produced

EXPERIMENTAL WORK AT LOUGHBOROUGH UNIVERSITY

Co-digestion of sewage sludge with:
- Food waste
- Agricultural waste

Parameters examined:
- Particle size
- Temperature
- Fibre

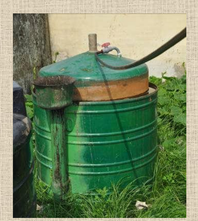
EXPERIMENTAL RESULTS: BIOGAS PRODUCTION

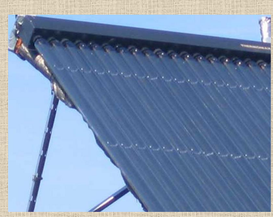


TOWARDS REMOTE MONITORING…

Aiming for autonomous remote monitoring of: CH_4, CO_2, O_2, pressure, temperature, H_2S

- **Using autonomous wireless gas sensing platforms- reliable long term performance and reduction in component cost**
- **The data to be sent to the cloud via GSM transmissions, and will be accessible via an online portal for remote monitoring by the facility management**
- **CO_2 and CH_4 sensing: high-accuracy infrared absorbance sensors,**
- **Pressure sensing: piezoelectric sensors (critical for understanding gas flows)**
- **Autonomous operation is achieved by custom-programmed microcontroller circuitry, which also manages data logging and remote transmission (GSM communications)**
- **Hybrid solar thermal heating of the digesters**





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