

ABSTRACT

Demonstrating the operation of on-farm biogas digesters is important to present a show case and help farmers understand the process. Four small scale portable on-farm biogas digesters have been operated to digest dairy manure. The methane yield ranged between 165 and 191 liters of methane per kg of volatile solids fed to the digester in 21 days cycle. Feeding 3 kg volatile solids per cubic meter of active microbial culture and operating the digester at 5 – 7.5% total solids appeared a reasonable operation option. The digesters require heating to maintain constant and uniform temperature which is necessary for the operation.

Anaerobic Digestion (Biogas Process)

Anaerobic digestion is a biological process that uses microorganism to convert organic waste to biogas. Biogas is combustible and can be used to generate heat or electricity. Digesting livestock manure generates combustible gas similar to natural gas, nutrients-rich liquid fertilizer, and fibers for soil amendments.

Anaerobic Digester

Air-tight containers or vessels in which the microorganisms are brought in contact with the organic waste.

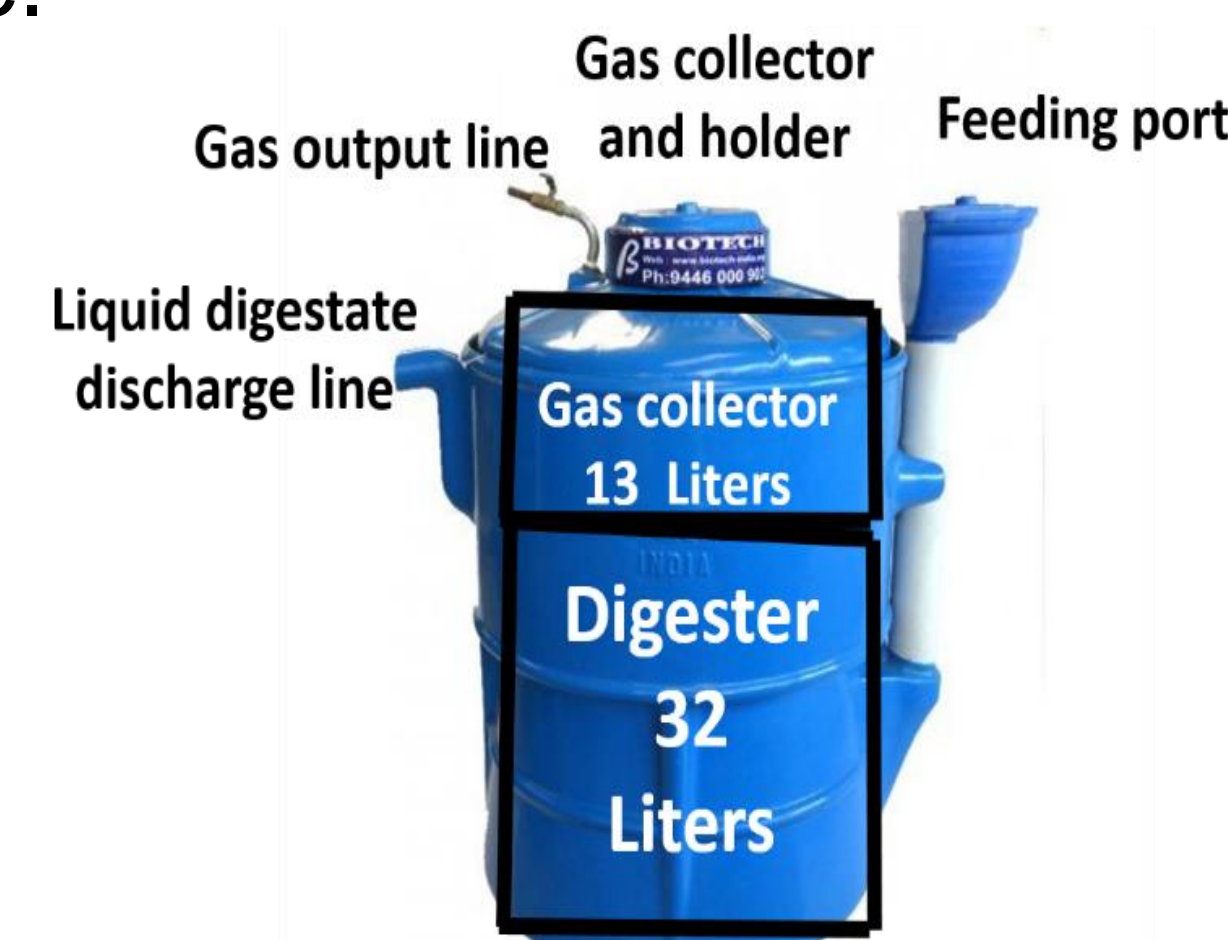


Figure 1: The biogas digester used in Lester's Dairy Farm

Feedstock

Is the organic waste (dairy manure) fed to the digester.



Figure 2: (A) Dry manure (B) Wet manure (slurry)

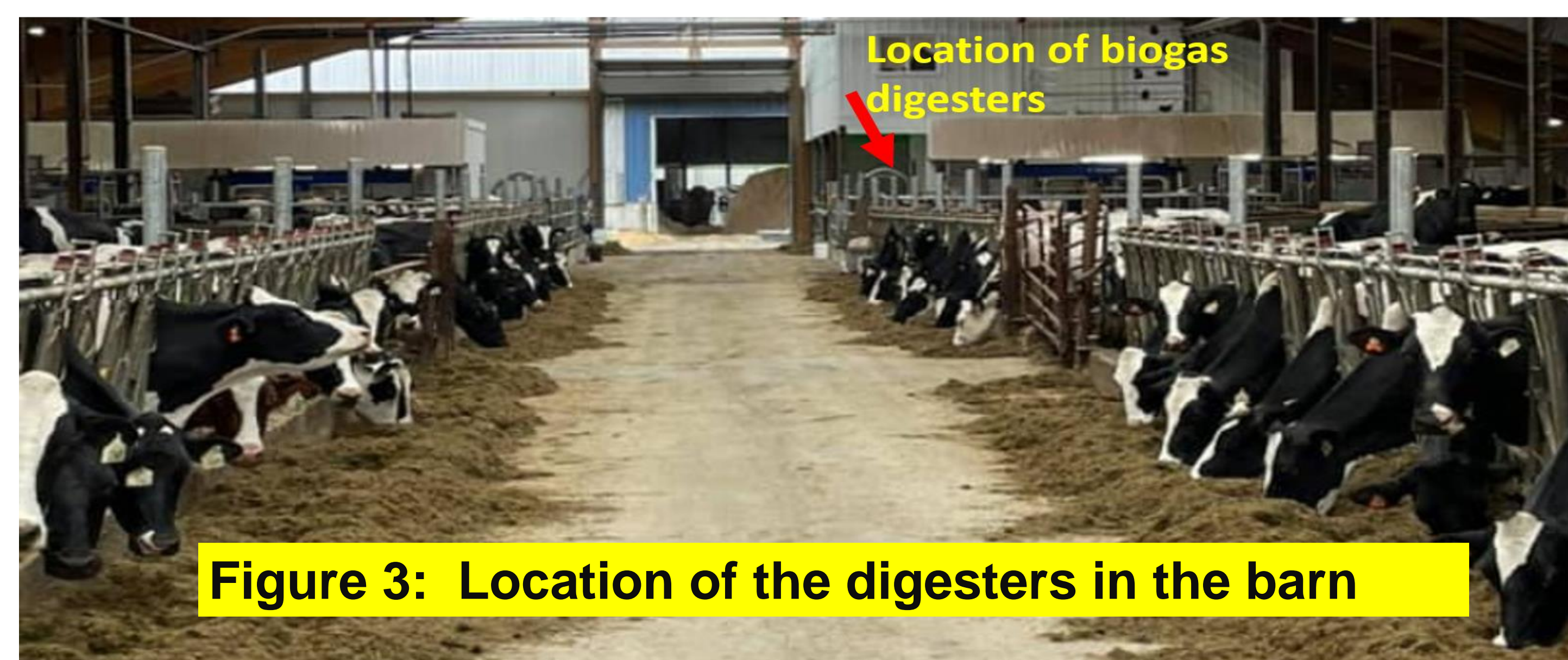


Figure 3: Location of the digesters in the barn

Digesters Set-Up

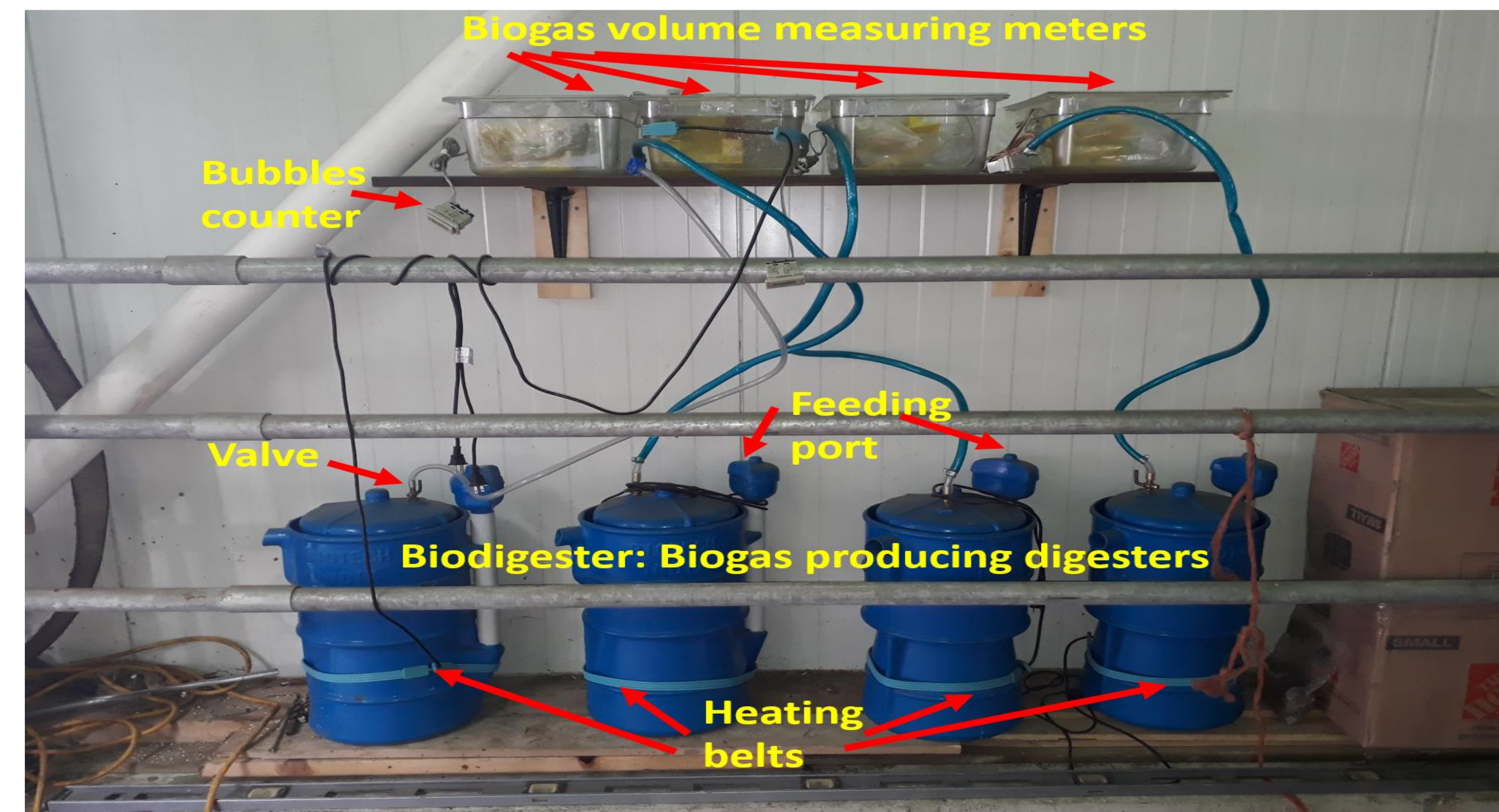


Figure 4: Digesters setup



Figure 5: Gas meters

Biogas Composition Analysis



Biogas analyzer kit



Portable biogas analyzer device



Biogas analyzer with the fitting



Biogas sampling probe



Biogas sampling pump-probe connected to the device



Biogas composition readings

Figure 6: Portable Biogas Analyzer

Table 1. Average Daily Waste Production From Dairy Barn

Average Daily Production of Wet Manure per Cow	0.0793 m ³
Average Daily Production of Wet dairy Manure Herd	20.63 m ³
Average Water Waste From Milk Parlour Sanitation	6.056 m ³
Total Waste Production From Dairy Barn	26.69 m ³

Operation procedure

The following steps have been followed to start up and operate the digesters:

1. Fill the digester with water
2. Bring the temperature of the contents to the operating level.
3. Remove a certain volume of water from the digester and add its equivalent of culture from the manure storage tank.
4. Mix the content manually.
5. Add fresh cow manure.
6. Mix the content manually.
7. Close the system (by putting the gas holder cap on top of the digester and closing the vent pipe) from the atmosphere until all oxygen is consumed by microorganisms.
8. Monitor the level of the gas holding cap; it should rise upon the production and accumulation of biogas.
9. When the gas holding cap reaches its maximum level; connect the vent tube to the gas meter, and slowly open the vent pipe.
10. The gas should start bubbling in the gas meter which should start tipping sideways and the meter digital counter should start counting the number of tipping.
11. Using the gas sampler, measure the gas composition at the outlet of the gas meter.
12. Take a sample of the digester content to analyze it for volatile acids, alkalinity, and pH at least daily.
13. Make sure the samples analyzed are representative.
14. Record and keep good records of the above analyses, as well as temperature, gas production, and gas composition.
15. When the pH drops, add alkalinity, the pH control agent, to the digester as required to keep the total alkalinity concentration.

Methane Production

The digesters produced between 165 and 191 liters of methane per kg of volatile solids fed to the digester in 21 cycle. The volume of methane produced decreased with the increase of the organic solid quantity (mass) fed to the digesters and when the total solids of the feed was increased to 10%.

Acknowledgement

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