

Anaerobic digestion: an introduction

WITH INPUTS FROM :
MARISKA RONTELTAP (IHE), ALSEADI ETAL (BIOGAS HANDBOOK).

Key principles

WHAT IS ANAEROBIC DIGESTION?

Anaerobic digestion

- Collection of **processes** by which **microorganisms** break down **biodegradable material** in the **absence of oxygen**
- Natural process, spontaneous
- Field conditions – absence of oxygen
- Intestines

Four steps


- Hydrolysis
 - Loosening of large polymers
- Acidogenesis
 - Fermentative production of Volatile Fatty Acids (VFAs)
- Acetogenesis
 - Production of acetic acid
- Methanogenesis
 - Production of methand

Conditions not optimal

- Temperature
- Feedstocks
 - Feed on each others' products
- Acidity - pH
 - Preferences vary
- Chain reaction
 - Positive and negative feedback loops

Good management = key


- Selection of substrates
 - Biogas potential
 - Digestibility
- Link to digester type
- Management indicators
 - Organic Loading Rate (OLR)
 - Hydraulic Retention Time (HRT)



Bioslurry (digestate) composition


Product	Unit	Value
Total Solids	% of Fresh Matter	1.5–45.7
Volatile Solids	% of Total Solids	38.6–75.4
pH		7.3–9.0
N Total	% of Dry Matter	3.1–14
idem	% of Fresh Matter	0.12–1.5
Nitrogen NH ₄	% of total N	35–81
Total phosphorus	% of Dry Matter	0.2–0.35
idem	% of Fresh Matter	0.04–0.26
Total potassium	% of Dry Matter	0.19–4.3
idem	% of Fresh Matter	0.12–1.15

Source: adapted from Nkoa (2013; cattle manure)



Learning more

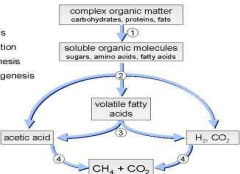
WHAT IS ANAEROBIC DIGESTION?




Four steps

- Combination of processes
- Simultaneous
- Reacting to each other


- ① hydrolysis
- ② fermentation
- ③ acetogenesis
- ④ methanogenesis





Conditions

- Temperature
 - Mesophilic (35 °C)
 - Thermophilic (55 °C)
- pH
- Mixing / movement
- Stoppers
 - Acidification, foaming




Performance

- Organic Loading Rate
 - Amount of BOD or chemical oxygen demand (COD) applied per day per cubic metre of digester

$$B_R = m \cdot c / V_R$$

B_R organic load [kg/d·m³]
 m mass of substrate fed per time unit [kg/d]
 c concentration of organic matter [%]
 V_R digester volume [m³]



Performance

- Hydraulic Retention Time (HRT)
 - Average time interval when the substrate is kept inside the digester

$$HRT = V_R / V$$

HRT hydraulic retention time [days]
 V_R digester volume [m³]
 V volume of substrate fed per time unit [m³/d]

What to remember

- Anaerobic digestion is a process performed by series of microorganisms
- Potential yield varies
- Performance of the digester depends on management
- Digestate is a powerful organic fertilizer but requires safe handling

Questions?

**HE WHO
ASKS A QUESTION
REMAINS A FOOL
FOR FIVE MINUTES.**

**HE WHO
DOES NOT ASK
REMAINS A FOOL
FOREVER.**

Thank you

For further information, contact me at:

hans@biomassresearch.eu

+31 6 520 58 537