A separate phases anaerobic digestion process with a dynamic digestate recirculation.

KEYWORDS

- ANAEROBIC DIGESTION
- AMMONIA
- OFMSW
- BIOGAS
- VOLATILE FATTY ACIDS

AREA

- ENERGY & ENVIRONMENT

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Patent Type
Patent for invention.

Co-Ownership
Sapienza University of Rome 20%,
University of Verona 35%,
University of Venice Ca 'Foscari 45%.

Inventors
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Industrial & Commercial Reference
Organic waste and organic fraction of municipal solid waste (OFMSW) anaerobic treatment, acidogenic fermentation, anaerobic digestion, process monitoring and control (pH, electrical conductivity).

Time to Market
Pilot scale: the technology is marketable in 2-3 years.

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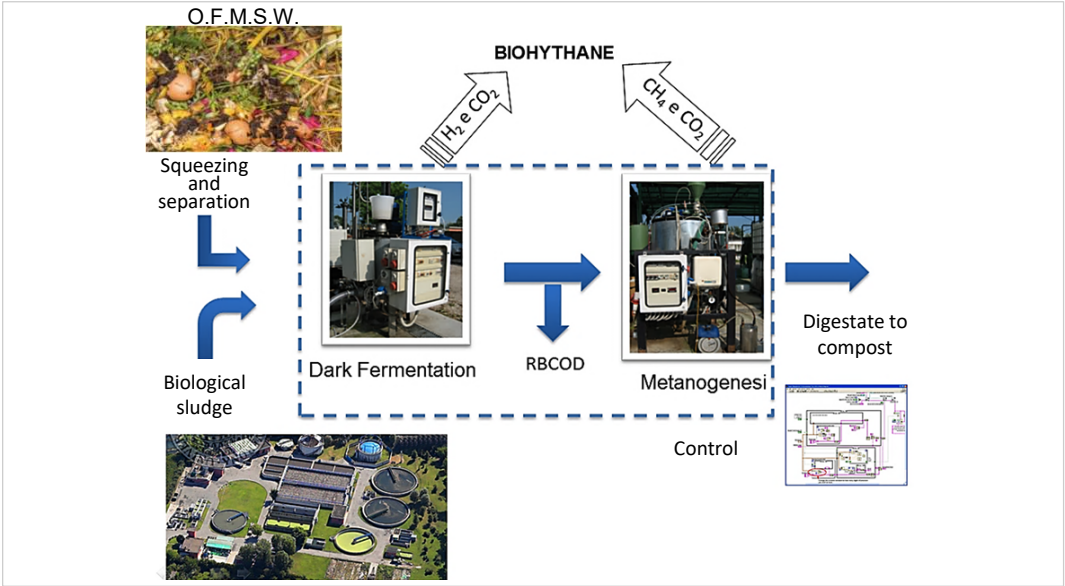

Abstract
The proposed invention is a method to optimizethe biological production of biogas and volatile fatty acids (VFA) using an anaerobic digestion process in separate phases. This optimization is achieved by controlling the pH in the fermentation reactor, through the automatic management of the digested recirculation coming out of the digester.
The amount to be recirculated is controlled by a mathematical model based of pH reading and ammonia estimation.

Publications

- Micolucci F, Gottardo M, Bolzonella D, Pavan P; Automatic process control for stable bio-hythane production in two-phase thermophilic anaerobic digestion of food waste; Elsevier, International Journal of Hydrogen Energy, 2014, 39:17563-17572.
- Gottardo M, Micolucci F, Bolzonella D, Uellendahl H, Pavan P; Pilot scale fermentation coupled with anaerobic digestion of food waste – effect of dynamic digestate recirculation; Elsevier, Renewable Energy, 2017, 114:455-463.

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Technical Description

The proposed process of anaerobic digestion with separate phases includes a dynamic recirculation of the digestate.

The recirculation ratio is managed by an algorithm that, through pH and electrical conductivity measurements from probes in the two reactors, estimates the ammonia concentration.

The algorithm also automatically establishes the recirculation flow rate to maintain the pH in the fermentation reactor at a value close to optimal conditions while at the same time preventing an excessive accumulation of ammonia in the system.

The system has a high resilience and a rapid and automatic ability to restore optimal settings, following stress conditions.

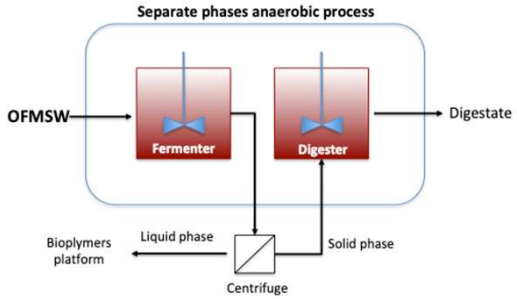
The process can be fed by Organic Fraction of Municipal Solid Waste (OFMSW) or by sludge from wastewater treatment, as well as zootechnical and agro-industrial waste.

Technologies & Advantages

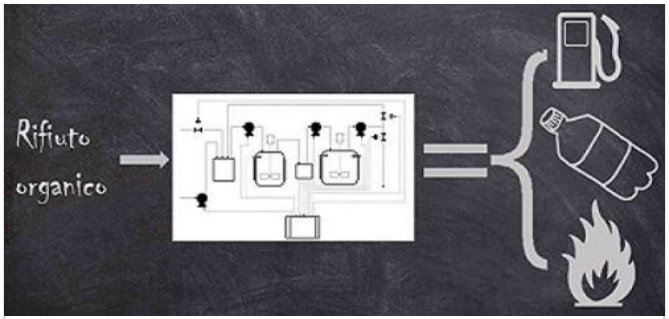
- Automatic management of fermentation process from the start-up to potential fluctuations of the system.
- Continuous pH and electrical conductivity measurements on line.
- The specific probes utilization allow recognizing on-line the process parameters without the need of time demanding procedures of titration.
- Ammonia concentration estimation with mathematical model.
- Automatic control of the recycled portion.
- Resilience and automatic system recovery in case of stress or fluctuations.
- Minimal investment & operating costs.

Applications

- Treatment of OFMSW or other fermentable organic waste.
- Automation of anaerobic digestion processes.
- VFA and biogas production.



Schematic overview of the separate phases anaerobic process.



Bio-products obtainable from the separate phases process: biofuels, precursors for biopolymer synthesis (volatile fatty acids), electrical and thermal energy.

Conductivity probe.

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