Maestría en Ingeniería de Diseño de Bioprocesos

Title

Design and construction of a didactic prototypes system, of anaerobic digesters with biogas purification for obtaining biogas and biofertilizer

Author

Sebastián Varela Pérez

Contributor

M.L.Ramírez Castillo

M.Murillo Murillo

B.R. Rodríguez Pastrana

May-August 2016

Design and construction of a didactic prototypes system of anaerobic biodigesters with biogas purification for obtaining biogas and biofertilizer

Sebastián Varela Pérez, M.L. Ramírez Castillo, M. Murillo Murillo, B.R. Rodríguez Pastrana

Maestría en Ingeniería en Diseño de Bioprocesos

sebastian.varela@upaep.edu.mx

Tercer Carril del Ejido Serrano S.N. San Mateo Cuanalá, Juan C. Bonilla, Puebla, México

1. Introduction

There are different models of anaerobic digesters, however the biochemical processes that are carried out inside to digest organic matter are similar.

Anaerobic co-digestion is a biological process in which organic matter is degraded by a series of biochemical reactions with anaerobic microorganisms, to obtain biogas and biofertilizer [1],[3].

The bioprocess is carried out in four stages: i) hydrolysis, stage that involves hydrolytic bacteria of the genus *Cellulomonas*; ii) acidogenesis, carried out by bacteria of the genus *Clostridium* spp., *Bifidobacterium* spp. among others; iii) acetogenesis, in which bacteria are fed on CO_2 and H_2 to produce acetate; iv) methanogenesis, is the last stage and it is considered as the most important in the bioprocess of methane production [1],[2],[4].

2. Objectives

2.1. General objective

To design and to build a didactic prototypes system of low cost with biogas purification for anaerobic digestion of organic matter mixtures.

2.2. Particular objectives

- To build a didactic prototypes system of anaerobic biodigesters of low cost.
- To build a biogas purification system with three stages: activated carbon, sodium hydroxide and urea.
- To characterize the products of anaerobic digestion with physicochemical and biological methods.

3. Method

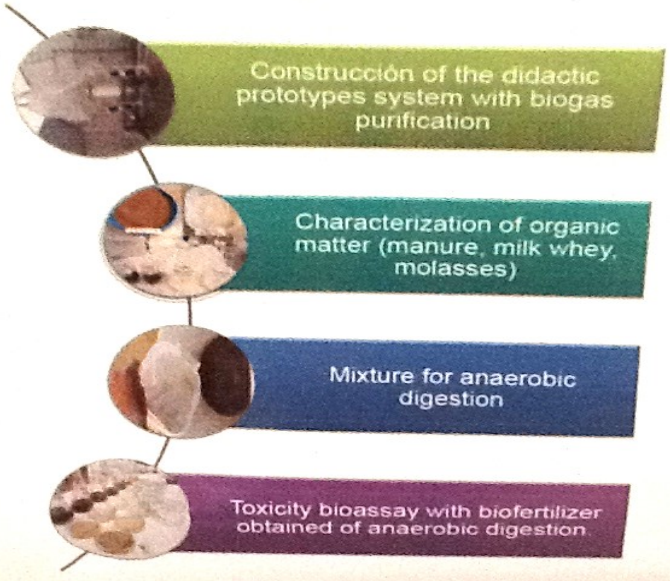
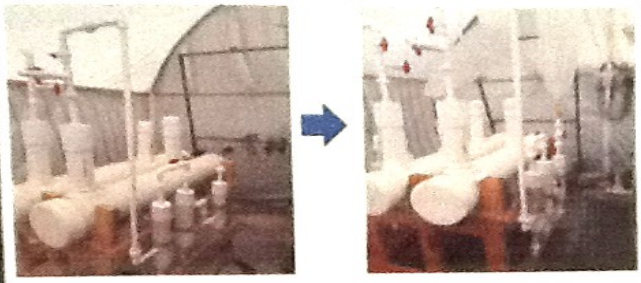


Figure 1. Methodology utilized in this research

Prototype construction



a) Prototypes of anaerobic digestion

b) Purification system

Figure 2. Design and construction of anaerobic digesters.

Mixture of sheep manure, whey and molasses

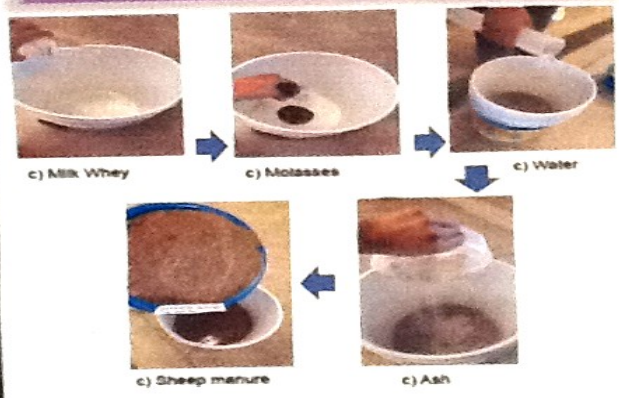


Figure 3. Mixture of organic matter and ash.

Toxicity bioassay

Figure 4. Germination of Lactuca sativa (L.), 120 h [4],[5].

4. Results

Figure 2 shows the built prototypes of anaerobic digestion with biogas purification system.

The toxicity tests showed that at low concentrations of biofertilizer, the germination of lettuce seeds was greater than 90% and the growth was normal and free of malformations, as well as the coefficient of variation of elongation of hypocotyl and radicle; the latter largest at concentrations lower than 10%. However, at high concentrations greater than 25% the growth of the radicle and hypocotyl showed abnormal characteristics, Figure 5. Figure 6 shows the results of the commercial formula of nutrient salts, the concentration did not affect the growth of the radicle nor the hypocotyl, the latter grew more, in some cases up to twice the radicle. The negative control (C^-) indicates the reduction of the vitality and aging of the seeds (the germinative power and the increase in the variability of the measures). Positive control (C^+) indicates growth inhibition.

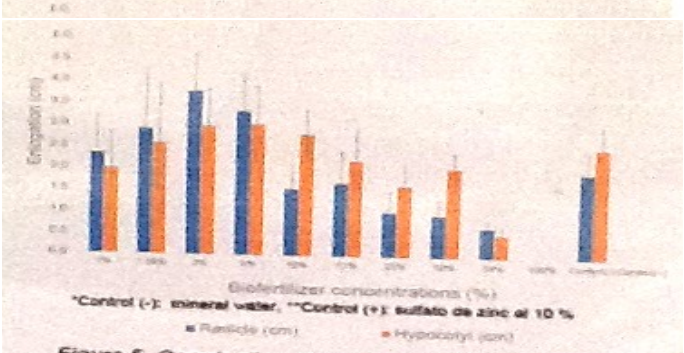


Figure 5. Germination of seed Lactuca sativa (L.) with biofertilizer.

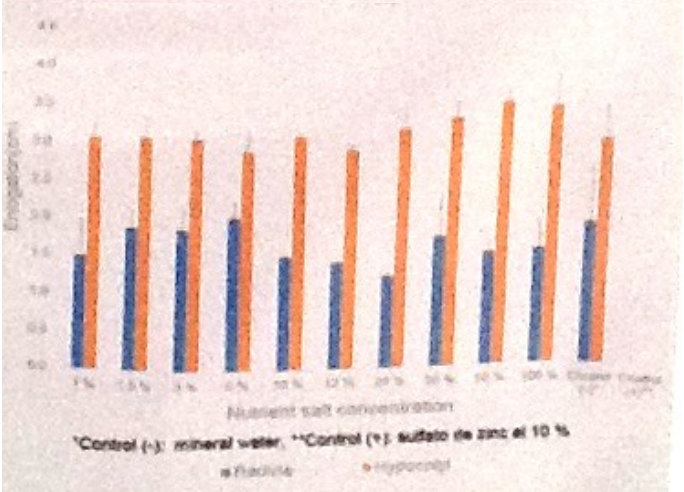


Figure 6. Germination of seed Lactuca sativa L. with a commercial formula of nutrient salts.

Acknowledgements

To CONACYT for scholarship No. 712529 to Eng. Varela Pérez Sebastián.

References

[1] Mann S. L., Hansen C. S. Anaerobic digestión and Biogas., *ASAE/CSAE Annual International Meeting Sponsored by ASAE/CSAE*, 2004.

[2] McInerney M. J., Bryant M. P. "Basic principles of bioconversions in anaerobic digestion and methanogenesis". In: *Biomass conversión process fo* and fuels. Sofer SS y Zabrosky OR (eds). Plenum Publishing Corp. New York. pp. 277-296. 1981.

[3] Sahlström L. "A review of survival of pathogenic bacteria in organic used ib biogás plants". *Bioresource Technology*. No. 87, pp. 162-166, 2003.

[4] Madigan M. T., Martinko J., Parker J., Brock Biología de los microorganismos. Edit. Prentice Hall International (UK), 1988.

[5] Sobrero M. C., Ronco A., *Ensayo de toxicidad aguda con semillas de lechuga Lactuca sativa* L. Secretaría de medio ambiente y recursos naturales. *acional de Ecología*, 2004.

2016