Wellcome

On behalf of the organizing committee and of the Mexican Association of Food Science and Food Biotechnology in Developing Countries (AMECA), we give you the warmest welcome to our bi-annual event, the "Fourth Congress on Food Science and Food Biotechnology in Developing Countries". This meeting is taking place from November 29 to December 01, 2010, at the World Trade Center of Boca del Río, Veracruz, México. The goal of this international scientific event is to gather experts from the academia, industry and government working in nine areas of Food Science and Food Biotechnology, such as Nutrition, Sensory Evaluation, Postharvest, Food Engineering, Food Biotechnology, Emerging Technologies, and Nanotechnology. These specialists will be presenting and discussing with delegates recent advances in research and technological developments generated in Mexico as well as in other participant countries including Spain, France, Canada, United States of America, Brazil, and Chile.

We wish that during your stay in Veracruz you may enjoy the scientific and social programs that we have carefully prepared for all delegates within the framework of this magnificent event. You may also enjoy the traditional hospitality and natural beauty which is always offered by Veracruz and its surrounding area.

Prof. Beatriz Torrestiana Sánchez
President of the Congress

Prof. Carlos Regalado González
President of AMECA

A Comparison of the Effect of Salinity on Thermophilic and Mesophilic Anaerobic Digestion

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This report aims to attain find out a different performance between mesophilic and thermophilic reactors in order to compare its particular sensibility under salinity conditions. Salinity effects were evaluated by COD efficiency test, biogas characterization (GC gas chromatography), methane production and methane yield determination. Chloride inhibition over bacteria activities, reduces the effectiveness of COD removal, in wastes treatments. Mesophilic and thermophilic reactors installed as a lab-scale bench, at The University of Birmingham in Civil Engineering School laboratory, were fed continuously with a feed based on waste from Cardbury´s with strength of 1700+/-200 mg/l COD and mineral salts. System was operated at a hydraulic retention time of 18 hrs, achieved by a flow rate 0.084 l/h. Reactors were run and monitored first with salinity of zero and followed by salinity increasing ranges such as 0.75, 2.5, 5 and 10 g/l chloride ion content. Mesophilic reactor indicated higher COD removal effectiveness than that thermophilic: 70% and 45% respectively. Thermophilic reactor had a better methane production than that mesophilic: 0.65 l/d and 0.55 l/d respectively. Consequently, methane yield within about 0.3 m^3 methane/kg COD removed and 0.75 m^3 methane/kg COD removed were obtained from mesophilic and thermophilic reactors respectively. Performance difference was significant: ANOVA: $F_{0.05,1,12}$=4.75; $F0_{CODr}$=38.71; $F0_{MProd}$=12.17; $F0_{MYield}$=16.24. Salinity has a high effect on methane production, basically at the last salinity period of 10 g/l Cl^-, where the whole system got stress on their sensibility, but difference was not significant: ANOVA: $F_{0.05,1,8}$=5,32; $F0_{Mesoph}$=4.06; $F0_{Thermoph}$=1.47. Salinity does not have a substantial effect on COD removal. Thermophiles sensibility got stress with high salinities (5 g/l as Cl^-), but they recovered immediately their performance. Bacterial viability reflects stress response under salinity conditions, but bacteria culture shown early to be used to a new conditions. Halide bacteria culture and two phase configuration should be considered for future research under salinity higher than 10 g/l Cl^-.

Keywords: Anaerobic digestion, biogas, methane production, COD removal, salinity.

A Comparison of The Effect of Salinity on Thermophilic and Mesophilic Anaerobic Digestion

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Introduction

Science disciplines such as biotechnology and bioengineering are involved into the prevention and control aims of environmental pollution and its importance has been increased since new technologies have been incorporated to the integral system, it means, control of pollution and recovery and reuse of end products.

The last twenty years, anaerobic digestion has covered integral system features also for liquid waste treatments. Its low energy consumption, isolated odours, effective treatment and biogas production offer important economical and ecological benefits. Therefore is likely preferred to an aerobic process (7).

Design and configuration of digesters allow an improvement of each of their phases by separating processes. Conventional and contact digesters do not have recommended features, but reactors such as up-flow filters, fluidized bed and up-flow anaerobic sludge blanket reactors comply the most of domestic and industrial requirements (8). Acidogenesis and methanogenesis reactions are likely to work at two separated stages in order to allow their improved performance on organic pollutant removal and energy recovery respectively (6).

Mesophilic and thermophilic operation, based on specific temperatures, 35°C and 55°C respectively attain different performance due to their special features (2).

Mesophilic processes have demonstrated to have lower organic pollutant removal than that thermophilic (4), and thermophilic processes have generated more methane production than mesophilic on several experiments despite its considerable sensibility (1 & 9).

Methods and Materials

This report aims to attain find out a different performance between mesophilic and thermophilic reactors in order to compare its particular sensibility under salinity conditions.

Comparison study of the effect of salinity on pollution removal, by COD efficiency test, is one of the specific aims to be achieved.

Methane production is another required specific aim to cover salinity effect comparison study, by biogas characterization and VFA´s determinations.

Consequently, methane yield comparison study is required to be observed.

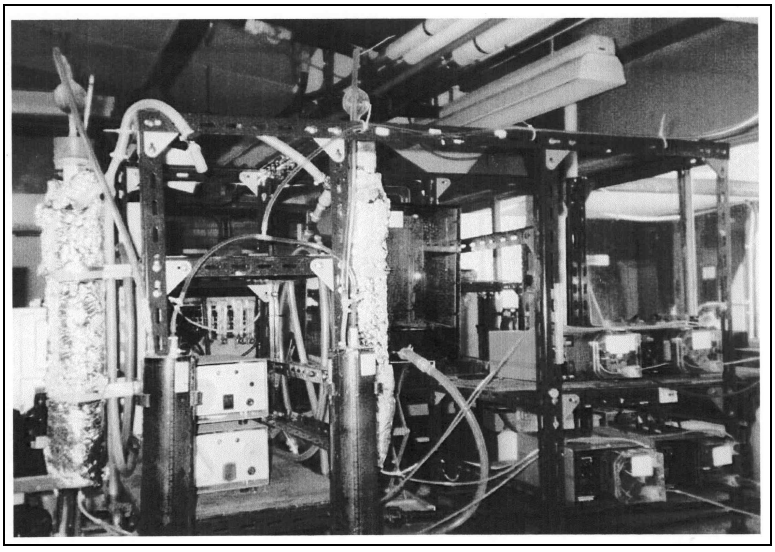
A constant monitoring of bacteria activities performance through the salinity application is required, by pH, alkalinity and SS live/dead measures.

Alternatives of new conditions of the salinity experimental system should be proposed if it is required.

Salinity wastes treatment has a wide study field due to several both domestic and industrial activities, mainly on sea-food processes and agriculture activities among others. Chloride inhibition is considered as an important factor that reduces the effectiveness of COD removal.

Analysis was based on a mesophilic and thermophilic system that operate with two filters packed with rashig rings and is installed as a lab-scale bench reactor in Civil Engineering School of the University of Birmingham.

Reactors were fed continuously with a feed based on a strong (fudge) waste from Cardbury´s with strength of 1700 +/- 200 mg/l COD and mineral salts. Both filters were operated at a hydraulic retention time of 18 hrs, achieved by a flow rate for mesophilic reactor at 0.084 l/h and for thermophilic reactor at 0.086 l/h. Reactors were run and monitored first with salinity of zero and followed by salinity increasing ranges such as 0.75, 2.5, 5 and 10 g/l chloride ion content accord to the same equipment operational conditions. A gradual increase of that inhibitor compound makes bacteria culture used to a new conditions.
Mesophilic and thermophilic effluents have been analysed. Analytical procedures (3), such as COD chemical oxygen demand, VFA volatile fatty acids, GC gas chromatography, pH, alkalinity, TSS total suspended solids, VSS, volatile suspended solids and SS live/dead staining technique (5), were made. Also statistical tools were used on analytical results in order to evaluate results and to control performance and operational conditions.

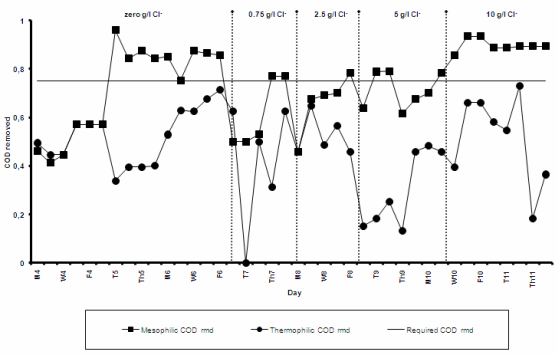


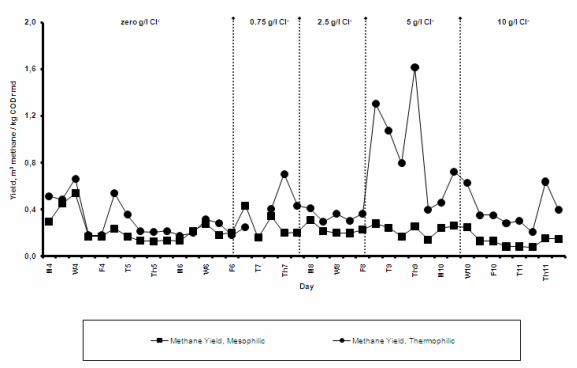
Results

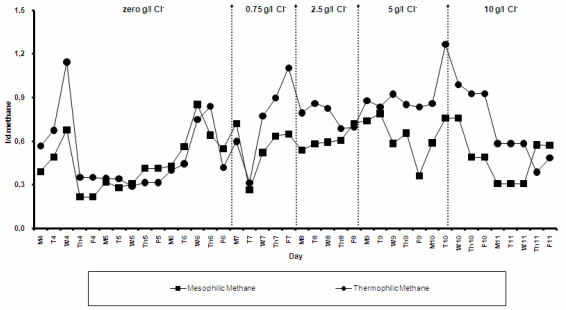
A significant difference was found in methane production and COD removal rates between mesophilic ant thermophilic reactors, therefore methane yield rates had similar trend through the system.

Mesophilic reactor indicated higher COD removal effectiveness than that thermophilic, where 70% and 45% effectiveness were reached respectively, feature that argues previous researches. Thermophilic reactor had a better methane production than that mesophilic, where 0.65 l/d and 0.55 l/d were attained respectively. Consequently, methane yield within about 0.3 m^3 methane/kg COD removed and 0.75 m^3 methane/kg COD removed were obtained from mesophilic and thermophilic reactors respectively

Performance difference was significant: ANOVA: $F_{0.05,1,12}$=4.75; $F0_{CODr}$=38.71; $F0_{MProd}$=12.17; $F0_{MYield}$=16.24..





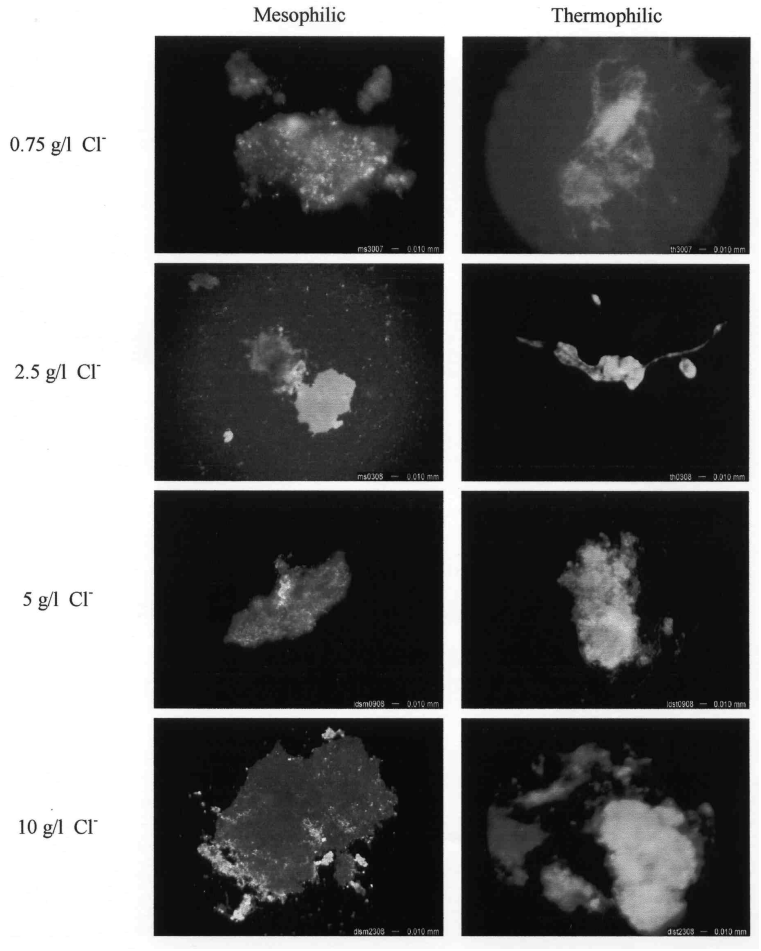


Discussion

Salinity has a high effect on methane production, basically at the last salinity period of 10 g/l Cl^-. Mesophiles sensibility go stress with salinity of 5 g/l as Cl^- and seemed to recover their performance but they fell strongly again at 10 g/l as Cl^-, when also thermophilies had the same effect, but difference was not significant: ANOVA: $F_{0.05,1,8}$=5,32; $F0_{Mesoph}$=4.06; $F0_{Thermoph}$=1.47.

Salinity does not have a substantial effect on COD removal. Thermophiles sensibility got stress with high salinities (5 g/l as Cl^-), but it recovered immediately its performance.

Bacterial viability reflects clearly that stress response under salinity conditions.



Although at the first time, salinity effect on bacteria viability was evident, bacteria recovered themselves immediatly both mesophilic and thermophilic ones. The most of mesophilic bacteria dead after 5 g/l Cl- while thermophilic ones seem to be live at the maximum salinity of the experiment. At bacteria viability figures, dead bacteria show a dark colour, and live bacteria show a clearly colour. Actually bacteria viability test show a red and green colour respectively.

Halide bacteria culture, two phase configuration and extended solid retention times should be considered in order to reduce any sensibility bacteria features, increase biogas production and allow an extended periods of new conditions for future research for comparison between mesophilic and thermophilic under salinity higher than 10 g/l Cl^-.

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