

RCN CONFERENCE ON PAN AMERICAN BIOFUELS & BIOENERGY SUSTAINABILITY

Biogas Generation from Sanitary Landfill Leachate

Universidade Federal de Pernambuco
Departamento de Engenharia Civil

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RECIFE/2014



LIMA - UFPE
Laboratório Interdisciplinar
de Meio Ambiente



Introduction

► Energetic Sustainability;

- Employment of alternative energy sources;
- Renewable energy sources in Brazil: 45%;

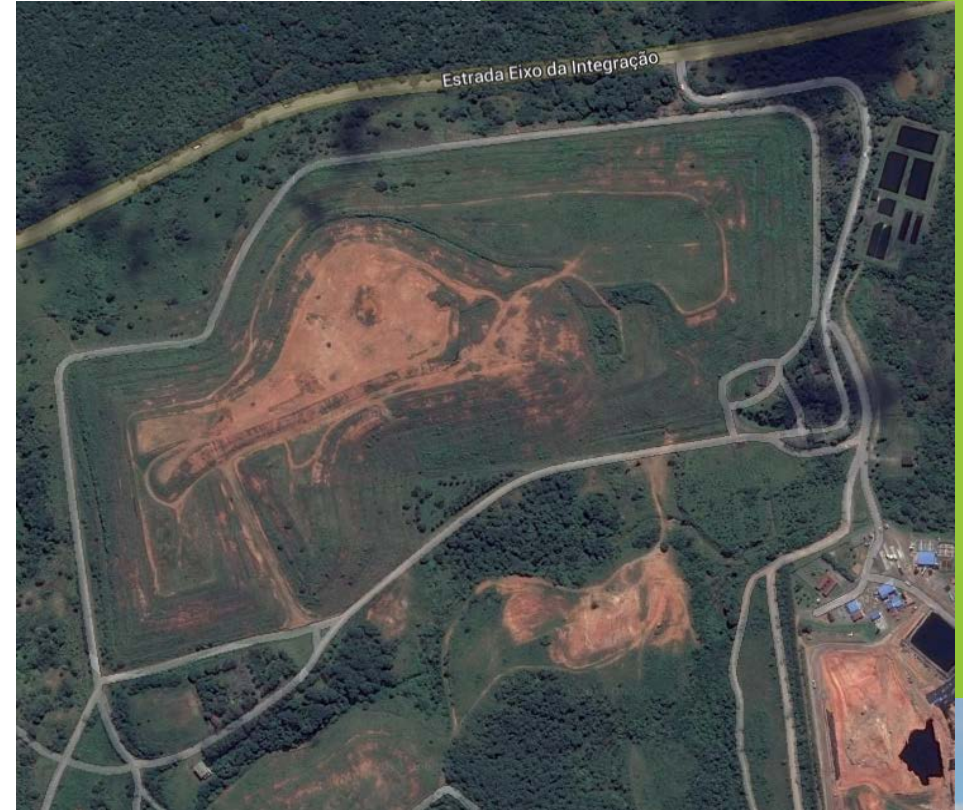
► Energy resulting from treatment of effluents;

- Collaboration between research institutions and industries



Introduction

- ▶ Anaerobic degradation process:
 - ▶ Methane generation: 50 a 70%;
- ▶ Problem: treat the leachate;
 - ▶ Complexity, toxicity, recalcitrance;



Introduction

- ▶ **BMP Testing - Biochemical Methane Potencial**
 - ▶ Initial residue composition;
 - ▶ Biodegradability conditions;
 - ▶ Pressure Build up;
 - ▶ F:M Ratio (Organic Load/microorganism).

Aim

- ▶ Evaluate the influence of anaerobic degradation in solid contaminants and liquids in the production of biogas through a 2^3 factorial design in BMP trials.

Materials and Methods

▶ Leachate COD

- ▶ Method: Colorimetric - SMEWW 5220 C (Closed reflux);
 - ▶ Threaded Test tubes (reflux);
 - ▶ Reagent: Potassium dichromate- $K_2Cr_2O_7$ (1,5mL);
Silver sulphate+ sulphuric acid(3,5 mL);
 - ▶ Thermoreaktor CR 2200;
 - ▶ Spectrophotometer: Thermo Scientific Genesis 10 - S - UV - Vis 600nm;

Materials and Methods

- ▶ Volatile Suspended Solids: (VSS) of the sludge
- ▶ ABNT /NBR 10664/Apr 1989
 - ▶ 10 g of sludge in vacuum filter NALGENE maximum pressure of 1 bar;
 - ▶ Vacuum pump: Quimis 03558;
 - ▶ Fiberglass microfilter GF-1 47mm Macherey-Nagel transferred to a porcelaine capsule and transferred to an oven Brasdonto – Modelo 3 at 105°C;
 - ▶ Calcinate at 550°C/1 h in oven Muffle Furnace Quimis;
 - ▶ Weighed on analytic balance Bioprecisa FA-2104N;

Materials and Methods

▶ 2³ Full Factorial Design

	Lower level	Center	Upper level
Sludge volume(mL)	10	30	50
Headspace (mL)	50	100	150
pH	6	7,5	8,5

▶ Control

- ▶ 50 mL of sludge without leachate ;

Materials and Methods

- ▶ pH adjust (Figure 1);
 - ▶ Bench pH-metro : Quimis Q400AS;
 - ▶ NaOH 40%;
 - ▶ HCL PA;



Figure 1- pH Adjustment .

Materials e Methods

- ▶ Anaerobic Sludge: Brasil Kirin Brewery - Guabiraba PE (Figure 2);
- ▶ Leachate: Leachate treatment station at the landfill Muribeca(Figure 3);
- ▶ BMP trial in triplicate (Figure 4);



Figure 2 - Anaerobic Sludge



Figure 3 - leachate



Figure 4 -triplicate trials

Materials e Methods

- ▶ BMP trials (Figure 5)
 - ▶ Glass vials(250 mL);
 - ▶ Nylon screwed lid with rubber ring;
 - ▶ Manometer ASTA NBR 14105-1 graduation in bar;
 - ▶ Gas collection valves and for pressure readings;
 - ▶ Aluminum foil covering;

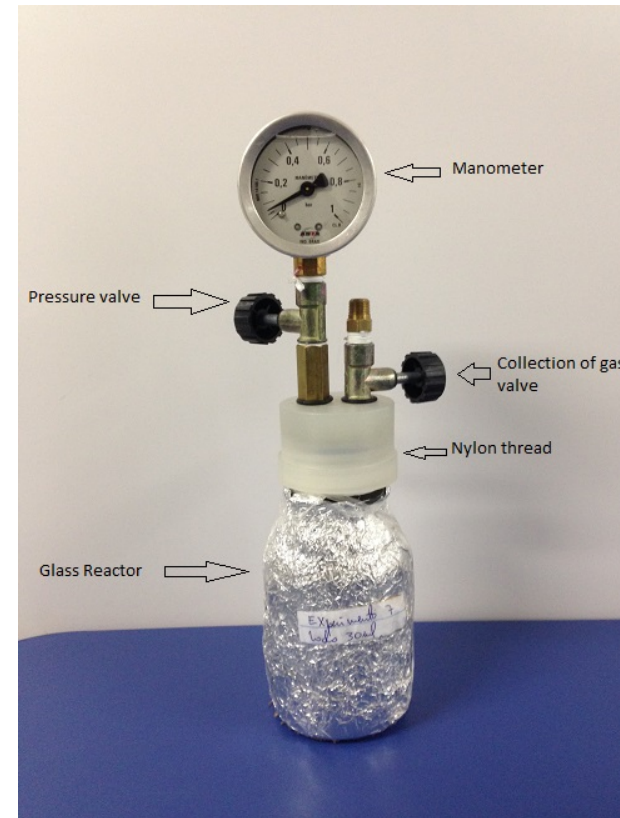


Figure 5 - BMP trials

Materials e Methods

▶ BMP trials

- ▶ Inoculate: Sludge + Leachate (according too experimental planning);
- ▶ Recirculation of nitrogen during 2 minutes(Figure 6) ;
- ▶ Temperature: 35°C - Oven Fanem - 320 - SE;
- ▶ Daily readings;



Figure 6 - Recirculation of Nitrogen

Materials e Methods

- ▶ Gas analysis
 - ▶ Methane (CH_4);
 - ▶ Carbon Dioxide(CO_2);
 - ▶ Chromatograph: CG Master/Gas;
 - ▶ Triplicate

Results

- ▶ COD leachate: 3.066 mgO₂/L;
- ▶ VSS Sludge: 152,27 g/L;
- ▶ Initial pH of the mixture: 8,3;
- ▶ Control : Production rate: 6,42mL/d;
Total volume produced: : 154 mL;

- ▶ Best Factorial planning:
 - ▶ 50 mL anaerobic sludge + 50 mL leachate;
 - ▶ pH: 7,5;

Results

▶ Biogas Production

- ▶ Production rate: 11,54 mL/day;
- ▶ Total volume produced: 277 mL;

▶ Biogas Composition

- ▶ 67,07% CH_4 ;
- ▶ 32,91% CO_2 ;

Conclusion

- There was no inhibition as the total gas production volume from the sludge mixture with leachate was greater than the control (pure sludge). The best experimental condition is the one in which the volumes of sludge and leachate are 50 mL with pH of 7,5 and headspace of 150mL. This shows that the process can be influenced by pH nearer to neutrality.
- The production of biogas with approximately 70% of the total volume of gas produced, shows the viability of adopting de production by this method.

Our thanks to



Thank you!

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