

Optimization Of Biogas Production During Start-up With Electrode-Assisted Anaerobic Digestion

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THESSALONIKI 2021 8th International Conference on
Sustainable Solid Waste Management

23/06/2021

OUTLINE

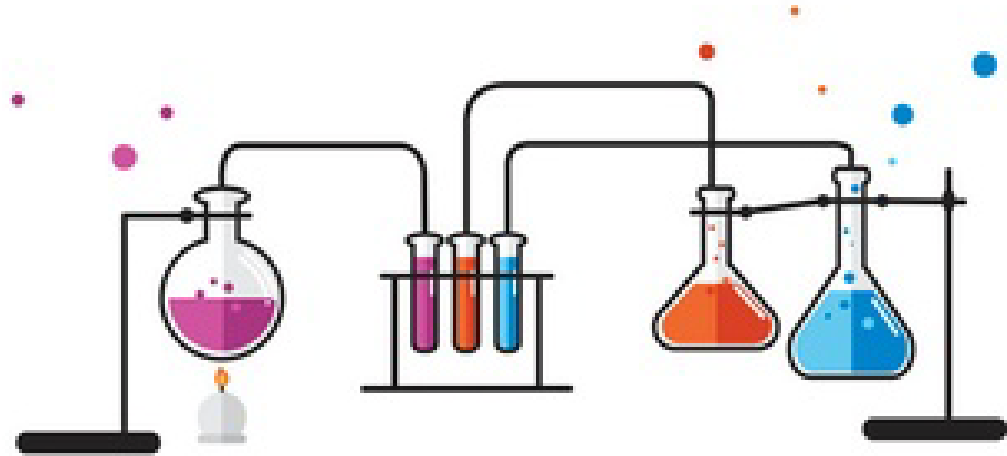
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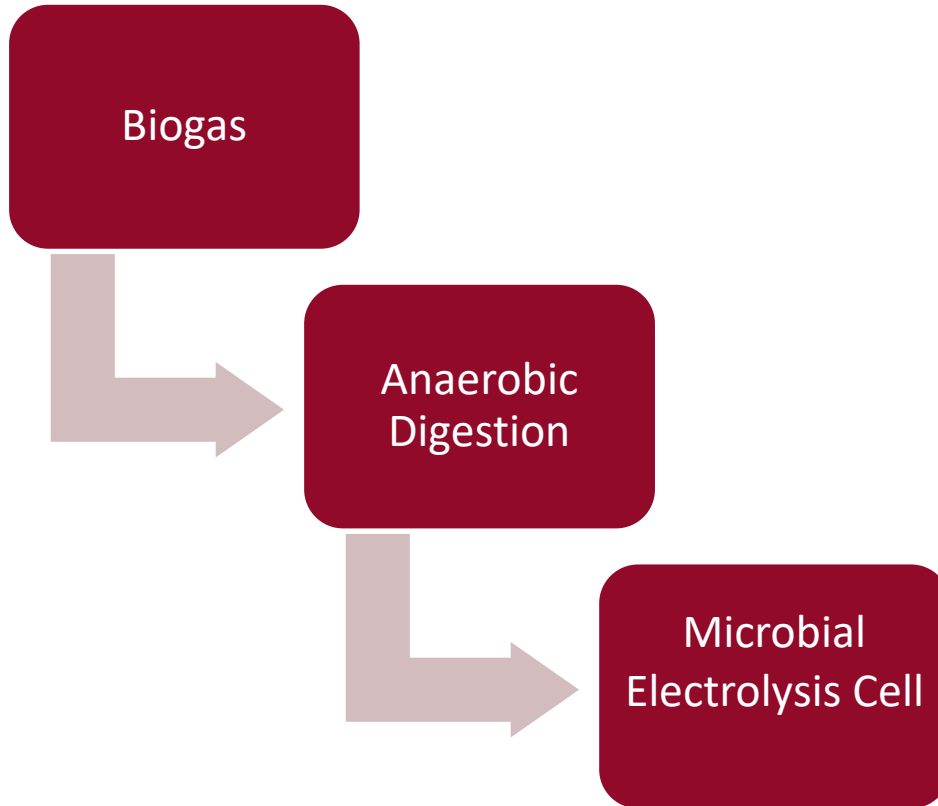
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Designed by Freepik

INTRODUCTION



BIOGAS

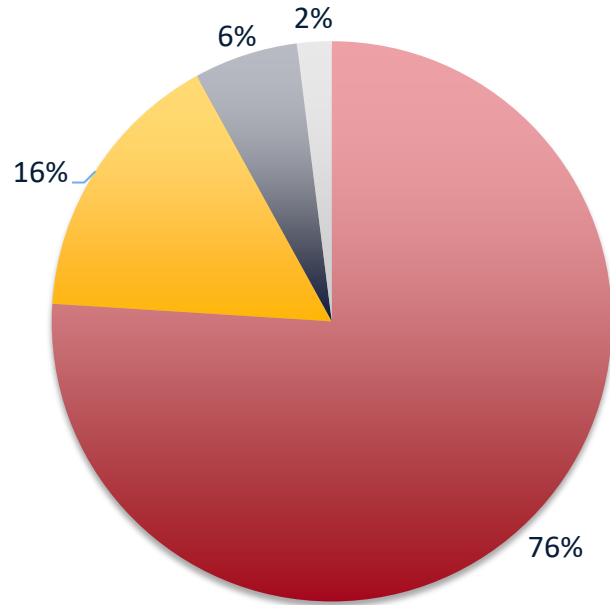
- Biogas is generated during “AD” and is mostly methane (CH_4) and carbon dioxide (CO_2), with very small amounts of water vapor and other gases.



With a composition of

- CH_4 : 60%
- CO_2 : 40%

Worldwide Greenhouse Gas Emissions

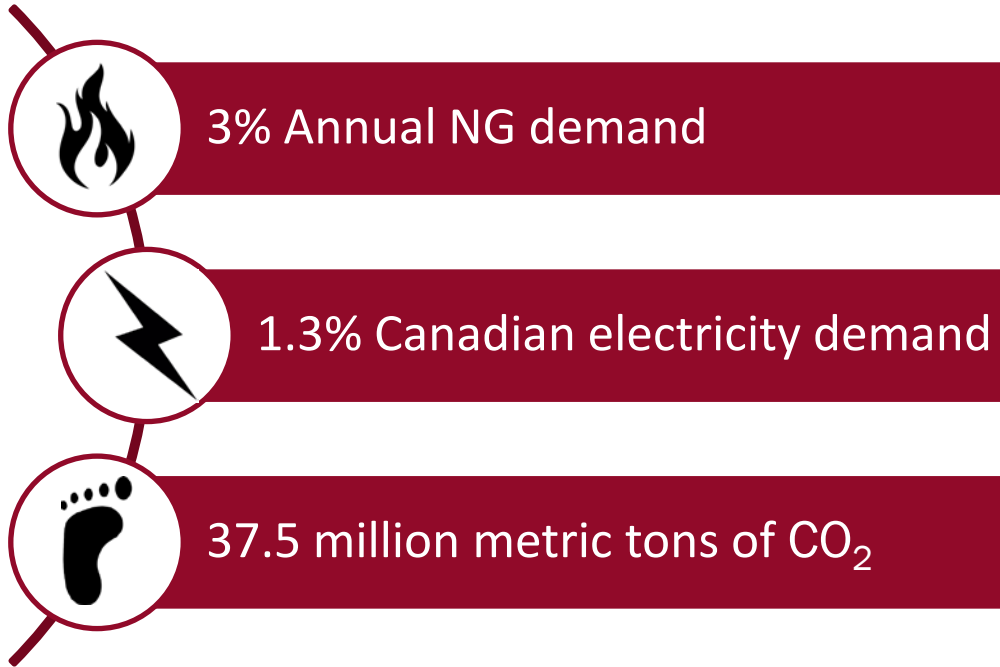


■ Carbon Dioxide ■ Methane ■ Nitrous Oxide ■ Others

- Canada alone represents about 5% of the world supply of natural gas, positioning the country as the 4th largest global producer.
- 15% of GHG emissions in Canada are due to methane



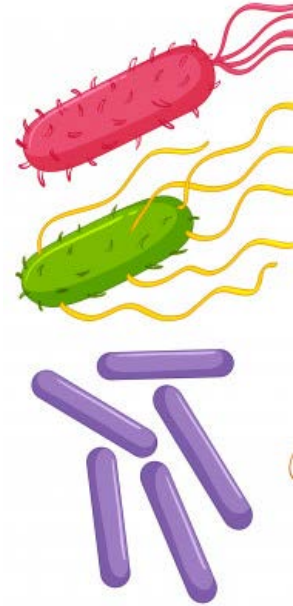
- According to the Canadian Biogas Association, biogas potential in Canada represents:



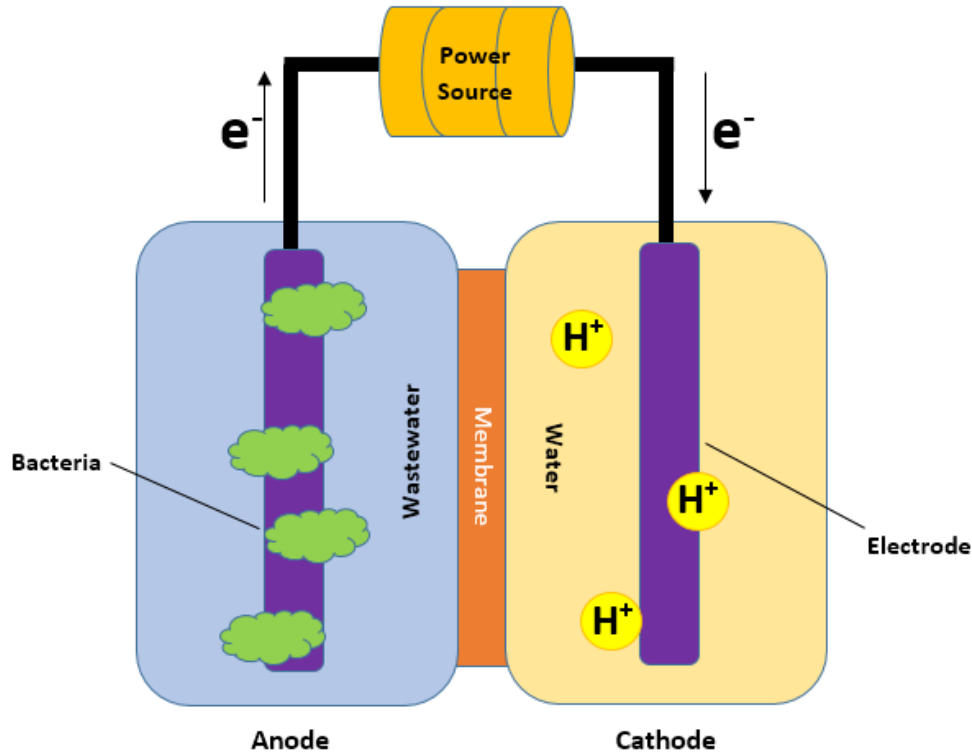
ANAEROBIC DIGESTION

Is the natural process in which microorganisms break down organic materials in the absence of oxygen.

The initials “AD” may refer to the process of anaerobic digestion or the built system also known as a digester.

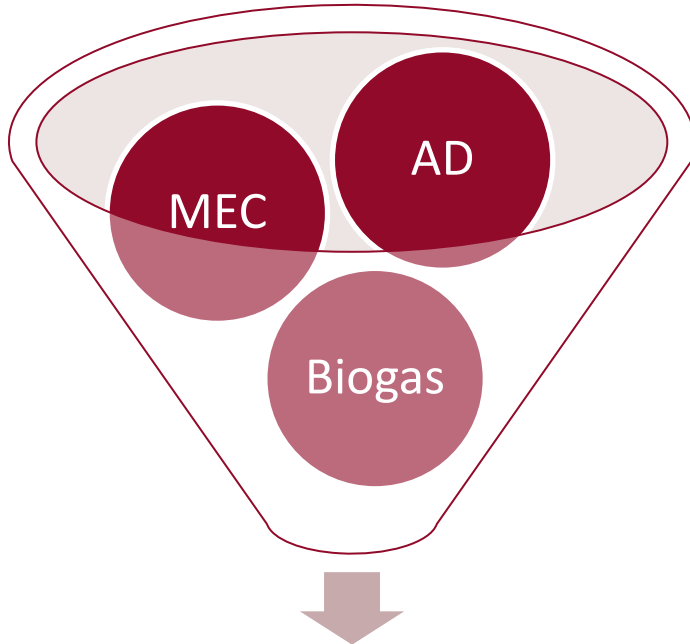


MICROBIAL ELECTROLYSIS CELL



A (MEC) is a biological device capable of convert organic material into CO_2 and hydrogen (H_2), along with free electrons by electrochemically active microorganisms.

By applying a voltage greater than 0.14V the MEC can drive H^+ production



**Microbial Electrolysis Cell-Enhanced Anaerobic
Digestion**

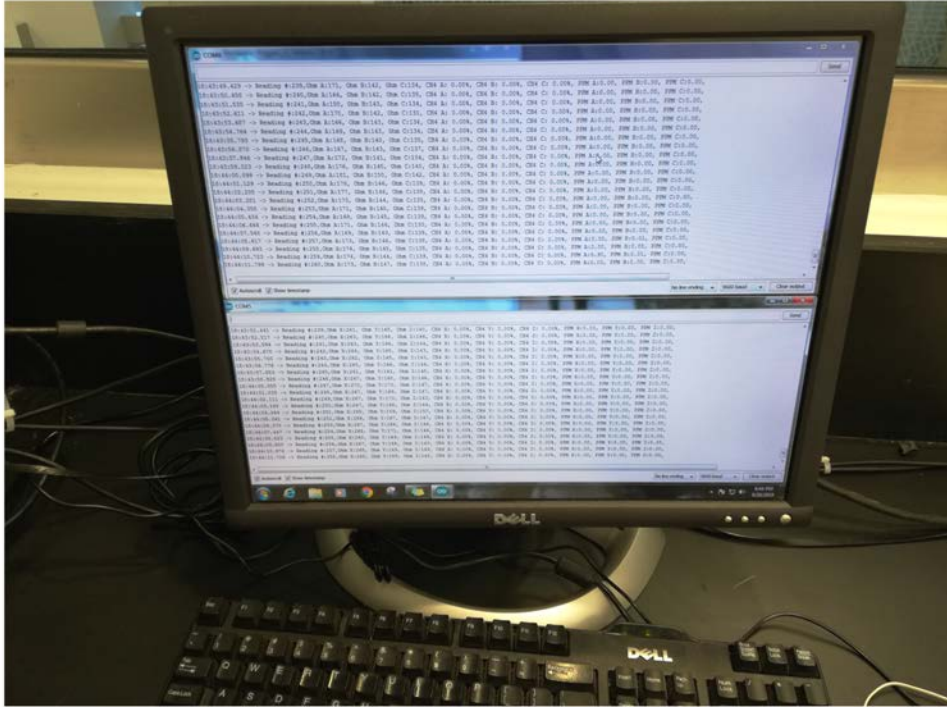


Methodology

Batch	Temperature (°C)	Toxic Shock	pH Adjusted	Bioaugmentation	Feedstock
#1	40	YES	YES	NO	SLUDGE
#2	40	YES	YES	YES	SLUDGE
#3	40	NO	NO	YES	SLUDGE
#4	40	NO	NO	NO	SLUDGE
Control #1	40	N/A			AUTOCLAVED SLUDGE
Control #2	40	YES			DI WATER
Control #3	40	N/A			SLUDGE

Toxic Shock: 10 ml NH₄⁺ -N @1000 ppm + 3ml 1N HCl

Bioaugmentation: 5ml M. Barkeri (DSMZ Medium 825) pH adjusted with 5M NaOH



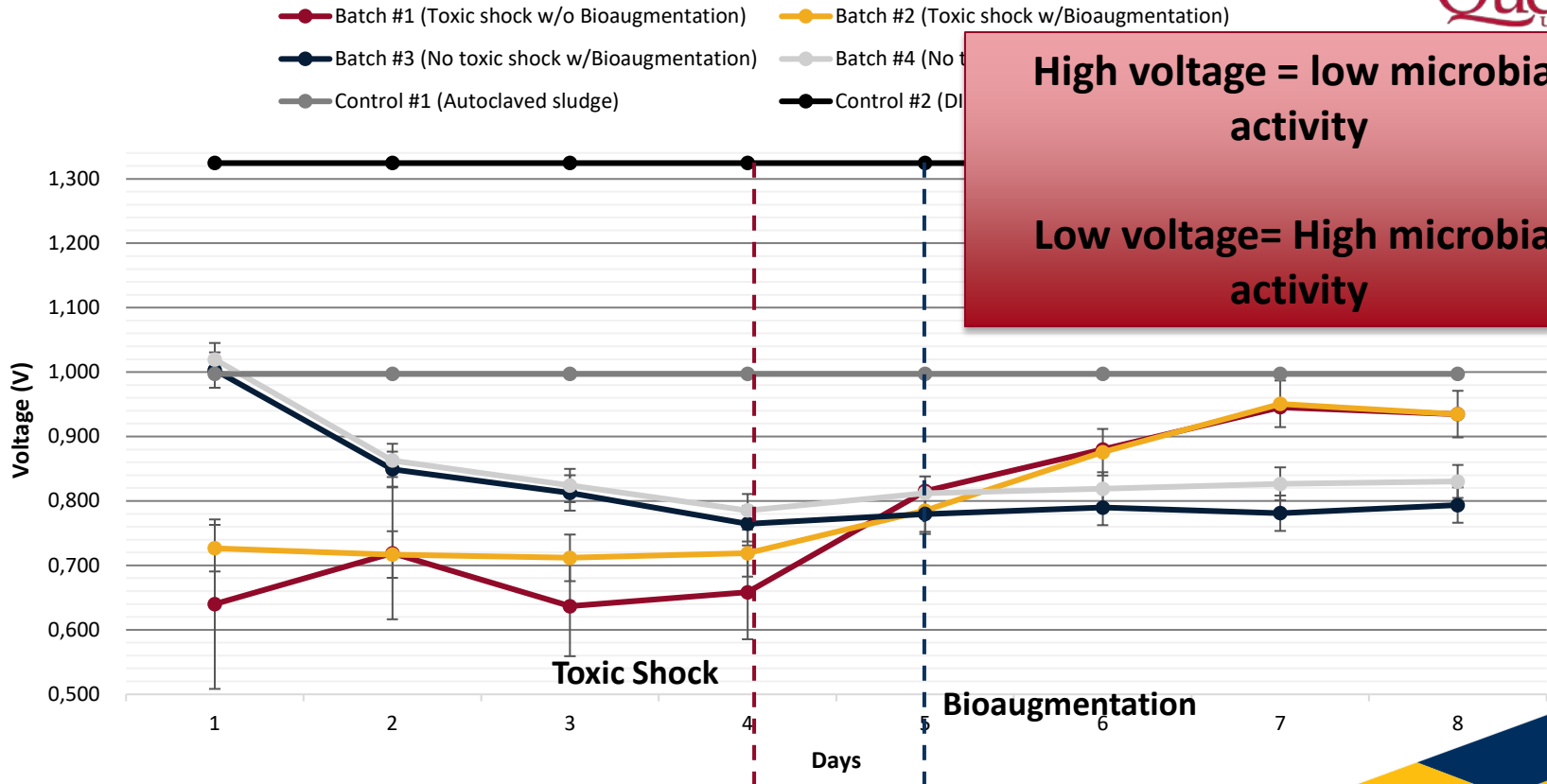
Data collection:

- A capacitive soil moisture sensor collected changes in bio-impedance and converted it to voltage during 8 days every second.
- An Arduino controlled the process.

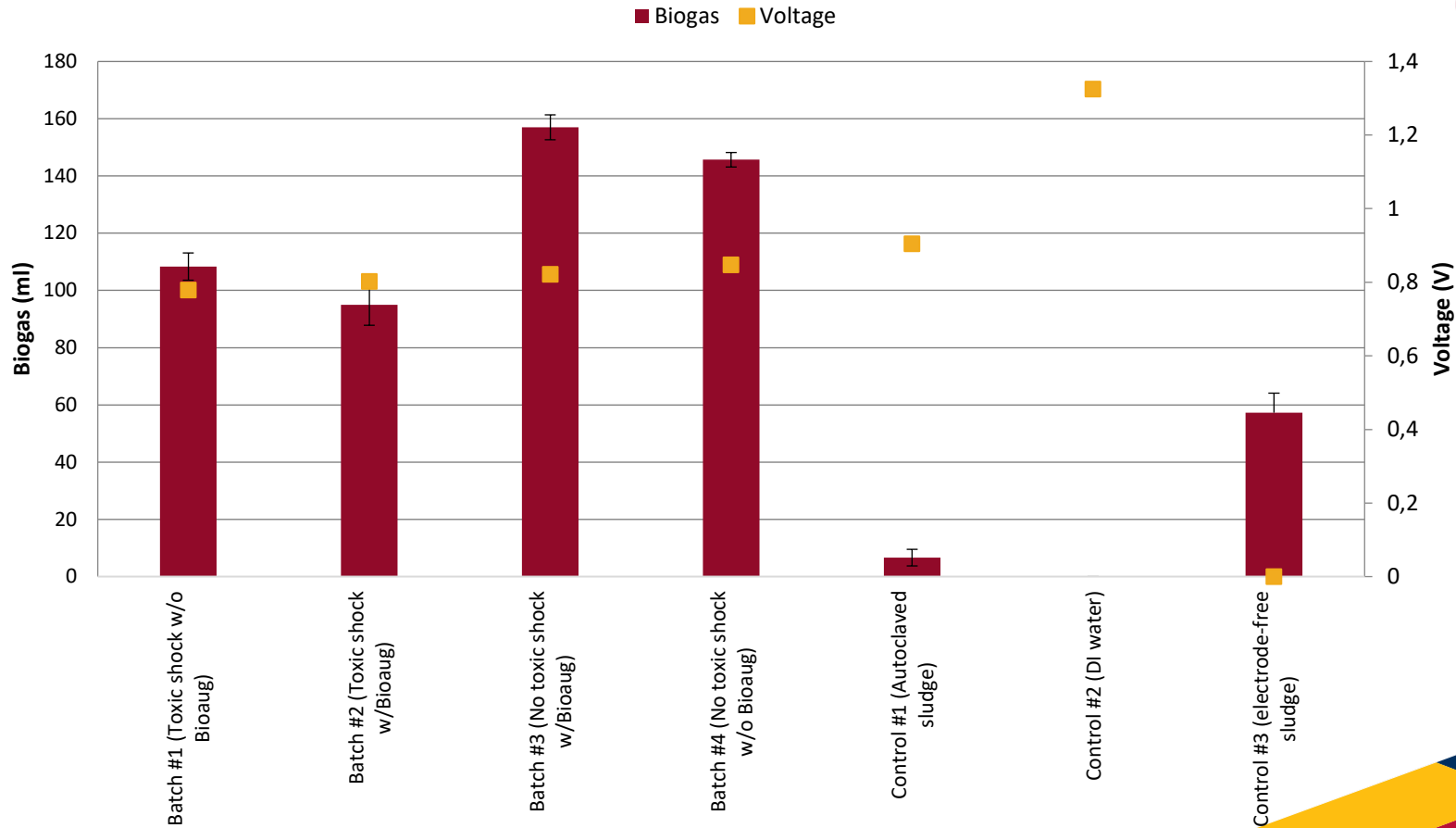


- Biogas was collected through water displacement.
- Resazurin (1 mg/L) was added to show oxygen intrusion.

Results Microbial Activity Tracking



Results Biogas Production in MEC-AD



1. Test the performance of MEC-AD under thermophilic conditions.
2. Analyze the microbial community composition in the MEC-AD system with 16S rDNA.
3. Develop a “smart utilities” procedure to tackle problems at the start-up stage with the help of real time monitoring technology.

- The potential application of commercial sensors to large-scale systems might be limited.
- MEC-AD biogas production exhibited a 63.7% increase in biogas output when compared to the control.
- MEC-AD with bioaugmentation under no inhibitory conditions showed a 7% increase in biogas volume

Acknowledgements

- Mitacs
- Utilities Kingston
- Canada Research Chairs Program
- Queen's University
- Champagne Bioresource Group
- NSERC Discovery grant Program



Thanks