Reducing Food Waste Contributions to Greenhouse Gas Emissions Through the Use of Anerobic Digesters

Amelia Bergbower, LUOP Mentor: Gaj Sivandran
Engineering Department, College of Arts and Sciences, Loyola University Chicago

Abstract, Materials and Methods

Abstract
The small batch anaerobic digesters resemble the reactors that could one day be used on our campus. With the help from the Provost fellowship, I have been able to investigate the different treatments that the inoculum could undergo to determine what would be most effective in producing methane gas. In this experiment diluting the inoculum as pretreatment was tested. Diluting the substrate can effectively create a more stable food source for an anaerobic digester [1]. Continuous feeding, or regular feedings can benefit a system by prolonging the life of the microbes and increasing stability [2].

To test this digester draw was taken from Metropolitan Water Reclamation District and diluted with various amounts of water. Each reactor was then fed the same amount of substrate. To measure which treatment was more effective the amount of total gas and methane produced by each treatment was collected. Each reactor besides the blank was fed twice more. It can be concluded that diluting the inoculum as a form of pretreatment is not harmful to the system.

Materials
• Automatic Methane Potential test system
• The AMPTS Scrubbers are filled with 2M NaOH
• Bubble counter determines the volume of gas produced fig. 3
• Each reactor is mixed and in a heated water bath
• Crucibles, tongs, furnace and incubator for TS/VS
• Inoculum- Digester draw from metropolitan wastewater reclamation district
• Substrate- Soylent

Methods
• Total solids versus volatile solids tests are carried out to determine how much inoculum and substrate is needed per each reactor. Approximately 400g of inoculum and 4g of substrate.
• Once that number is determined each reactor is filled according to its various treatments outlined in fig. 2. The inoculum is diluted with water to certain percentages.
• The scrubbed reactors were created by having an outtake tube taking gas to an NaOH scrubber and then to the bubble counter in the AMPTS, the total gas reactors were created by directly linking the outtake to the bubble counter fig. 3
• After the initial feeding the reactors were fed substrate 2 more times

Introduction
Climate change is quickly impacting the environment. Humans are an active contributor to the increasing rates of climate change; food waste contributes to 8% of greenhouse gases. At Loyola University Chicago there is a need to work towards reducing this carbon footprint, this can be done using Loyola’s food waste. The food waste can be taken and utilized in the processes of anaerobic digestion to create biogas. Anerobic digestion follows four steps as seen in Fig. 1. Introducing this program to Loyola will help eliminate food waste and benefit the environment. In order to accomplish Loyola’s net carbon goals, we have experimented with small-scale anaerobic digesters to test this beneficial program.

Results

Conclusion and Next Steps

Conclusion
• With time microbes die off, with each feeding the rate that gas is produced increases. This stems from the weaker, or microbes that are less fit for the environment, dying off. The microbes that remain are more effective in converting food waste into methane gas
• Regular feedings contributed to the reactors continued off-gassing, keeping them stable and thriving
• Diluting as a pretreatment is not more effective or ineffective, the dilutions will in time catch up the 100% inoculum. The dilutions all follow the same trends as the 100% inoculum.

Next Steps
• 3 out of the fifteen reactors were used to collect gas into gas bags. No data was taken from these, but the collected gas can be experimented on. Gas chromatography can be used to determine the contents of the “other gas”
• More feeding experiments can be carried out to determine how often the reactors should be fed to create maximum gas production
• Gene sequencing can be utilized to determine the microbes that are more fit from the systems
• This will help build a catalog of microbes that are useful for anaerobic digestion