M.A.D.W.A.L.T.

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June 10th – 19th 2014

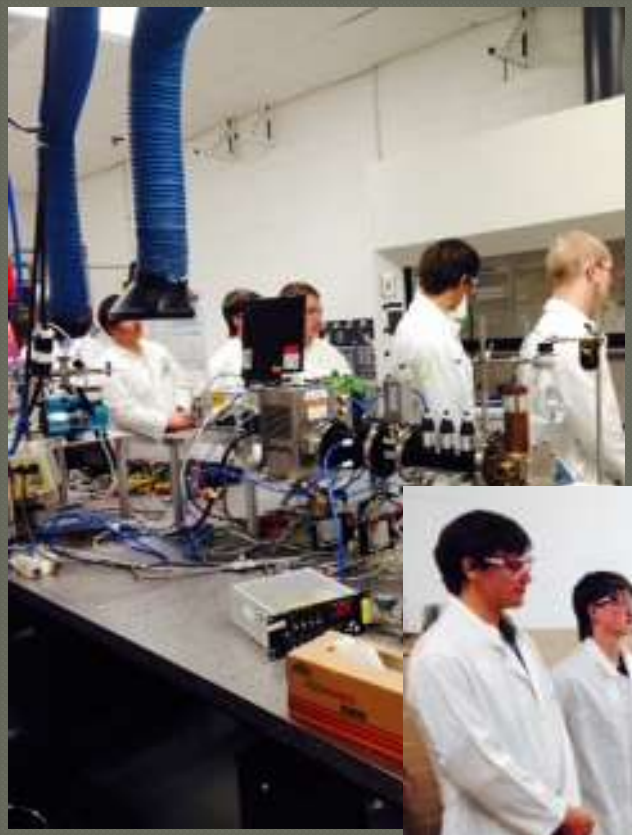
Mobile Anaerobic Digester With Air Locking Technology

What is an Anaerobic Digester

An Anaerobic Digester is a reactor that contains two populations of bacteria that in collaboration makes methane, in the absence of oxygen. The methane can be used as an alternative fuel source.

Tour of AFCEC Labs

- Day 1 we toured the labs and learned about the anaerobic digester



Large scale Anaerobic Digester

- Bacterial population in the digester comes from cow manure
- These bacteria naturally make methane
- The bacteria are fed food waste
- The digester is monitored daily

Day 2

Analyses and feeding of the 'Large Digester'

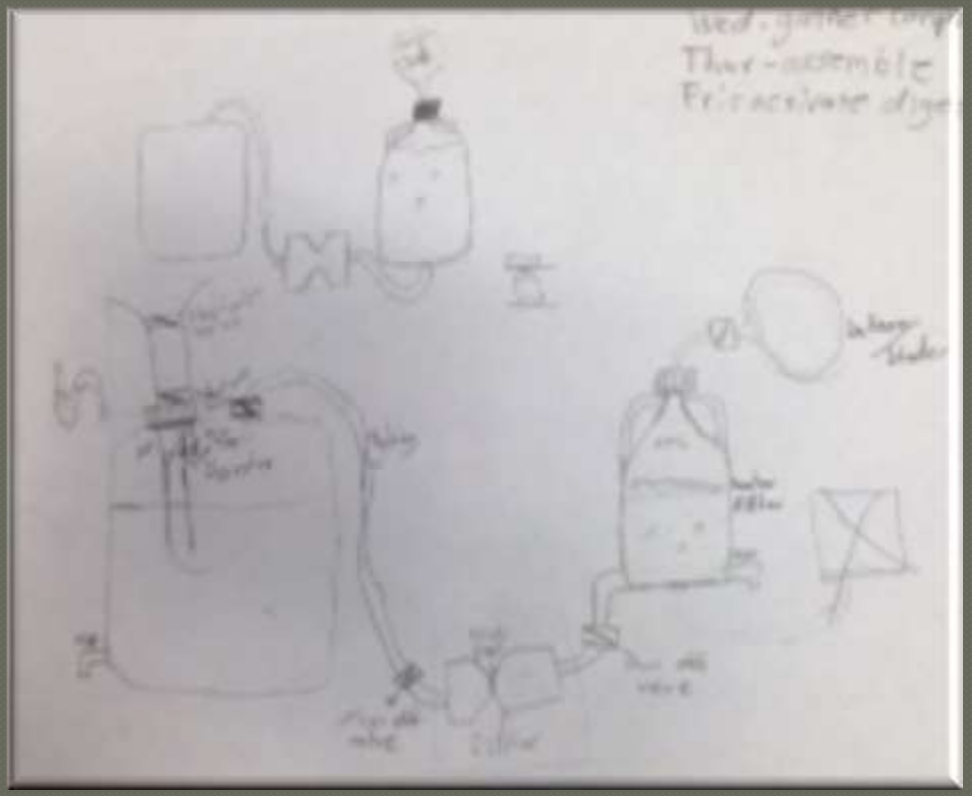
We took readings of temperature and pH.
We also measured total and volatile solids, and took a gas analysis.

Feeding the large digester

Preparing a pork and bean, potatoes, and bread mixture for the digester

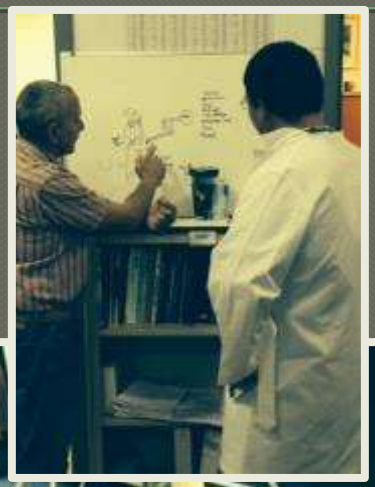
Making a drying bed for sludge from the digester

Design of a small scale digester



- Small scale test system
- Can be used to test variables such as changes in food, water, temperature etc.

Day 3 – Design Day!



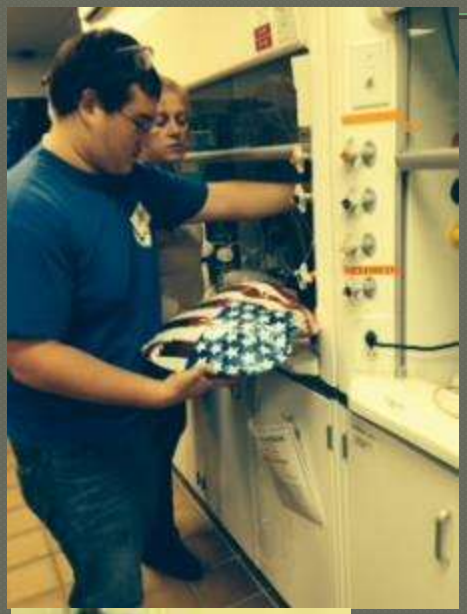
Why an airlock?

We incorporated an airlock into our design to minimize the amount of oxygen that would get into the digester while feeding it. It had several drain tubes incorporated in order to allow only food to go in, and methane to stay in.

Start Up

On day four we inoculated MADWALT with the bacterial consortium(bacteria, water, and manure blend) from the large digester and fed it enough food to last the weekend. We also sealed the air lock and startted the digestion.

Testing the MADWALT



We ran the gas from the digester through two filters that we made in the lab. One filter had steel wool, activated charcoal, and Drierite™. The steel wool scrubbed out the Hydrogen Sulfide, the activated charcoal scrubbed out carbon monoxide , and the Drierite™ took out the water in the air. The Second filter we made was a water bubbler that ran the gas through deionized water to take out all the Carbon Dioxide. In the end we were left with mostly methane with trace amounts of other gasses.

Testing The Gas

When we checked the gas prior to filtration.

Methane(CH_4)- 13.9%
Carbon Dioxide(CO_2)- 60.3%
Oxygen(O_2)- 3.8%
Carbon Monoxide(CO)- 65ppm
Hydrogen Sulfide(H_2S)- 765ppm
Bal. - 21.7%

After we filtered the gas.

Methane(CH_4)- 38.2%
Carbon Dioxide(CO_2)- 5.1%
Oxygen(O_2)- 7.2%
Carbon Monoxide(CO)- 39ppm
Hydrogen Sulfide(H_2S)- 1ppm
Bal.- 49.2%

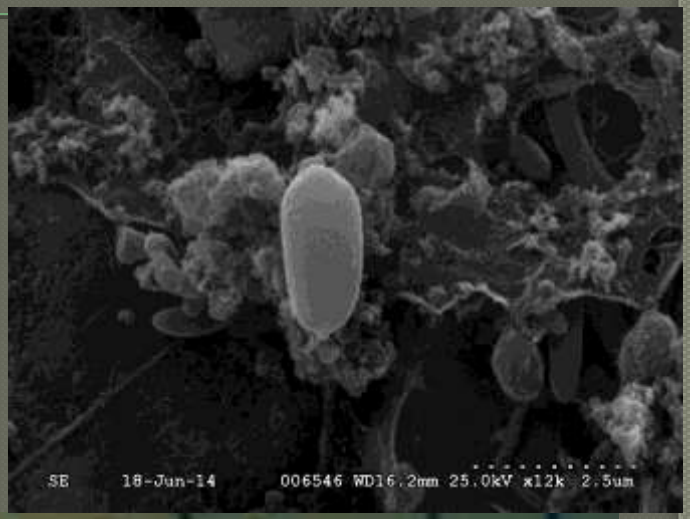
Death of a Digester

On day six, five days into its life, M.A.D.W.A.L.T. went sour. This means that the methanogenic bacteria in the digester died. After conferencing with Dr. Diltz, Dr. Luckarift, Mrs. Sizemore, and Mrs. Farrington, we came to the conclusion that it was a combination of over feeding, rapid change in temperature, and a lack of ventilation that killed the digester.

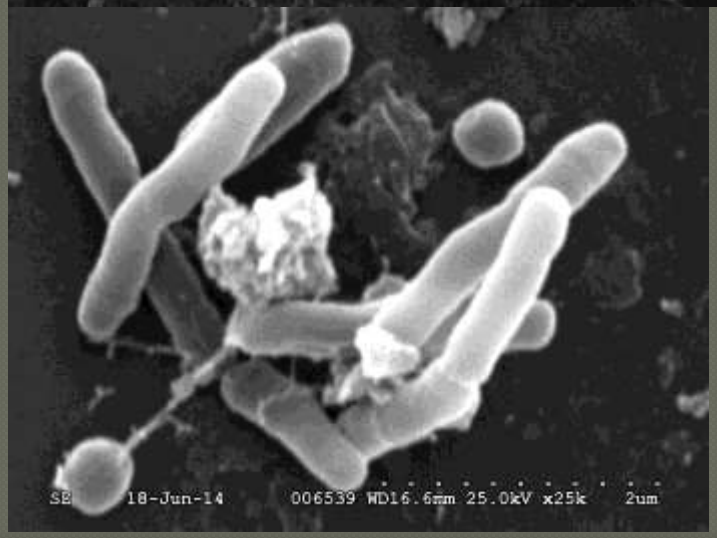
Death of a Digester (cont.)

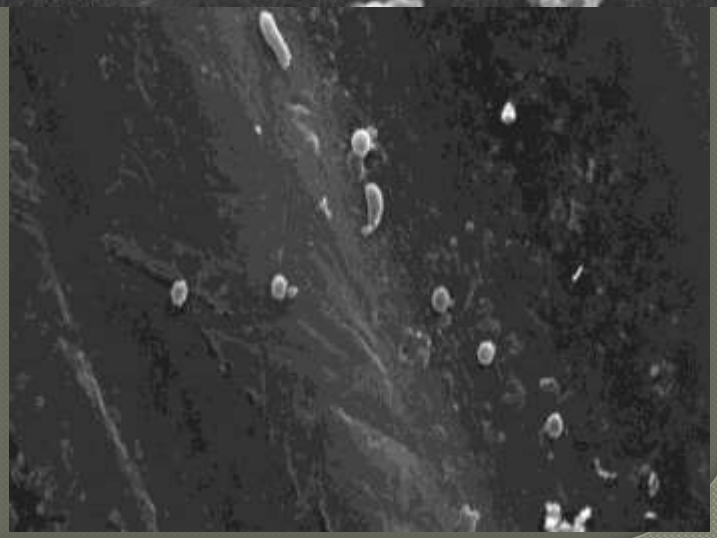
Our digester was such a success that it produced too much Methane and it effectively smothered itself due to lack of storage of the off put gas.

Microscopy of the bacterium



Scanning electron microscope

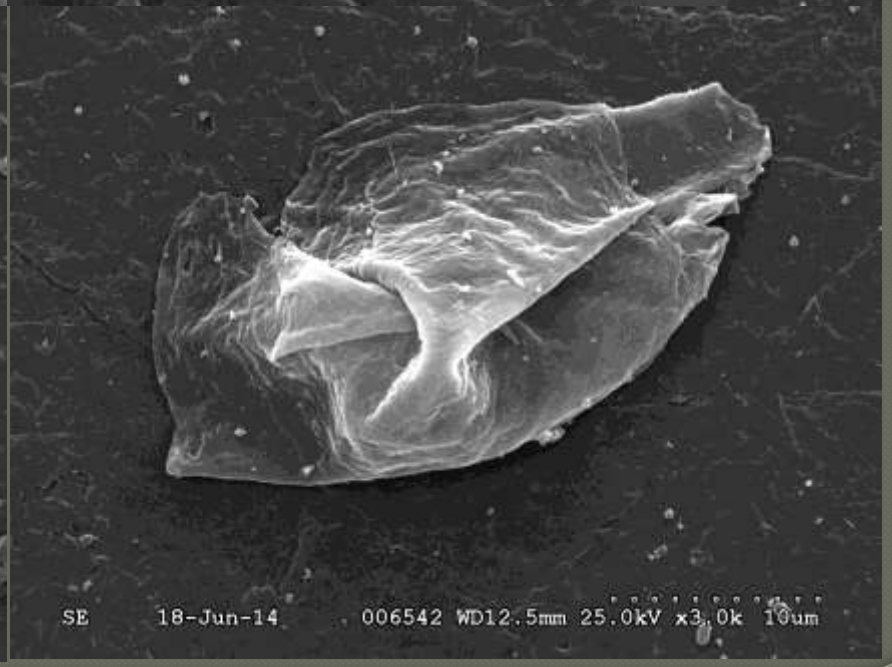




SE 18-Jun-14 006545 WD16.2mm 25.0kV x12k 2.5um

SE 18-Jun-14 006543 WD12.5mm 25.0kV x8.0k 5um

SE 18-Jun-14 006544 WD12.3mm 25.0kV x2.5k 20um


SE 18-Jun-14 006542 WD12.5mm 25.0kV x3.0k 10um

In closing

Throughout our time at the AFCEC buildings it was a very eye opening and inspiring journey. We both were immersed in new and exiting fields of science and this opportunity has greatly impacted the future of us both.

In closing

It was an adventure of first times for every one…..

Dr. Luckarift eating
Taco Bell™ for the first time

…Even Dr. Heather

Acknowledgements

Dr. Bobby Diltz
Mr. Bob Nichols
Ms. Susan Sizemore
Ms. Karen Farrington
Dr. Heather Luckarift

Dr. Joe Wander – STEM coordinator