Universal Anaerobic Digestion Systems

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Great Problems Seminar: Power The World

Abstract

Currently, methane digestion systems present a high initial investment for installation. If one system can be found to work efficiently at any size farm, there is a possibility for mass production of this system which would significantly lower the cost. Lowering the cost would make this technology a financially feasible option for more farms, and allow a growth of energy production from methane digestion.

Background

- Methane digestion is the process of collecting bio-gas from a slurry of animal manure, organic solids and water.
- Bio-gas can be burned in generators, producing mostly water and small amounts of carbon dioxide as byproducts.
- Implemented for alternative energy production at farms for over 30 years.
- Traditional methane digesters have used either plug flow or complete mix technology.
- Recent research has produced a temperature phased anaerobic digester (TPAD) system for farm usage.
- Tinedale farms (2500 cows) in Wrightstown, Wisconsin was the first farm to use TPAD and was able to produce enough bio-gas to run two 375-kW generators.
- Difficult for small farms to produce enough manure to produce excess power, so co-digestion is a possibility.
- Numerous government grants and tax subsidies are available for prospective farmers building methane digestion systems (USDA Grant through the farm bill).
- Methane digestion systems qualify for carbon credits because of green house gas reduction.
- Methane has 21 times the insulating ability of carbon dioxide and thus is a crucial factor in climate change.

Methods

- Interviewing Mason Dixon Dairy farms and Jordan Dairy farms provided us with insight on basic methane digester operation and expert opinions on what constitutes an ideal system.
- Investigating case studies produced by farms, educational institutions, and government organizations on methane digester technology and policies.

Diagram of Temperature Phased Anaerobic Digester

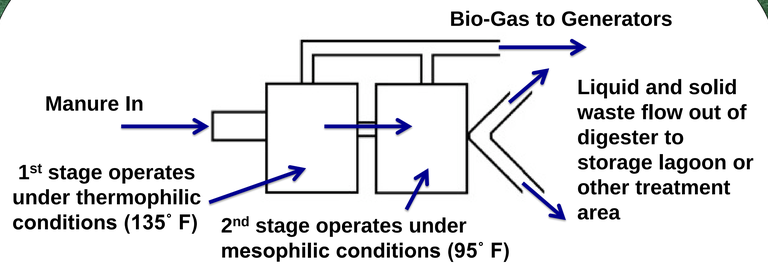
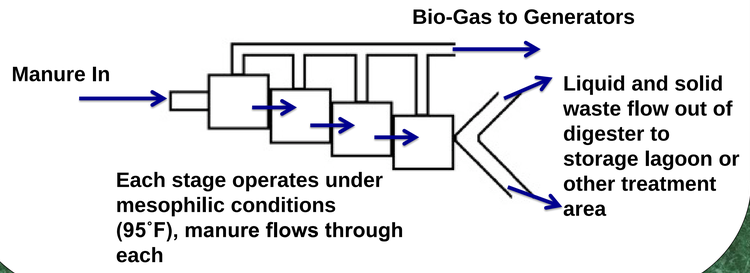


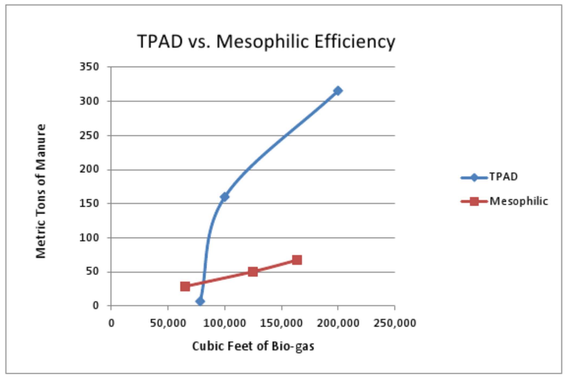
Diagram of Complete Mix Digester System (Mason Dixon Dairy)



Final Comparison

- TPAD produces up to 48% more bio-gas than other systems (in laboratory tests).
- Slightly more expensive than traditional systems because of temperature monitoring equipment (exact numbers not available)
- TPAD has been shown to be unreliable in the farm setting (Tinedale), while complete mix systems have been proven effective at numerous farms (Mason Dixon).

Gas Production vs Manure Imput for TPAD and Mesophilic Digestion Systems



A comparison of the bio-gas production potentials of TPAD and Mesophilic digestion systems

Conclusions

- The TPAD system has shown great promise in initial trials at Tinedale farms and in laboratory tests.
- While it has been proven to be superior for waste water treatment applications, it still needs to be adopted to farm environments.
- Currently, while less efficient, multi-stage, mesophilic digestion systems are the best design for a proposed mass produced methane digestion system based on cost and reliability.

Acknowledgments

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