

Animal Manure Management: Innovative Technology for Odor Control, Energy Production and Nutrient Recovery

The increase in production and concentration of intensive livestock operations along with increased urbanization of rural regions have resulted in greater awareness and concern for the proper storage, treatment, and utilization of livestock manure. Anaerobic digestion offers an environmentally sustainable solution for livestock manure management. In anaerobic digestion, nutrients are conserved, odors, flies and pathogens are reduced, and greenhouse gas emissions are eliminated, while a significant amount of energy is recovered in the biogas. The biogas produced can be collected and used either as a direct energy source (e.g. for heating water) or converted to electricity. Nutrients, such as N and P, contained in the organic matter are conserved and mineralized to more soluble forms, providing a more predictable biofertilizer or, where available cropland is limited, facilitating nutrient recovery technologies for regulatory compliance.

In Florida, the use of large volumes of flushwater for dairy manure collection means that conventional anaerobic digestion, using complete-mix or plug-flow technologies, is neither practical nor economical, due to the dilute nature of the manure streams. A full-scale, demonstration fixed-film anaerobic digester has been developed and is in continuous operation at the University of Florida's Dairy Research Unit (DRU) in Hague, Florida. This unique anaerobic digester design allows biogas recovery and biological stabilization (permanent odor reduction) of the liquid portion of flushed dairy manure at ambient temperature conditions.

The DRU fixed-film biogas digester is partially filled with media, which provides a large surface area for bacterial attachment. This enables stable biogas production at low hydraulic retention times (~3 days) even at low ambient temperature conditions (~20 °C). The DRU fixed-film biogas digester demonstrates the application of fixed-film anaerobic digestion to the treatment of flushed dairy manure at a working 500 milking cow dairy under field conditions. Model equations have been developed to predict total chemical oxygen demand (COD) levels in flushed dairy manure wastewater as a function of fresh flushwater usage per animal unit for similar dairy operations, providing an important design parameter for implementation of fixed-film anaerobic digestion systems.

Generally, the fixed-film design is suitable for any livestock manure that is subject to dilution with water for transport or processing, such as dairy and swine. Also, fixed-film digesters have a smaller footprint than conventional designs – an important factor where the land base is limited or local planning issues are a concern.

Research continues in characterizing the volume and concentration of flushed dairy manure after mechanical separation and sedimentation, monitoring the biogas production levels and treatment efficiency of the anaerobic digestion process, characterizing the reduction in odor levels, monitoring nutrient transformations, and evaluating pathogen destruction.

Manure matters ... at the University of Florida



UF/IFAS Fixed-film Anaerobic Digester



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