Appendix D—Anaerobic Digesters

EPA, USDA, and DOE offer resources on the design and performance characteristics and benefits of anaerobic digesters—used to convert bio-based materials to biogas that can be used for power and/or heat production.

One such resource is the AgSTAR Program, a voluntary effort sponsored by the three agencies. (See <www.epa.gov/agstar>.) The program encourages the use of methane recovery technologies, such as anaerobic digestion, at confined animal feeding operations that manage manure as liquids or slurries. These technologies reduce methane emissions while achieving other environmental benefits.

The EPA Office of Wastewater Management, Municipal Technologies Branch, offers resources and information to municipal wastewater treatment facilities, which can also process their biosolid waste in anaerobic digesters and then capture and use the gas. (See <www.epa.gov/owm/mtb>.)

The USDA Natural Resource Conservation Service (NRCS) has published design guidelines for three types of anaerobic digesters:[87]

- A ***covered anaerobic lagoon***, as defined by NRCS, is "a constant volume lagoon designed for methane production and recovery in conjunction with a separate waste storage facility." A cover can be floated on or suspended over the surface of a properly sized anaerobic lagoon to recover methane. Ideally, the cover is floated on the primary lagoon of a two-cell lagoon system, with the primary lagoon maintained as a constant volume treatment lagoon and the second cell used to store treated effluent until it can be properly applied to land. The lagoons are not usually heated and the lagoon temperature and biogas production vary with ambient temperatures. Coarse solids, such as hay and silage fibers in cow manure, must be separated in a pretreatment step and kept from the lagoon. If dairy solids are not separated, they will float to the top and form a crust. That crust will thicken, reducing biogas production and eventually filling the lagoon.

A ***complete-mix digester*** is a constant volume, flow-through, controlled temperature tank designed for methane production and recovery. These digesters can accommodate the widest variety of wastes. Complete-mix digesters are usually above-ground, heated, insulated, round tanks; however, the complete-mix design has also been adapted to function in a heated, mixed, covered earthen basin. Wastes can be mixed using gas recirculation, mechanical propellers, or liquid circulation. A complete-mix digester can be designed to maximize biogas production as an energy source or to optimize volatile solids reduction with less regard for surplus energy.

A ***plug-flow digester*** is a heated, unmixed, rectangular tank. New waste is pumped into one end of the digester, horizontally displacing an equal portion of older material and pushing the oldest material out through the opposite end. Biogas formed in a digester bubbles to the surface and can be collected by a fixed rigid top, a flexible inflatable top, or a floating cover, depending on the type of digester.

The demand for anaerobic digesters for livestock manure treatment, wastewater treatment, and energy production has accelerated quickly throughout the past few years. Factors influencing this market demand include increased technical reliability of anaerobic digesters through the deployment of successful operating systems during the past five years; growing concern of farm owners and municipal treatment works about environmental quality; an increasing number of state and federal programs that share in development costs; increasing energy costs and the desire for energy security; and the emergence

[87] USDA, n.d.

of new state energy policies (such as net metering legislation) designed to expand growth in reliable renewable energy and green power markets.

Managing Manure With Biogas Recovery Systems: Improved Performance at Competitive Costs, an AgSTAR brochure, provides background on anaerobic digestion and explains how the methane it produces can be captured and used to generate heat, hot water, and electricity. It includes information to help dairy and swine farmers determine if a biogas recovery system is right for their farm and describes the environmental benefits of anaerobic digestion systems. It also provides a table that compares the cost and environmental effectiveness of conventional animal waste systems to those of anaerobic digester systems. Download the brochure at <www.epa.gov/agstar/pdf/manage.pdf>.

Emerging Technologies for Wastewater Biosolids Management, a report from the EPA Office of Wastewater, is designed to help municipal wastewater treatment system owners and operators find information on emerging biosolids management technologies, such as anaerobic digestion. Featured technologies can be used to reduce the volume of residuals to be managed, produce stabilized biosolids that can be used to help improve soil fertility and tilth, or promote the recovery of energy from biosolids. Technical and cost data for more than 60 technologies are provided. Another 25 early-stage technologies are also identified. Download the report at <www.epa.gov/owm/mtb/epa-biosolids.pdf>.