

## Anaerobic Digestion of Manure in New York State

There are currently nine dairy farms and one duck farm conducting anaerobic digestion of manure in New York State; one dairy farm is about to begin. Anaerobic digestion produces methane gas that may be used for heating purposes and/or to generate electricity. It produces essentially pathogen-free solids that may be used as fertilizer and animal bedding.

Five of the nine dairy farms use a digester designed by RCM (Berkeley, Calif. [www.rcmdigesters.com/](http://www.rcmdigesters.com/)). This digester consists of a subsurface concrete pit, typically 300,000 to 600,000 gallons in capacity, covered by a cylindrical, above-ground, rubber roof resembling the compressed-air bubbles that cover tennis courts in the winter.

Optimal digestion and minimal residence time requires a temperature in the range of 97-100 F. The temperature may be achieved by means of a propane-fueled boiler and/or by heat (via a heat-exchanger and circulating fluid) from the engine that drives the electrical generator.

A digester maintained in the temperature range above is said to be operating under *mesophilic* conditions. Digesters of more recent design can operate under *thermophilic* conditions--in the temperature range of 125-135 F--which results in more complete digestion of the manure and shorter residence times. In order to maintain these higher temperatures with maximum energy efficiency, though, the digester must be provided with additional insulation. The firm Cow Power, Inc. (Syracuse, NY, <http://www.manuremanagement.cornell.edu/Docs/Cow%20Power,%20Inc.pdf>), which has designed two hard-top digesters currently in operation, is considering, for future digesters, the use of a Styrofoam/concrete composite manufactured by Tri-State Solarcrete (Payne, OH, <http://www.solarcrete.com/>).

A cow typically produces ~16 gal/day of manure containing about 12% solids; rinsewater dilutes the manure so that by the time it reaches the digester, it is a slurry containing about 8% solids. Cow Power, Inc. is looking into the preliminary separation of water, using reverse osmosis, and to increasing solids content of the digester feedstock to about 25%.

Some farms have been adding food wastes (from outside the farm) to the digester, which may provide extra revenue for the farm in the form of tipping fees and may also increase the volume of methane produced. The firm Microgy, a division of Environmental Power, is active in California, Texas and Wisconsin; it builds digesters on farms at no cost to the farmer, for the privilege of using those digesters to treat wastes other than manure (<http://www.environmentalpower.com/companies/microgy/>).

New York has a solid waste regulation that may pose a problem for farms processing food wastes. The regulation distinguishes between recognizable and unrecognizable food wastes: a recognizable food waste might be, for example, a batch of discarded grapes or

tomatoes, whereas food waste commingled with manure and put through a digester would clearly be unrecognizable. Unrecognizable food waste cannot be applied to certain types of soil, as identified by soil maps. The regulations must be revised to recognize digestate as a new (and benign) category of waste that may be used for land spreading.

The methane gas produced by the digester powers a (modified) diesel engine or a turbine that, in turn, drives an electrical generator. A respectable electrical output is 200 watts/cow (= 5 cows/kW).

Most states now have so-called “net-metering” laws: if a farm is equipped with an electric meter that can run in either direction, when the farm consumes power from the power utility, the meter runs forward in the usual way, but when the farm produces electricity, the meter is reversed. A web site on net-metering, with links to a summary of the net-metering laws in different states is:

<http://www.awea.org/faq/netbdef.html#Whatismetring>

If a farm generates more electricity than it uses, it may sell the excess back to the grid, but this rarely translates into profit for the farm. The utility usually pays the wholesale rather than the retail rate, and the farms have significant expenses for frequent oil changes (e.g., \$540/barrel/month) and for equipment maintenance and overhaul. In short, a utility generally produces electricity much more economically than a farm.

There are credits available for the destruction of methane, a greenhouse gas more than 20 times as potent as carbon dioxide. New York’s net-metering law says that “attributes” associated with the generation of electricity are to follow the flow of energy. The utility asserts that credits are an attribute and that since generated electricity flows to the power company, *it* should receive the credits. The farmer, on the other hand, would like the law revised so that the *producer* of the electricity receives the credits.

Accompanying the methane generated in the digester is hydrogen sulfide (H<sub>2</sub>S), which is corrosive to the equipment. Some farms keep the engines hot by running them around the clock, so that H<sub>2</sub>S never condenses on the equipment. Other farms use a chiller to condense the digester effluent prior to combustion, so that moisture and some of the H<sub>2</sub>S are removed; H<sub>2</sub>S is less corrosive in the absence of water. Another farm uses iron impregnated wood to scrub out H<sub>2</sub>S. NY State Electric & Gas Corp. is working with 20 farms in Cayuga County that collectively have 20,000 milking cows. The company is looking to collect the methane and pipe it to the utility, but virtually complete removal of H<sub>2</sub>S is required, and it is planning to use activated carbon to accomplish this.

For more complete general discussions of the topics above and of others, please visit the web site:

<http://www.manuremanagement.cornell.edu/HTMLs/FactSheets.htm>

For discussions of individual farms, see:

[http://www.manuremanagement.cornell.edu/Lessons/List\\_anaerobicDigestion.aspx](http://www.manuremanagement.cornell.edu/Lessons/List_anaerobicDigestion.aspx)

