PENNSTATE
Department of Agricultural
and Biological Engineering

Oregon Dairy Farm LLC Case Study

Type of farm: Dairy
Name of farm: Oregon Dairy Farm LLC
County: Lancaster
Digester designer: Richard Waybright
Digester Installer: Subcontractors with Farm as General Contractor
Construction start date: 1985
Date Digester became operational: 1986
Number of animals contributing to the digester: 385
Type of barn: freestall
Manure handling system: alley scraped
Type of bedding: sawdust
Type of digester: modified plug flow (slurry loop)
Digester cover: hard (concrete)
Digester temperature: mesophilic 90°F to 100°F
Biogas uses: operate the CHP unit to produce electricity and heat
Biogas utilization equipment: engine generator set
Heat recovery utilization: engine generator and exhaust jacket to heat digester and farmhouse domestic hot water and heat
Power Purchase Agreement: No
2007 Status of Digester: operational

Introduction:

Oregon Dairy Farm LLC is located in Lancaster County, in Litiz, Pennsylvania. The dairy farm has been in the family since 1952. The farm decided to install an anaerobic digester for odor control and energy during the early 1980's energy crisis. Oregon Dairy has the second oldest, continually operating dairy digester in the state of Pennsylvania.

There are a total of 430 cows on the farm, 385 contribute manure to the digester. The remaining 45 cows are dry. There are also 230 – 240 heifers being raised off farm.

Digester information:

Dick Waybright from Mason Dixon Farm designed the Oregon Dairy digester. The farm acted as the General Contractor. The construction for the heated, slurry loop modified plug flow digester started in 1985 and became operational in 1986. When the digester was designed and built for 300 cows, there were 280 cows on the farm. Currently 385 cows contribute manure to the digester. Some of the raw manure by-passes the digester and goes to the lagoon undigested. The digester is 40' in diameter and 12' in depth with a capacity of 150,000 gallons of manure. A center dividing wall running almost the full diameter of the tank makes this a slurry loop digester thereby causing the manure slurry to loop from one side of the circular digester to the other.

The digester tank and top are concrete and buried below-grade under two feet of soil. The soil surrounding the tank acts as thermal insulation. The hydraulic retention time (HRT) is 20 days. The actual percent solids of the manure is not known. The digester mesophilic temperature is kept above 90°F and no higher than 100°F. Manure is alley scraped into a pit with gravity flow to the digester.

Manually valved pits for directing raw manure to the digester or to the storage lagoon

Hot water from the engine generator set heat exchanger is used to heat the digester using 50 feet of stainless steel piping, replacing the original steel pipes, inside the digester on pedestals mounted five feet above the digester floor. A building is located above the digester which houses the combined heat and power unit (CHP) and a biogas storage bag.

Digester clean out has occurred twice since its construction and operation (1994 and 2000). The tank's internal inspection revealed minimal corrosion; the farmer stated "The tank was in good shape."

The digester was installed for odor control and energy. The owner stated the digester was a good investment and has made the manure easier to handle, spread and there is no crust formation in the manure storage. He also stated there is very little management time involved with the digester.

Biogas system:

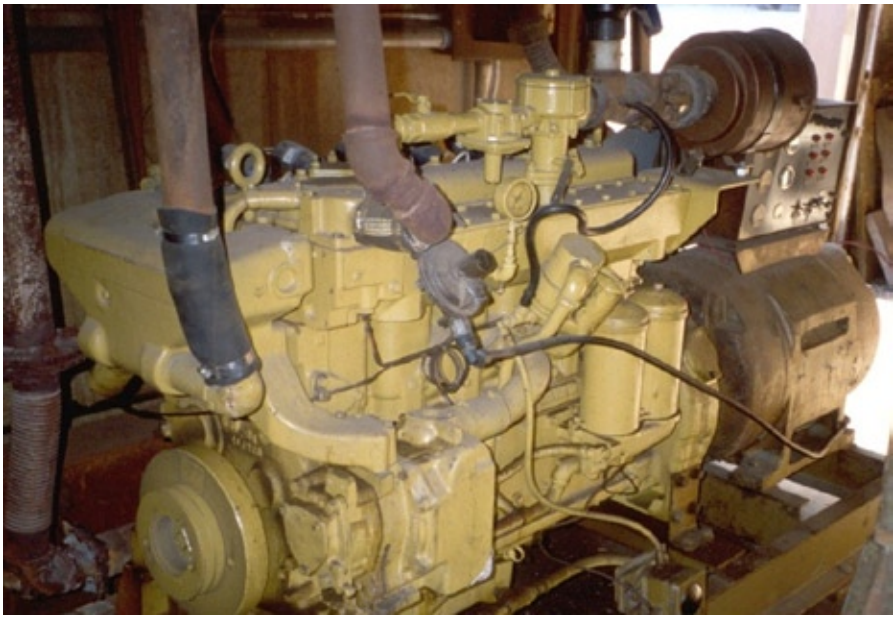
Oregon Dairy does not have a biogas flow meter so average daily biogas production is unknown. The biogas is stored in a gas bag, which is in the building covering the digester. An iron sponge was used at one time to clean the biogas of hydrogen sulfide but is no longer used. Raw biogas is piped to the CHP unit to run the engine and produce electricity. Biogas carbon dioxide (CO_2) and hydrogen sulfide (H_2S) concentrations are not measured. A biogas flare is not installed.

Combined heat and power unit (CHP):

The biogas is piped to a Caterpillar engine coupled to a 65 kW generator purchased from Martin Machinery Inc. of Ephrata, PA. Hourly average electricity production is 45 kWh. The engine generator set is located inside the same building that houses the digester gas storage bag. The CHP unit runs 24/7/365 days a year. Oregon Dairy's operation and maintenances costs average $6,000 a year for oil changes every four to six weeks. Heat from the engine water jacket and exhaust jacket makes hot water to heat the digester and domestic hot water and winter building heat for the farmhouse.
The iron piping supplying hot water to the farmhouse has been replaced with PVC pipe.

Power purchase agreement:

Although the CHP unit is paralleled with the grid, Oregon Dairy does not have a power purchase agreement with Pennsylvania Power and Light (PPL) Electric Utilities Corporation. The farm is saving $2,000 - $2,500 a month in electricity costs by generating their own electricity for three houses (two of which are residences) and the store.



Oregon Dairy CHP unit

Digester effluent:

The nearly odorless digested manure is pumped up hill to the storage lagoon to wait for land application. Digested effluent is not separated.

Project costs:

The total investment for the digester project was $125,000. The Oregon Dairy Farm received a 10% IRS Tax Credit for installing the digester in a time when the country was in an energy crisis.

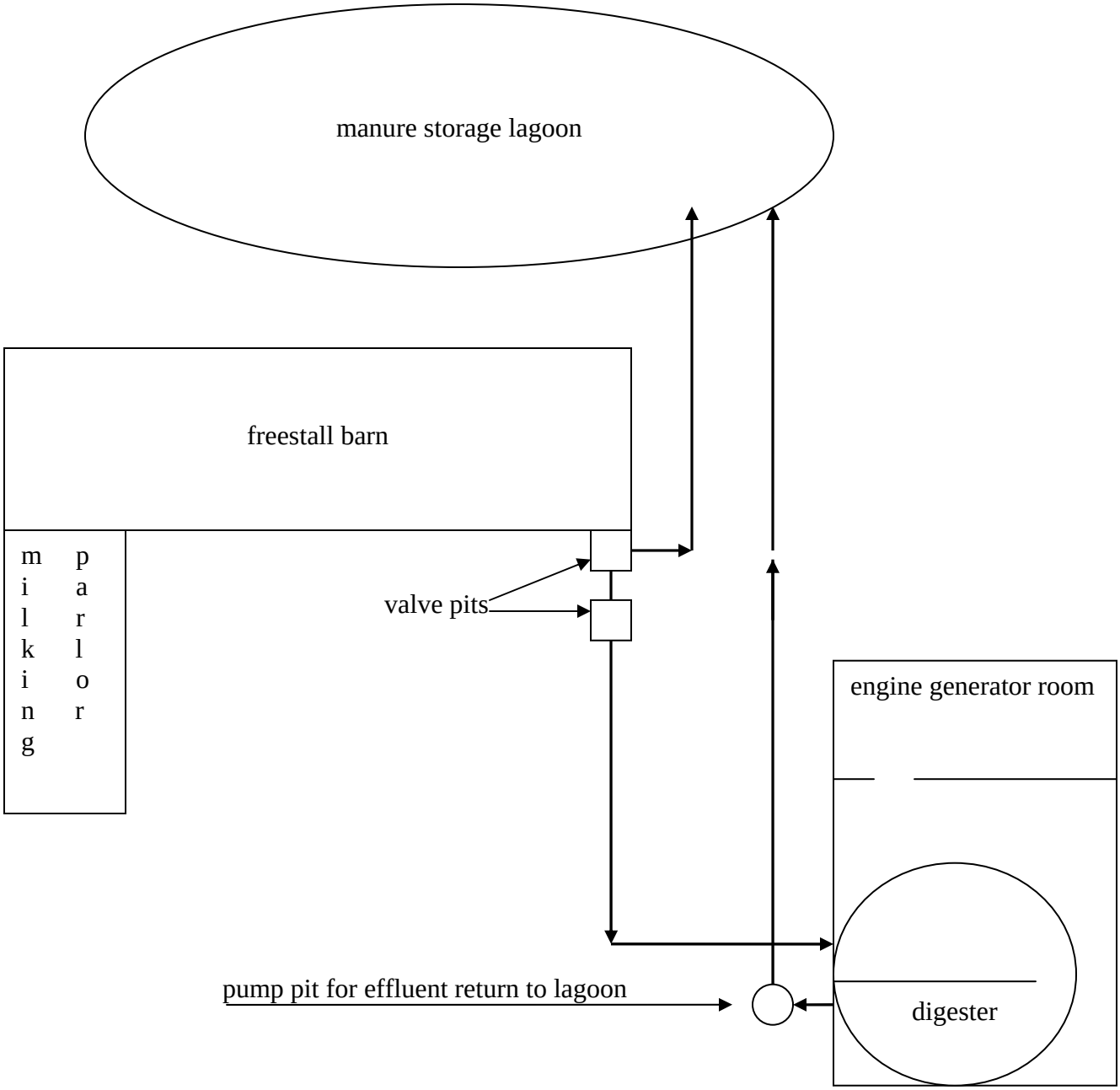
Lessons learned:

The owner stated he would construct larger service holes for cleaning the digester. Install stainless steel pipes during construction for anything above manure level. He would also insulate the digester tank. He likes the fact that the digester is underground and inside a building. The day to day monitoring of the digester takes very little management time.

Would you install a digester again? Yes

Storage lagoon

The information obtained in this case study was collected by Penn State researchers, Deborah Topper and Patrick Topper during a farm tour at the Oregon Dairy Farm LLC and discussions with the owner in 2006 .



Schematic of Oregon Dairy Farm LLC Anaerobic Digester System