

# **A “SELF SCREENING”ASSESSMENT METHOD: DETERMINING THE APPROPRIATENESS OF A MANURE DIGESTION SYSTEM ON AN ANIMAL PRODUCTION FACILITY**

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## **INTRODUCTION**

At the request of AURI, an approach has been developed with the intent of providing animal producers tools to “self-screen” or self-assess the potential viability of installing manure digestion system systems. Producers interested in exploring the option of installing a digestion system will be able to:

1. Learn how a system would benefit the facility,
2. Gauge the ranges of system installation and operating costs,
3. Identify equipment and materials currently on the farm which will be usable,
4. Assess, through a simple weighted checklist, the likelihood of successfully installing a system.

## **CAVEATE**

Information herein is meant to highlight critical issues associated with installing a successful manure digestion system. It is specifically and explicitly not intended to be a tool to formulate final decisions of whether installation of a system is advisable. A final decision on system installation should be made only after consultation with professionals experienced with animal manure digestion.

## **DESCRIPTION OF A SUCCESSFUL DIGESTION SYSTEM**

An anaerobic digester is a completely closed (oxygen free) system that receives and biologically treats manure with naturally occurring organism. **A successful system is easy to operate, is cost effective and characterized by consistent and significant: reduction in total solids, production of methane rich biogas, and effluent with less odor, pathogenic organisms and weedseeds than was present in the incoming waste. In a successful system no additives or additional organisms are required.**

Anaerobic digestion systems may have biogas capture and utilization for production of power and/or heat. The system may have solids recovery.

## **DIGESTION SYSTEM BENEFITS**

Digestion systems offer potential economic and non-economic benefits. Actual benefits will vary from farm to farm. Whereas properly designed anaerobic lagoons may provide similar results; a heated

digester is remarkably smaller and will permit treatment year around with predictable recovery of usable products. Digesters are often a better investment than a lagoon over the long term life of the structure.

### Economic

Digestion systems may both directly and indirectly enhance revenues of the production facility.

#### 1) Direct Economic Benefits

Several ways a digestion system may directly impact the facility are:

- A system, which includes equipment to convert biogas to electricity, and hot water, may sell electricity directly to utilities; gas or hot water may also be sold.
- A system, which includes equipment to remove suspended solids from the liquid, may sell digested fiber.
- Digestion systems will greatly reduce the viability of seeds found in the waste stream. Consequently, there is the potential less herbicide will need to be purchased.
- Though the market is not developed to date, there is speculation that waste managers treating certain waste streams may eventually be able to sell pollution credits; current discussion focuses on sale of CO<sub>2</sub> credits associated with combustion of manure derived methane which would otherwise have been emitted to the atmosphere.
- Through the assistance of a tax specialist system ownership may be structured to permit sale of certain tax benefits associated with system installation.

#### 2) Indirect Economic Benefits

The greatest potential indirect economic benefit is the reduction in risk of the facility being subject to legal action and forced outright closure. Digestion systems, properly designed and operated, significantly reduce the odors associated with manure management.

Even if electricity or hot water are not directly sold:

- Digestion systems with biogas conversion equipment (boilers, engine generator sets) have the potential to replace purchased electricity and fuel.
- Recovered digested solids may be used for animal bedding, offsetting the cost of bedding purchase.
- System using solids separation equipment will reduce lagoon or storage cleaning costs.
- Because digested manure is biologically stable, the design size (and capital cost) of the storage facility will correspondingly be greatly reduced.
- While the research has not been completed in the US, research in other countries indicates manure stream nutrient availability and plant uptake may be improved with digestion. Fertilizer purchases are expected to be reduced and crop yields possibly improved.
- The pumpability of digested liquid is greatly improved.

### Non-Economic

Staff as well as neighbors would prefer to not deal with odors associated with manure management. In digestion, compounds, which usually produce odors, are greatly reduced. Pathogenic organism are greatly reduced, most more than 90%, many more than 95%, a few only 50% or more (note: they are not to be considered eliminated).

## COSTS ASSOCIATED WITH DIGESTION SYSTEM INSTALLATION

The obvious questions asked when considering digestion systems are:

1. What will be the capital cost?
2. The operating costs?, and,
3. How well will the system fit into the current operation?

### System Capital Cost Ranges

Prices vary with system design and components, location, contractors and suppliers. This table provides approximate costs for a relatively simple effective system style currently employed successfully in a variety of locations in the US. There are more exotic approaches, with correspondingly higher initial capital outlays.

| Facility Size   | Cost Range <sup>*+</sup> |
|---|--------------------------|
| 500 cows,<br>1000 sow farrow to finish,<br>5000 finishing hogs<br>2500 sow farrow to wean     | \$250,000-300,000        |
| 1000 cows,<br>1500 sow farrow to finish,<br>10,000 finishing hogs,<br>5000 sow farrow to wean | \$300,000-\$350,000      |
| 2000 cows,<br>2500 sow farrow to finish,<br>15,000 finishing hogs,<br>8000 sow farrow to wean | \$450,000-\$500,000      |

<sup>\*</sup>These estimates are for digestion systems with Engine Generators,  
reduce prices by 1/3 if no genset is to be installed

<sup>+</sup>These estimates do not include solids separation,  
increase value by \$35,000-\$45,000 if solids separation is to be included

### System Operating and Maintenance Costs

Digestion systems with cogeneration will cost about \$0.015/kWh generated to operate. This includes all engine generator and digester daily and intermediate expenses. This is about 5% of the initial capital costs.

Digestion systems without cogeneration will require minimum daily attention, and about the equivalent 5% of the initial capital cost in short and long term maintenance.

If solids separation is to be part of the system, operation and maintenance will cost between \$0.50 and \$1.50 per cubic yard of solids recovered. If solids separation is not to be included, the producer will have to consider the cost of lagoon cleaning.

### Fitting the Digestion System into the Existing Facility

The least cost approach to digestion system installation is to use existing equipment to the largest extent possible. Under nearly all circumstances, existing equipment may be used and the costs cited above reduced. Production facilities may have existing manure pits, pumps, separators, and buildings. Cost of

constructions will be lower in those cases. One notable exception is that existing standby power gensets may not be used.

Biogas collected in the digester may be piped to an engine attached to a generator. This engine will have to be purchased, as standby generators are almost all not continuous duty nor built for this type medium Btu gas. Engine and generator controls will have to be special ordered.

Mixing digestion system produced electricity into the farm system is as simple as connecting to the main switch buss bar.

Mixing digestion system produced hot water from the engine into the farm system will be as simple as installing heat exchangers.

### **DOES A DIGESTION SYSTEM MAKE SENSE? -A “SELF SCREENING” CHECKLIST**

Digestion systems are not for everyone.

A checklist is provided to assist in assessing whether installation of a digestion system on a facility has a reasonable chance of success. Only those issues most likely to impact system success have been included. This is an empirical approach based on opinions formulated after observing many digesters and situations.

There are key first issues, which are critical to system success. Inadequacies in these areas will almost certainly result in an unsuccessful system.

Differing circumstances impact whether a digestion system is appropriate. An approach is offered which will “weight” conditions to balance the differences that may exist from facility to facility. The producer should use the given weighted values as guidelines.

The interpretation at the bottom of the sheet is a “first cut”. The producer and consultants are the best interpreters of the results.

### **FINAL WORD OF CAUTION**

Having assessed the likelihood of success, actual success is contingent, among many, on the quality of digestion system design. Select only those designers able to demonstrate a track record working with the type of waste at the facility in question and at the scale anticipated at the facility.

### **FURTHER INFORMATION**

Further information may be obtained through the EPA-USDA-DOE AgSTAR program by calling 1.800.AgSTAR95.

## Checklist to Evaluate the Likelihood of Heated Manure Digestion System Success

| <b>Key Issues</b>            |  | YES/NO |
|------------------------------|--|--------|
| Site Permanency              | Projected facility life is less than 10 years                      |        |
| Bedding                      | Sand (dairy)   |        |
| Confinement                  | Dairy: animals on pastured or on drylots more than 10% of the time |        |
|                              | Hogs: "all in-all out"   |        |
| Storage                      | Storage and collection pit the same                                |        |
| Manure removal               | Flush  |        |
| Site Development Limitations | Problem finding 150X150 area for system                            |        |
| Water managed                | No water meter or meter is unread                                  |        |
|                              | Rainwater comes in   |        |
|                              | Dairy: parlor holding area hosed down, not scraped*                |        |
|                              | Parlor tankroom water flows to manure pit*                         |        |
| Management                   | Is there question who will be incharge                             |        |
|                              | Problem finding a good Farm Mechanic or service company            |        |

**NOTE:** Any "YES" in the above list is an area which may require costly changes that reduce likelihood of system success.

\*Is the producer willing to make necessary changes?

| <b>Weighted Issues</b>   |  |                |                                |            | <b>Weight</b> | <i>Selection</i> |
|--|--|----------------|--------------------------------|------------|---------------|------------------|
| (Select the best description, place corresponding <b>Weight</b> value in the <i>Selection</i> column, add <i>Selection</i> values, compare with guideline <i>Interpretation</i> below) |  |                |                                |            |               |                  |
| Why install a Digester?  | "A good idea"  |                |                                |            | 1             |                  |
|  | Environmental Concerns                                   |                |                                |            | 3             |                  |
|  | Financial benefit  |                |                                |            | 6             |                  |
| Animal numbers   | Holsteins  | Farrow/ Finish | Farrow/Wean                    | Finish     |               |                  |
|  | < 300  | <500           | <1000                          | <3000      | 1             |                  |
|  | 300-500  | 500-1000       | 1000-2500                      | 3000-5000  | 3             |                  |
|  | 500-1000   | 1000-1500      | 2500-5000                      | 5000-10000 | 6             |                  |
|  | >1000  | >1500          | >5000                          | >10000     | 8             |                  |
| Electric rate, Actual/ kWh charge  | <\$0.05  |                |                                |            | 1             |                  |
|  | \$0.05-0.06  |                |                                |            | 3             |                  |
|  | \$0.06-0.07  |                |                                |            | 6             |                  |
|  | >\$0.07  |                |                                |            | 8             |                  |
| Floor heating  | In use in the production areas (and parlor holding area) |                |                                |            | 10            |                  |
| Fuel rate, average   | <\$0.50/gal Propane                                      |                | <\$3.00/1000 CuFt Natural gas  |            | 1             |                  |
|  | \$0.50-\$0.75/gal Propane                                |                | \$3.00-\$4.00/CuFt Natural gas |            | 2             |                  |
|  | \$0.75-\$1.00/gal Propane                                |                | \$4.00-\$5.00/CuFt Natural gas |            | 4             |                  |
|  | >\$1.00/gal Propane                                      |                | >\$5.00/CuFt Natural Gas       |            | 6             |                  |
| Use depreciation On taxes  | No   |                |                                |            | 0             |                  |
|  | Partial  |                |                                |            | 3             |                  |
|  | Entirely   |                |                                |            | 8             |                  |
| Score  |  |                |                                |            |               |                  |

**Interpretation:** 0-20 = success questionable, 21-35= success possible, 35-46= greatest chance of success

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