North Carolina Cooperative Extension Service

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SWINE News

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TURNING SWINE MANURE INTO FERTILIZER: THE PSF SOLUTION

Premium Standard Farms has started the construction of a "Next Generation" environmental system on one of its farm complexes, Valley View Farms in Northern Missouri. The objective of this project, the construction of the Crystal Peak fertilizer plant, is to convert hog manure into a high value commercial fertilizer using a process developed and patented by Premium Standard Farms and its technology partners.

The process of developing the Crystal Peak plant began following a 1999 Consent Decree between the company and the State of Missouri. That agreement called for the company to develop "Next Generation" technology with the assistance of a State-appointed panel of experts and to invest $25 million in manure management research and technology. The Crystal Peak plant is one of their major initiatives and will cost an estimated $9 million.

The system consists of the following steps:

1) Manure collected from each of the barns will first be processed through an Internal Recirculation Process (IRP). This process consists of a screen to remove large solid particles, and an 8 inch wet well to allow for settling of solids . Screened and settled solids are combined to generate an 8% solids fraction. Separated liquids are acidified with sulfuric acid to minimize odor and ammonia, and will be used for flushing fresh manure out of the barn. Concentrated solids will be transferred to a digester.

2) The digester used is an in-ground digester heated to 90°F using waste heat from the dryer. In this digester, organics in the manure are broken down, resulting in the production of methane. This methane is captured, and used later on in the process. Besides producing valuable methane, the digester will also reduce the odor of the manure, making further processing more practical. Manure will reside in this digester for a period of approximately 1 month.

3) Effluent from the digester will be pumped to a settling basin. The settled solids gathered here will be further concentrated using a centrifuge. The liquids, both those separated in the centrifuge and those obtained directly from the settling basin, will be pumped to a holding pond where they will be stabilized using sulfuric acid, which prevents the escape of ammonia.

4) The liquids in the holding pond will be accumulated throughout the year in three lagoons that have been converted to storage ponds. During the winter these liquids will be transferred to an area where they will be sprayed onto a pad and allowed to freeze. The freezing and subsequent thawing cause a separation of minerals in the liquid fraction because pure water freezes first and thaws last. While thawing, the liquids will flow from this pad and, based on electrical conductivity, they will be directed either to a brine pond (mineral-containing water) or to a treated water pond (clean water) for recycling. An analogy to this process is icebergs at the North pole; the icebergs, although floating in salt water, consist of fresh water.

5) The brine pond will contain a high concentration of minerals, including nitrogen and potassium. This material will be mixed with the solids obtained after centrifugation, which is high in phosphorus. After mixing, the material will be formed into pellets, dried and charred using methane derived from the digester as an energy source. Emissions derived during this drying process will be captured using wet scrubbers and dust filters, and the captured material will be recycled in the system. The pellets will be marketed as a high-quality fertilizer with composition expected to be 12-8-8.

6) Liquid harvested from the freeze-thaw process will be stored in a newly generated water storage cell and either used as irrigation water or further processed to produce drinking water for the pigs on site.

The Crystal Peak process is an interesting combination of technologies for solving environmental issues facing the swine industry. Emissions

of ammonia from manure storage are minimized by using a cover on the digester and by acidifying subsequent material streams (acidification is very effective for lowering ammonia emission). Ammonia and possibly odor emission from the housing is also reduced through acidification of flush water. Odor from the stored manure also is minimized through the digestion process.

Energy contained in the manure is captured in the form of methane, and this methane is used to dry the harvested minerals in the production of a high-quality fertilizer. Their system avoids having to generate and market electricity, two steps that are major obstacles for conventional digesters. It also makes the energy cost of this system relatively small, especially if good separation of minerals and water can be achieved by using the freeze-thaw process powered by Mother Nature.

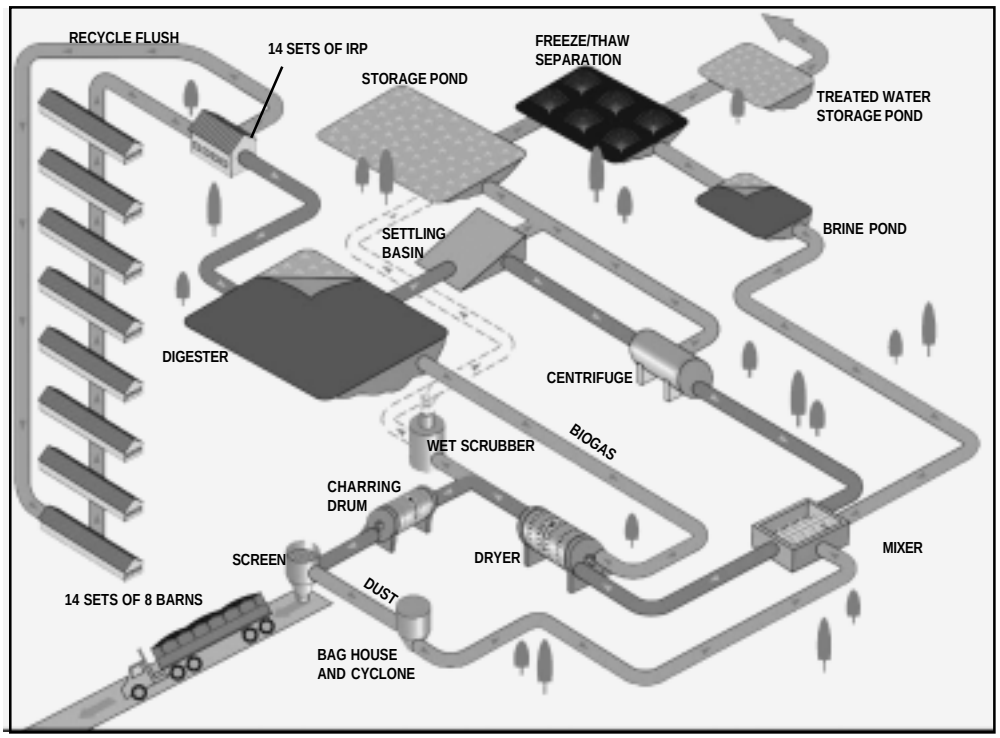

Diagram of the Crystal Peak fertilizer operation.

Another benefit of the system is that its end product, fertilizer with a composition of 12-8-8, is not a niche product and is easily marketed. Many methods of producing value-added products from animal manure target niche markets, which may work for smaller operations. But if a large portion of the swine industry were to adopt such value-added technology, the market would quickly become saturated, and the price of the end product would plummet.

Because the Crystal Peak system uses a freeze-thaw process, it will be suitable only for climatic zones were winter temperatures fluctuate from substantially below freezing to above freezing. In North Carolina, alternative methods for separating minerals from the liquid fraction would have to be applied (evaporation of the water may be a better option here). However, the system is a very intriguing solution to swine manure disposal, and it will be interesting to see how it operates in practice. *—Theo van Kempen*

NEW GASIFIER AT NCSU

Animal Science swine waste researchers at North Carolina State University has been evaluating gasification technology. The primary purpose was conversion of animal manure into an energy source and mineral ash that could be used as a feed ingredient for pigs.

At first, a complicated gasifier was tested that turned out to be a poor fit for the animal industry. However, recently, a Canadian company, BGP, has provided us with a simpler gasifier that seems to fit agricultural applications much better.

The design of the BGP gasifier is based on years of experience, with the primary objective being the destruction of waste without causing air pollution. The original design contained no moving parts other than a door for loading and unloading and a downdraft blower. However, to better fit this technology to animal agriculture, the unit is being re-engineered to allow simple but automatic loading and unloading, thus allowing for unattended processing of waste. A diagram of the re-engineered unit is provided in Figure 1.

In the BGP gasifier, a downdraft burner is used to heat the L-shaped combustion chamber to 800° C. Heat transfers from the combustion chamber to the gasification chamber through heat-conducting tiles (the rest of the unit is lined with insulating fire-bricks). Feces are introduced in batches into the gasification chamber through a hatch on the top of the unit. Inside, the high heat causes the fecal material to gasify. Gases formed during this process escape from the gasification chamber into the combustion chamber, where they are burned and, in turn, fuel the system. Ashes remaining after gasification of the feces are dumped into an ash chamber using a tilting floor in the gasification chamber. There, any remaining carbon is burned off. Ash is removed from the bottom of the ash chamber by means of an auger.

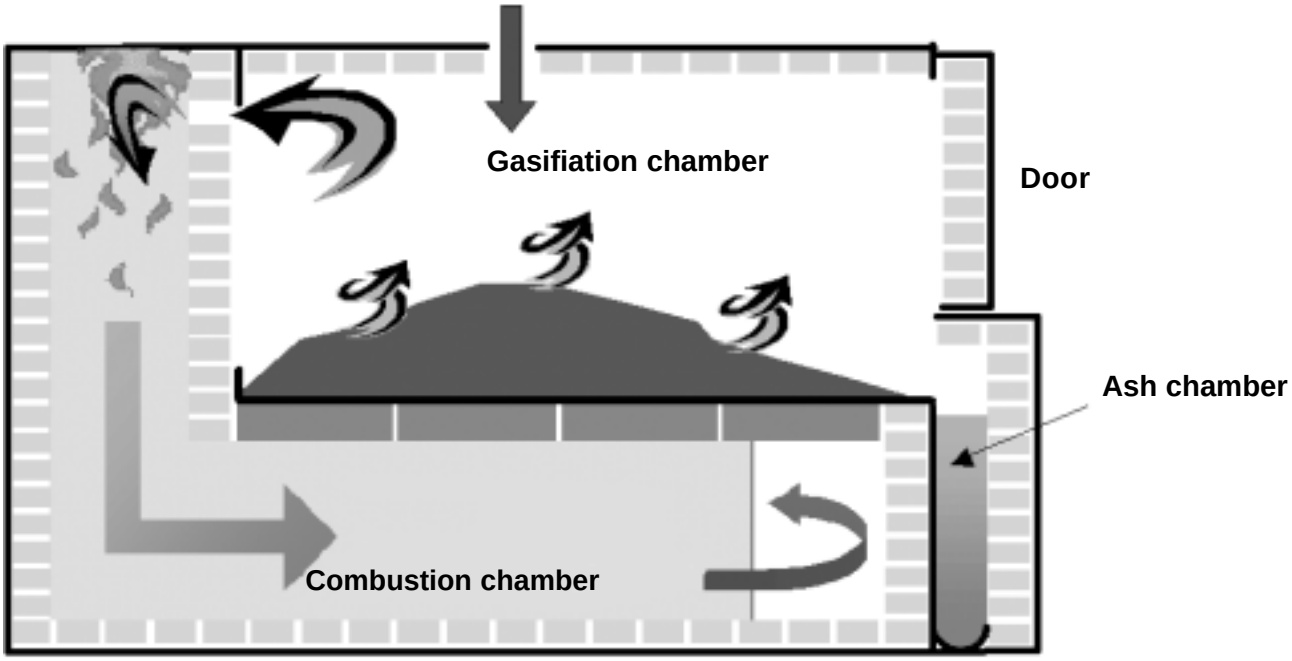

Figure 1. Diagram of the BGP gasifier.

Experiments with the BGP gasifier have shown that the unit is indeed easy to operate and that it delivers fail-safe operation. Batches of manure can be gasified in approximately 4 hours. The remaining ash is of high quality and should be well suited for use as a feed ingredient, resulting in the complete recycling of phosphorus.

Using such a system on a farm with 5,000 grow/finish pigs would result in a total heat output of approximately 0.55 megawatts (of which approximately 15 to 30 percent is from the fuel source used to fuel the system). A portion of this heat can be harvested in the form of hot water, or it can be converted to electricity.

The latter, although technically possible, is not the best solution as such systems increase in efficiency with size, with an on-farm system probably not being economical. Using the heat as hot water would allow for heating of buildings, which can result in cost savings. Other uses of heat may exist as well. One possibility is to use it to evaporate water from the liquid waste stream and concentrate the waste so it can be used as a concentrated fertilizer.

Another possibility is to gasify the feces in a central location so that a much larger operation can be built. In that case, the heat could be used more efficiently for production of electricity. If a profitable market for electricity does not exist, then the heat could be used to produce steam for a feed mill or rendering plant.

One of the reasons gasification technology is appealing is that it is more environmentally friendly than regular combustion processes. Although gasification is a combustion process, during gasification both temperature and oxygen availability can be controlled. This control is responsible for the lower levels of pollutants. For example, NOx emissions are temperature-dependent, with production becoming pronounced at temperatures over 700° C and becoming of concern over 1,000° C.

One major benefit of gasification of fecal material is that any bioactive compounds in it will be destroyed. This includes antibiotic residues, bacteria, viruses, and prions. Although there is little proof now that any of these form a real concern for public health, such destruction would be welcomed by the general public.

The test unit is located at the Animal and Poultry Waste Management Center in Raleigh. Tests are being performed with swine manure, poultry and turkey litter, and swine and poultry mortality. —*Theo van Kempen*

CALENDAR OF EVENTS

April	
20-22	**Pork 101** Lincoln, Nebraska
May	
25-27	**Pork 101** College Station, Texas
June	
9	**Pork Academy** Des Moines, Iowa
10-12	**World Pork Expo** Des Moines, Iowa
July	
19-22	**12th International Conference on Production Diseases in Farm Animals** East Lansing, Michigan
25-29	**American Society of Animal Science Annual Meeting** St. Louis, Missouri

ON-FARM PERFORMANCE TESTING: The following breeders with validated herds have tested animals in the past 30 days.

Breeder	Address	Breed
Bob Ivey*	314 N.C. 111 S, Goldsboro 27530	L,D,Y,CW
Wesley Looper*	4695 Petra Mill Road, Granite Falls 28630	Y,L,H,D,X
Thad Sharp, Jr. & Sons	5171 N.C. 581 Hwy., Sims 27880	Y,D,X
Thomas Farms	8251 Oxford Road, Timberlake 27583	X
Tidewater Research Farm*	207 Research Station Road, Plymouth 27962	D,Y,L

*Realtime Ultrasound

—Frank Hollowell, David Lee