Iowa Manure Matters

Odor and Nutrient Management

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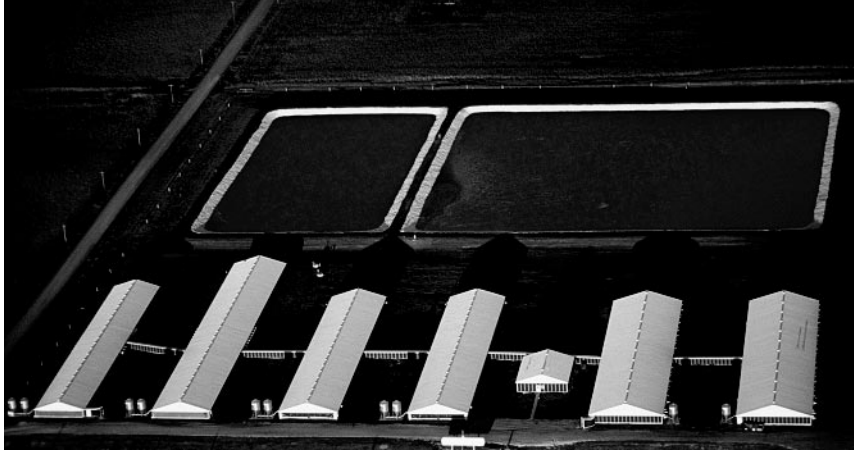

Geotextile covers for liquid manure storages

by Jeffery Lorimor, Department of Agricultural and Biosystems Engineering

A new type of manure storage cover is being tested in the upper Midwest. Artificial covers are being used throughout the state on liquid swine storages, and natural ones develop on bovine storages. The two primary types of artificial covers used are biocovers and solid synthetic covers. Covers have been shown to effectively minimize odors and gases emanating from the storages.

Biocovers are typically composed of 8 to 12 inches of straw, grass, or chopped cornstalks blown onto the liquid manure surface. Biocovers work well for one season. They are typically applied in the spring and removed during pumpout in the fall. Recurring costs for biocovers include the estimated biomass cost of 5 to 10 cents per square foot of surface area, as well as the spring application and additional fall agitation costs.

Geotextile cover with straw on Minnesota swine lagoon.

Solid synthetic (plastic) covers also are being used on a few storages in Iowa. They are more expensive initially (typically $1.00 per square foot of surface area), but do not require the recurring costs and management input. One problem with solid covers is their tendency to balloon up as they capture gases. The wind can then catch the covers and damage them.

Geotextile covers have been tested by Minnesota researchers. Geotextile is a tough, porous fabric that feels like felt. Its toughness makes it easy to install; it is light so it floats; and because it is porous, gases do not accumulate under it and cause ballooning. Replicated tests in Minnesota were conducted with 200-gallon tanks of swine manure. The geotextile covers reduced odors 59 percent and hydrogen sulfide emissions 71 percent compared with uncovered tanks, but the reduction was less than for straw covers or solid PVC covers that ranged from 70 to more than

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90 percent. Geotextile covers typically cost less than $1.00 per square foot, making them potentially good alternatives for reducing odors from both basins and lagoons.

A geotextile cover has been in place on a swine lagoon in Minnesota for more than a year. It has some straw on top of it to help minimize gaseous emissions (see photo). Currently, it is functioning well.

Manure cover pays for itself in quality of life for Williamsburg family

by Tracy S. Petersen, ISU Extension Communication Systems

If you ask Gary Boland, there's more than one way to recover business expenses. The Williamsburg pork producer takes an alternative view when considering the costs of his synthetic manure cover. From a financial point of view, the cover may never fully pay for itself. In terms of quality of life, the costs are already covered.

In 1998, after he expanded his operation to a 2,000-head nursery and 4,000-head finishing operation, Boland decided to address the odor issue. "The nursery we added southwest of the house smelled worse than we thought it would," he said.

Flipping through a magazine, he landed on a rubber and plastic sheet designed to cover a manure pit and to trap odors. It took a year to design and install the system that covers a 14.5-foot deep pit that measures 120 feet by 120 feet. The cover is held aloft by foam float logs, and secured at the edges with 4 inches of dirt in a U-shaped trench.

The system was designed with the help of AgSTAR, a program jointly sponsored by the U.S. Environmental Protection Agency, U.S. Department of Agriculture, and U.S. Department of Energy. The AgSTAR program provides tools, guidance, and methods to help confinement operators recover methane.

Once the system was developed, installation was a neighborhood affair, Boland said. "The cover came in a very large crate," he said. "Twenty neighbors helped lay it out and place the float logs in it. Then we used a rope and a tractor in each corner to pull it into place."

Now, nearly 2 years later, the $20,000 effort was worth it, said Boland, who raises hogs for Premier Swine Breeding Systems. He networks with Tom Gilliam, Newcastle, Oklahoma, who does the farrowing. "It's helped immensely," Boland said. "Some days it cuts the odor by 80 percent and on others it cuts it 100 percent."

It's not surprising that the response from neighbors has been positive. "I've got good neighbors," Boland said. "Nobody ever complained to us about the odor. But now that I have the cover on, they all tell me the odor is less."

Now that the cover is installed, the maintenance is minimal. "I have some tape to patch the holes," Boland said. "Other than that, all I have to do is keep the weeds mowed to keep the rodents out." The cover is expected to last 10 to 15 years.

During the summer, when more methane is produced, the excess gas is burned off. Boland said his pit does not produce enough methane to make harvesting it feasible. However, the nutrient value of his manure has increased since he put the cover on, helping to offset the cost. "My hog manure has outyielded commercial fertilizer," he said. "I haven't bought fertilizer for 2 years." Boland noted that he tries to inject all of his manure on his 500 acres of cropland.

Boland and his wife are ambassadors for the Iowa Pork Producers Association and speak often about their operation and odor management system. They've played host to an array of visitors, from European producers to staff members of Iowa senators Tom Harkin and Chuck Grassley.

Many U.S. producers are interested in odor management systems but consider the cost prohibitive. Boland received some financial assistance from the Odor Control Demonstration Project. Administered by Iowa State University and funded by the Iowa Legislature, the project was created in 1997 to demonstrate odor control technologies. Participating producers received up to half of their expenses for the odor control technologies used on their operations. "If the swine industry ever gets more profitable, I think these systems may get more popular," Boland said.

Resource for manure management record keeping

by Craig Tordsen, Department of Agronomy

How are you going to record information about manure applications to satisfy record keeping requirements? The answer is the Iowa Crop Management Database (CMD). CMD was developed at Iowa State University as an easy-to-use computer program to record agronomic and economic information on crop production, including livestock manure applications. The program has a built-in list of different types of livestock manure commonly produced in Iowa and their default nutrient values. It is also possible to enter nutrient values from your farm. Combined with the fertilizer recommendation part of the program, manure application rates can be determined and recorded for each field location.

The CMD computer program will run on a Pentium PC or a Power Mac. The cost of the CMD program is $100. It is available by contacting Extension Software Services, 110 EES Building, Haber Road, Ames, Iowa 50011-3070 or by calling 515-294-8658. If you would like additional information about the program, contact me at 515-294-6685.

Gieselman leading DNR animal feeding operation program

by Karen Grimes, Iowa Department of Natural Resources

Wayne Gieselman, a Morning Sun hog producer, began work on July 1 to coordinate the Department of Natural Resources (DNR) animal feeding operation program.

Gieselman, age 50, has a vision for Iowa that includes keeping Iowa as a top animal-producing state with abundant clean water and air. "My vision for my children and grandchildren is that they would still be able to live in Iowa and enjoy clean water and clean air," he said. "People need to be more aware of what they do to the environment.

"I don't believe that manure, properly applied and handled, causes a problem for water quality," he added. "There's certainly a threat if it's done wrong. Some of the mistakes made are just from not knowing or understanding the mechanics or biology of manure and its impacts. Let's show people how to do it right and convince them that they need to.

"My goal for this job," he said, "is to take a more educational approach and convince people to do the right thing."

Gieselman has the opportunity to do that in this position. He is helping to develop rules that regulate animal feeding operations, coordinating the implementation of existing rules and making recommendations on actions needed to protect the environment. He has a team in place to review manure management plans and construction permit applications.

An Iowa State University graduate, Gieselman has a degree in agricultural engineering. He is the former chief engineer for the floodplain division of the Iowa Natural Resources Council and served for six years on natural resources and environmental commissions. He has operated a hog and grain farm near Morning Sun since 1982.

Methane recovery from manure: Control odor and produce energy

by Paul Miller, USDA–Natural Resources Conservation Service, Des Moines

It might surprise a lot of people, but manure can be nearly odor free. And it could make you money! New advances in methane digestion technology are finding success in Iowa. Several different types of anaerobic digesters have recently been installed in Iowa with assistance from the USDA-Natural Resources Conservation Service (NRCS) and AgSTAR. AgSTAR is a voluntary program of the U.S. Environmental Protection Agency that is designed to encourage the widespread use of livestock manure as an energy source.

Methane Process. According to Shihwu Sung, assistant professor in environmental engineering, and director of Anaerobic Systems Engineering at Iowa State University, anaerobic digestion occurs when bacteria produce biogas by decomposing organic matter, such as manure, in an environment without air. The process involves the following three steps:

1. Hydrolytic bacteria convert complex particulate matter into dissolved compounds with low molecular weight.
2. Acidongenic/acetogenic bacteria convert the dissolved compounds into organic acids and hydrogen.
3. Methanogenic bacteria finally consume these acids or hydrogen to generate methane and carbon dioxide. For more information on this topic, see an article by Shihwu Sung, *The Viability of Methane Production by Anaerobic Digestion in Iowa*—case studies prepared for USDA–NRCS by Iowa Energy Center and Iowa State University, Department of Economics, page 2.

Anaerobic digesters are sealed with covers that trap the biogas produced in the digester. The biogas is then pulled from the digester by providing a slight vacuum on a pipe with a gas pump or blower. Biogas, which contains 60–80 percent methane and has a heating value of approximately 600–800 Btu/ft^3, is then used to produce energy. Methane can power an engine generator to produce electricity and can be used to operate a boiler or space heater, as well as chilling and refrigeration equipment. Gas that is not used for energy production is ignited and flared to reduce methane emissions and odor.

Success Stories. Gary Boland of Williamsburg, Iowa, wanted to reduce the odor coming from his earthen manure basin that served his pig nurseries. A floating cover, placed over the basin and kept afloat on top of the manure with 10-foot-long foam board logs, captures the biogas (approximately 60 percent methane). Methane produced by the stored manure is burned in a solar-operated flare, reducing or eliminating odor. The manure can still be used as fertilizer because none of the nutrients are lost or destroyed. Gary's extra cost for the cover was about $7.50 per head for his 2,700 head nursery (about $1.00 per square foot of basin surface) (see article on pages 2–3).

Steve Crawford, a Story County hog producer, is testing new anaerobic digestion technology. The anaerobic sequencing batch reactor (ASBR), developed at Iowa State University, has been highly successful at converting swine manure to biogas. The ASBR is currently producing biogas with more than 70 percent methane and is using the biogas to operate a boiler to produce heat. This on-farm system treats the manure from 2,800 hogs and is being used for a demonstration site. The per-head cost was approximately $65 based on 5,000 head the unit was designed to handle.

SWIneUSA, located in Union County, is

currently operating a complete mix anaerobic digester on a 5,000-head farrow-to-wean swine operation. The biogas from the $100-per-sow digester is operating an engine generator that currently produces 60 kilowatts of electricity for use at the operation. The unit provides most of the energy needed by the farm. Waste heat from the engine generator is captured and used to heat the digester.

Pollution Concerns. Growth of the livestock industry has generated the need for improved methods of manure management that are cost-effective and reliable. Pollutants from decomposing livestock manure can cause major problems, including surface and groundwater contamination as well as surface air pollution caused by odors, dust, and ammonia. Then there is the additional concern over the contribution of methane emissions to global climate change. In response, researchers have developed advances in biogas technology. The technology promotes the recovery and use of biogas to generate electricity or for heating and cooling needs.

The First Farm-Based Digester. In 1972, a farm near the town of Mt. Pleasant, Iowa, became the site of the first farm-based methane digester in the United States. The McCabe farm, a hog production facility, was near a town that was expanding to the farm's border and the McCabe's had to find an odor-free system of managing swine manure. It took several years of development, but a successful digester was created by adapting technology from a municipal wastewater treatment facility. The system has experienced very few problems and is used solely for odor control.

Major Improvements. The recovery of methane from animal manure is not new technology. More than 2 decades of research has gone into biogas systems that were developed in the 1970s when oil prices began to escalate. These early systems often failed. Biogas systems such as anaerobic digesters have a much greater success level now because of the improved technical support and increased profitability through the sale of manure by-products. Some dairy facilities report that they generate more revenue from the sale of electricity and other by-products than from the sale of milk. Aside from the moneymaking factors, digesters do help reduce odors. And that is a major concern for many livestock producers in Iowa.

For More Information. The USDA–NRCS can help landowners decide if a biogas system is appropriate for their operation. AgSTAR estimates that more than 2,000 livestock facilities across the United States could benefit from biogas recovery systems. For more information, please contact me at 515-284-4370 or the AgSTAR Program at 1-800-952-4782. For Internet resources on manure management and the AgSTAR program, visit extension.agron.iastate.edu/immag under the Publications link.

Minimizing risk when applying manure in winter

by Jeffery Lorimor, Department of Agricultural and Biosystems Engineering

If you don't have to apply manure in the winter, don't. If you do, there are ways to lessen the risk of having the manure run off, which results in nutrient losses and water quality degradation. The Iowa Department of Natural Resources recommends that winter-applied manure be applied to land with 4 percent slopes or less and that practices are in place to minimize erosion. There are two other factors to consider to reduce the risk of manure losses with snowmelt runoff: manure application timing and crop residue cover.

Research at Iowa State University shows that the risk of manure losses with surface runoff can be reduced significantly by adjusting the timing of the manure application. A study in 1994 and 1995 compared four different manure application timing treatments: 1) fall incorporated manure, 2) manure

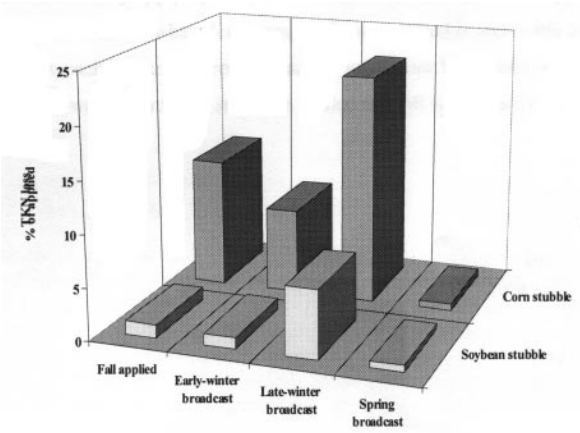

Figure 1. Total Kjeldahl nitrogen losses for corn stubble and soybean stubble.

applied early in the winter on frozen ground, 3) manure applied late in the winter on top of the snow, and 4) spring-incorporated manure.

The study showed that the greatest risk of surface runoff losses occurs when manure is applied on top of snow late in the winter and that losses from standing cornstalks are likely to be greater than losses from soybean stubble. In general, the more time that elapses between application and runoff, the less the risk of environmental degradation (this is true anytime, not just in the winter).

During the first year of the study, the late-winter manure was applied on top of snow on February 14. The next day a major thaw began. By the end of the thaw, the snow was gone, and much of the manure had gone with it. Ninety pounds per acre of manure nitrogen (49 percent of the nitrogen applied) were lost with the snowmelt. Table 1 shows the nitrogen concentrations in the runoff from the snowmelt.

The rest of the year losses were minimal. When the large February snowmelt is neglected, there are no statistical differences among treatments for the year. The second year of the study, losses were minimal, and no significant differences were found among treatments.

Losses were higher from standing corn stubble than from soybean stubble (Figure 1). The corn stubble held deeper snow than the soybean stubble so more liquid runoff potential existed. Table 2 summarizes the overall nitrogen losses for the 2 years of the experiment for both cornstalks and soybean stubble, and includes the "catastrophic" losses of the single snowmelt event of February 1994.

Anytime manure is applied on frozen ground there is an increased risk of environmental degradation. If manure must be applied in the winter, the environmental risk can be minimized by applying early in the winter ahead of snowfall. Applying manure on soybean stubble where less snow has been captured is preferable to applying on a deeper snowpack in standing cornstalks. If manure must be applied on frozen soil late in the winter, waiting until the snow has melted off will significantly reduce the risk of runoff losses.

Table 1. Nitrogen concentrations in snowmelt runoff for four manure application treatments (February 1994).

Date	February 15	February 16	February 17
		Parts per million	
Fall applied	6.7	8.7	30.6
Early-winter applied	33.2	92.4	91.9
Late-winter applied	1,086.0	739.0	116.2
Spring applied	5.6	3.4	7.0

Table 2. Nitrogen lost in surface runoff from corn and soybean stubble plots. Summary of 2-year averages in pounds per acre and percentage of the applied amount.

	Fall inject		Early winter		Late winter		Spring broadcast	
	lb/acre	%	lb/acre	%	lb/acre	%	lb/acre	%
Corn stubble	11.8	12.4	17.1	8.2	41.0	22.1	3.9	1.2
Soybean stubble	1.4	1.5	2.8	1.4	19.2	10.3	2.2	0.6

Manure applicator certification 1999 and future training

by Karen Grimes, Iowa Department of Natural Resources, and Jim Johnson, ISU Extension to Agriculture and Natural Resources

This past year, 1999, was the first year manure applicators needed to be certified to meet requirements of state law. Iowa law requires producers with average weight capacity of more than 200,000 pounds of confined hogs or poultry or more than 400,000 pounds of confined cattle to be certified as a confinement site applicators if they are applying manure from their own facilities. In addition, anyone applying manure for a fee must be certified as a commercial applicator.

Nine hundred and forty commercial applicants and 1,819 confinement site applicants attended initial certification meetings conducted by the ISU Extension this year. Of the people attending the training sessions, 804 commercial manure applicators and 1,318 confinement site applicators paid fees to become certified manure applicators in Iowa. Added to these totals are the 64 people who chose to take a test to meet certification requirements, with 87.5 percent of them qualifying for certification.

"The training should help applicators be more knowledgeable about the value of manure as a nutrient, not a waste product," said Wayne Gieselman, Iowa Department of Natural Resources (IDNR) livestock program coordinator. "It also has given applicators the tools they need to prevent contamination of our waters. Although the program won't eliminate every spill, it will help applicators know what to do if there is a spill. They'll know who to contact and what actions to take to prevent or minimize pollution."

How to become certified for the first time. Manure applicators must attend a training session or pass a test to qualify for initial certification. Applicators still needing to become initially certified should contact their local ISU Extension office to schedule a time to view a videotape that will qualify for certification, or contact the DNR to determine the testing schedule. More information on the certification process can be found on the Web at extension.agron.iastate.edu/manure

How to become recertified. Commercial manure applicators who are currently certified need to attend a 3-hour recertification meeting each year to continue their certification status. Their certification is good for 1 year.

Confinement site manure applicators who are currently certified will need to attend a 2-hour continuing education program each year for 3 years to become recertified. Their certification is good for 3 years.

ISU Extension will be offering recertification and continuing education meetings in February and March 2000 in most counties. Watch for more details.

Questions? The IDNR administers the program. For more information, contact one of the six DNR field offices:

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