

RECOMMENDED STRATEGIES FOR ODOR CONTROL IN CONFINEMENT SWINE OPERATIONS

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Summary:

Odors coming off a swine facility are generated from three different sources: the unit itself, from the storage facility, or the land on which the manure is applied.

To reduce the total amount of odor generated from a swine facility, odor generation and emission by each of these three sources needs to be reduced. Within each area, several options for odor reduction are available. Practices that have been proven to be effective and that can be immediately implemented are listed in Table 1. Other options are being developed or tested. Research into these practices will reveal whether or not they can be successfully implemented in the future.

Table 1 is organized in four sections covering practices that:

1. reduce odor generation in barns,
2. reduce odor emission from facilities and storage units,
3. increase odor dispersion, and
4. reduce odor emission from manure application.

For each practice, advantages and disadvantages are listed. The effectiveness and the cost of implementing each practice is indicated using odor generation from a standard swine facility as a base line. This unit is assumed to be constructed using state-of-the-art recommendations including deep pits or an uncovered manure storage facility, curtain sidings or mechanical ventilation, and no dietary modifications to reduce odor generation.

To obtain an overall reduction in odors from a facility, reductions need to be made in odor generated by the unit itself, the storage facility, and from land application.

Some practices listed in Table 1 are best management practices (BMP). These are practices with well-documented beneficial effects on sustainability of a production system. Their implementation should be encouraged even without considering their potential for odor reduction.

The cost of each practice is indicated. A “low” cost is assumed to be less than \$0.50 per GF pig produced (\$1.25/Animal Unit); “moderate” is assumed to add \$0.50-\$1.50 per GF pig produced (\$1.25-3.75/Animal Unit), and “high” is assumed to add more than \$1.50 per GF pig produced (\$3.75/Animal Unit) to total production costs, as compared to the base line unit.

Conclusions and Recommendations

A number of practices are available to reduce odor from swine facilities. A reduction in odor coming off a swine facility is achieved only if the odors emitted by the unit itself, from the storage facility, and from the land application of the manure are reduced.

At this time, the following practices are recommended:

1. The odor from the unit itself can be reduced by a combination of dietary practices and the installation of a biofilter.
2. The odor from the storage facility can be reduced by installing an effective lagoon cover. In larger units this may be combined with a manure separator and (or) a methane digester.
3. The odor from the land application of manure can be reduced by injecting the manure into the soil.

Research into odor reduction is ongoing, and many new technologies are being developed. As independent research using these technologies becomes available, some of these technologies may prove to be even more effective than the ones listed in the table. SDSU swine research being conducted at the Southeast Research Farm near Beresford has demonstrated that biofilters reduce odor emissions from confined buildings by 96%.

Table 1: Odor Reduction Practices for Swine Operations

Section 1: Reduce generation of odor						
Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
a. Low protein diets	Diets are lowered 3-4% in CP compared to NRC rec. Crystalline AA are added to diets so that AA levels follows NRC rec	Avoid overfeeding CP. Fewer problems with enteric diseases in pigs. Reduced N in manure, reduced ammonia emission	Reduced consumption of byproducts and alternative ingredients	Moderate	Low. (Sometimes the cost of LP diets are actually lower than regular diets)	Cost offset by increased productivity and more efficient nutrient use. Should be considered a BMP
b. Low sulfur diets	Diets using no micro-minerals on sulfate form and no excess sulfur containing AA	Reduced production of H ₂ S	Some restrictions apply to the mineral sources that can be used	Moderate	Low	Should be considered a BMP
c. Phase feeding	Diets are changed frequently during the production phases to match the nutrient requirement of the pigs	Overfeeding and underfeeding with nutrients can be reduced	More diets are required on the farm	Low	Low	Should be considered a BMP
d. Precision diet formulation	Diets are formulated based on digestible contents of amino acids and minerals and the net energy content of the diets. Also, the ideal protein concept is used in diet formulation	Diets that more precisely match the requirement of the animals can be formulated. Reduction of excess nutrients in diets and thus in manure	Research is needed to establish digestible contents of nutrients in feed ingredients and the animals requirements for digestible nutrients	Low	Low	At least 3-5 years of research needed before concept can be implemented
e. Pelleting diets	All diets used in the operation are pelleted prior to use	Reduces dust generation and decreases amount of feed wasted in the manure pit	None	Low	Low (\$10/ton for mixing, this cost offset by increased nutrient digestibility)	

Table 1. Odor reduction practices for swine operations (cont.)

Section 2: Decrease Emission of Odor						
Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
a. Flush systems for manure removal	Removes manure frequently by flushing all the pits	Effective in reducing emission from pit	Increased labor, need for outside storage	Moderate	Moderate	
b. Pit systems w/ reduced manure surface	Sloped bottom of pits make sure manure surface is reduced	Reduces emission from pits	None	Moderate	Moderate	Usually combined with increased flushing
c. Oil spraying	Vegetable oil sprayed in facilities at regular intervals	Bound dust also odors present in the dust	More slicky surface	Moderate	Moderate	Reduces health risk for human workers in barns
d. Biofilters	Air exhausted through a biofilter made from organic material that captures the odors. Clean, odorless air is released.	Very effective. Simple to construct. Environmentally friendly	Building design. Aesthetics	High	Low to moderate	Odor reduced by 96% in SDSU research. Cannot be used with curtain-sided barns
e. Storage additives	Additives added to manure storage facility	Supposed to reduce odor generation	Not a proven technique	Low	High	Questionable technique
f. Rigid manure storage covers	Mechanical cover is applied to the manure storage unit	Very effective	Can be costly	High	High	
g. Flexible manure storage cover	Flexible material applied on top of storage facility. May be textile or plastic membrane or floating clay balls		Can cause problems when agitating manure, support structure may be needed	High	Moderate	Several different materials can be used
h. Biodegradable manure storage cover	Straw is applied on top of storage facilities	Inexpensive	Needs to be filled every three months. More difficult to agitate storage unit	Moderate	Low	Effectiveness highly dependent on how the cover is managed
i. Manure separators	Separates manure into a solid and a liquid fraction	Decreases odor generation from storage	Relatively expensive, only applicable to large operations	Moderate	High	More effective separators are available in Europe
k. Methane digesters	Treat waste with 3 to 10% total solids. Biogas methane production from manure	Manure treatment can decrease odor at application time. Generation of electricity can help pay for treatment costs	Costs: \$250,000 O + M = \$7,500/year Cost effectiveness dependent on contract with electrical company.	High	High	May be combined with manure separators

Table 1. Odor reduction practices for swine operations (cont.)

Section 3: Increase Dispersion of Odor						
Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
a. Shelterbelts	Create a vegetation barrier for dust and odorous compounds emitted from the building exhaust	Cost. Environment. Aesthetics	Requires planning and time	Low	Low	
b. Windbreak walls	Solid or porous wall constructed 10 to 15 feet from the exhaust fans will cause dust to settle	Rapid implementation	Cost. Aesthetics	Low	Low to moderate	
c. Setback distances	Optimize distance between odor emission sources and urban areas.	Cost.	Not applicable for facilities currently in operation	High	Variable	Effectiveness can be calculated through the OFFSET model (Univ. of Minn.)

Section 4: Land Application of Manure						
Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
a. Manure injection or incorporation	Manure injected directly into soil. Can be done in pasture or bare soil or into a growing crop	No emission of odors from manure when applied to soil	Takes more horsepower and more sophisticated equipment	Very high	Low	Should be considered a BMP