Pork Industry Handbook: Controlling Odors from Swine Buildings

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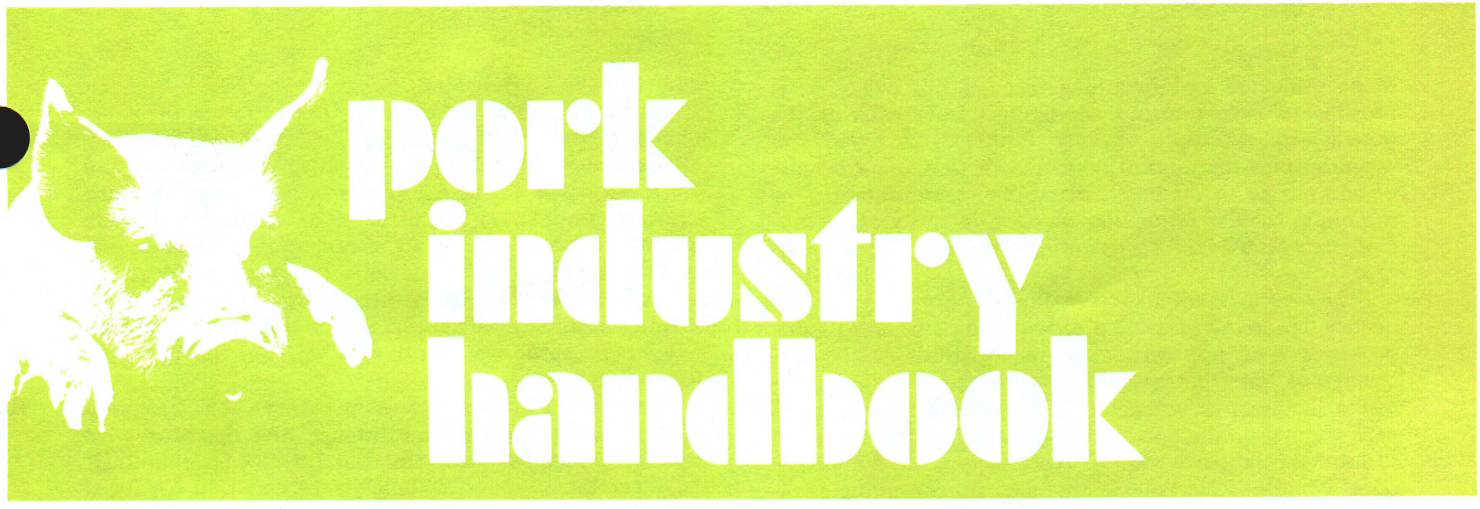


COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

# Controlling Odors from Swine Buildings

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Odor control is a significant problem for pork producers throughout the country. The problem most often consists of neighbor complaints and occasional legal actions seeking either monetary damages or court injunctions. To operate compatibly within the community and to provide maximum self-protection, the pork producer must be aware of some basic information and strategy concerning odor control and practice those techniques appropriate to the location.

Odors are primarily a subjective response; there are few universally good or bad odors. People react to odors according to their attitudes and previous experience. This factor is usable by pork producers as they maintain an image of responsibility and productivity. Operators of well-maintained and attractive facilities who have maintained a cooperative public attitude are seldom subjected to odor complaints. Odor frequently becomes an issue along with complaints of water pollution, flies, noise, and other issues when there is faulty site selection, improper facility design, or inadequate management.

Compounds emanating from swine buildings have never exceeded safe air standards and are not hazardous to humans. Under certain situations, such as manure pit agitation, however, dangerous gas concentrations can develop. Odors, therefore, are nuisance pollutants and, like other nonhazardous assaults on the environment, must be regarded accordingly. Important are intensity, duration, and frequency of detection. Within an agricultural community, it seems appropriate that livestock odors be occasionally noticed, but nuisance complaints result when intensity or frequency exceeds reasonable limits.

## Sources of Odors

Odors from swine production facilities arise predominantly from manure decomposition. Odor from fresh manure is generally less offensive than odor released when manure undergoes anaerobic or septic decomposition. The exact nature of this odor is a function of the ration fed to the animals, the animal's metabolism, and the environmental conditions under which decomposition occurs. Therefore, individual facilities can have differing odors; anaerobic lagoons have odors easily distinguishable from deep pit or scraped buildings.

Manure decomposition is not the only odor source. Rotting feed materials may also contribute an objectionable odor. Some food processing by-products fed to livestock are particularly notorious. Ensiled cannery wastes, wet whey, cooked garbage, and other decomposable materials deserve particular attention. Recognize, however, that feeding of these by-products to livestock is frequently the best use for them — thereby converting them to nutritious feeds. The cost of solving the odor problem must be balanced against the benefit of using what might otherwise be a wasted resource with its inherent environmental cost.

Other odor sources include dead animals not quickly buried or removed from the site, pesticide sprays, and manure handling facilities. Each of these odor sources can be handled by appropriate control procedures.

## Odor Measurement and Analysis

Considerable effort has gone into identifying compounds resulting from manure decomposition. These gasses, when released into the air, are the odorous constituents. Ammonia, hydrogen sulfide, skatole, indole, and the amines and mercaptans are the most common. Although there is merit in identifying these compounds as released, this help is limited in the design of an odor control program.

More usable odor measurements include *odor intensity* — more often measured in the field with a Scentometer. This device consists of a plexiglass box held in front of the nostrils so that only air which has passed through an activated carbon filter is inhaled. By standing on the site

to be evaluated and breathing through this device, it is possible to keep odorous compounds from entering the nostrils. By selectively opening unfiltered air ports, you can determine the ratio of odor-free air to dilute a volume of odorous air to the barely detectable concentration. This technique enables estimation of odor intensity. This estimate can be used in documenting changes in odor intensity.

The measurement and estimation of odor detection frequency has received widespread use for evaluating odor problems. This approach attempts to determine the percentage of time that an odor can be detected at the site where the receiver is located. For example, if a home is near a pork production operation, it might be important to estimate the percentage of time, (i.e., 5, 10, 20%), that odor would be detectable at that site. By consulting available data on wind direction and velocity, temperature, and relative humidity, it is possible to estimate odor distribution or frequency. This calculation is helpful in assessing the severity of an odor problem.

**Principles of Odor Control**

Although odors seem mysterious and difficult to manage, the principles of odor formation and control are relatively few and straight-forward. For an odor to be detected downwind, odorous compounds must be (a) formed, (b) released to the atmosphere, and (c) transported to the receptor site. These three steps provide the basis for most odor control. If any one of the steps is inhibited, the odor will diminish.

Since odorous compound formation is generally the product of biological decomposition, steps to stop odor formation generally inhibit biological activity. Moisture reduction is the most common technique. By maintaining a manure-covered surface in a dry condition (less than 40% moisture), anaerobic biological decomposition is generally halted; odors are most prevalent immediately following rainfall and when manure surfaces are allowed to remain moist over an extended period. Other inhibiters of biological activity of animal manure include chlorination, pH adjustment, and in nature, temperature control.

Although odorous compounds may have formed in manure or manure storage systems, few complaints will be registered unless these compounds are allowed to escape into the atmosphere. The most common means of inhibiting the escape of odorous compounds is covered manure storage tanks. Covering inhibits the interchange of odorous compounds between the liquid surface and overlying atmosphere. This interchange may also be reduced by altering the chemical state of the compound of greatest concern. For example, in regions where hydrogen sulfide is a major problem, the addition of lime or other alkaline material will reduce hydrogen sulfide volatility. This procedure should be tried on a small scale, however, to make certain the chemical adjustment will improve rather than worsen the odor problem.

Another means of preventing odor is inhibiting transport of manure odor from the production and release site to the area where odor control is necessary. Odor transport has been inhibited in certain locations by the installation of sprays that scrub the odorous materials from the air, and of barriers that cause more complete mixing of the odorous materials with odor-free air to achieve sufficient dilution. This approach has received only limited application with livestock production odors but is widely used in industry.

**Odor Control Techniques**

Perhaps the most critical and effective means of reducing odor complaints occurs in the initial site selection. Although it is difficult to set definitive perimeters beyond which odor will not be a problem, a pork producer must seriously consider odor control as he selects a site. Sites near residential developments, commercial enterprises, and recreational areas are particularly prone to problems. A site may be ideally suited for livestock production in terms of transportation, feed supply, and zoning regulations, but may be inappropriate because of existing or proposed development in the area.

There is a general relationship between the perception of odor nuisance, separation distance, and size of a swine production facility. For facilities of 1,000 or fewer animals the incidence of odor complaints is noticeably reduced beyond one-quarter mile. For larger units, separation distances of approximately a half mile are necessary for adequate protection.

Terrain is another factor to consider in site selection. Facilities in a confined valley are particularly prone to have odors drift down the slope with relatively little dilution. Such sites should be avoided if residences or other odor sensitive sites are downslope.

Although wind direction is important in evaluating an odor control site, most locations have winds from several directions during the year. The simple location downwind of development is not sufficient. By referring to published data, one can estimate the percentage of time the wind will blow from the odor source to the point in question and thereby make a more rational decision concerning site suitability. Where distance alone is used as the criterion, it must be expected that odors can be transported in excess of a mile downwind under appropriate climatic conditions. If these conditions are sufficiently rare and the damage is slight, this might not be an inhibiting factor toward development.

The second opportunity for reducing odor problems occurs during the design and construction of a facility. By application of odor control principles, the probability of odor can be minimized. Designing outdoor lots that are well drained, watering systems that do not flow onto the lot surface, and runoff control facilities that are remotely located from areas of odor sensitivity will achieve some odor reduction. In modern, roofed housing units the methods of manure removal from the pens, manure transport, and handling are most important for odor control. Also, animals must be kept clean and dry. Among approaches for accomplishing this are slotted floors, flushing gutters, and frequent pen scraping. Covered storage tanks control odor release from stored manure. Where treatment is required and odor control is important, aerobic systems such as oxidation ditches and floating surface aerators, although more expensive, are effective to curtail odor emissions.

The operation and management of a livestock production facility also offer considerable opportunity for odor control. Maintaining the operating systems is probably most important. Overflowing manure storage tanks, broken scrapers, leaking waterers, and ruptured retention ponds and dikes are among the most common causes of odor complaints.

Anaerobic swine manure treatment lagoons are of special concern in odor control. Properly designed and managed lagoons are not free of odors but seldom cause an odor problem. However, overloaded or shock-loaded lagoons are more likely to have objectionable odors. Where multiple-celled lagoons are used, it is important

that the cell or cells receiving fresh manure not be loaded in excess of the recommendations for your particular area. Anaerobic lagoon odors are most common in the spring and early summer when the water temperature warms and manure accumulated during the winter undergoes rapid decomposition. Another alternative is to add surface aeration sufficient to maintain the lagoon surface in an aerobic condition.

Where practical, locate lagoons as far as possible from neighboring residences, roads, and other odor-sensitive areas. Separation distances are particularly important when anaerobic lagoons are used. One helpful approach is to double the normal separation distances. This may make the selection of anaerobic lagoons inappropriate for larger (more than 1,000 head) facilities in other than the most remote sites. Shielding lagoons from view is also helpful.

Disposal techniques and timing are also important for odor control. When manure is applied to cropland, a field downwind of neighboring residences on that day is important. Morning application is more desirable than late afternoons, which limits drying time. Neighbors are generally most sensitive to odor problems in early evening when utilizing outdoor recreational facilities. When manure disposal is necessary and odor control is critical, immediate incorporation of the manure can effectively minimize odor complaints. Where soil is suitable and neighbors are particularly close, direct soil injection is a valuable technique.

**The "Extra Mile"**

The above approaches generally provide great assistance to the livestock producer in coping with complaints of neighbors. When these techniques are not suitable, further steps must be taken. Although some are experimental and have not received widespread acceptance, they are worthy of consideration. There are alternate waste treatment schemes that can be employed to reduce odor emission. These are generally more expensive but may be justified for larger enterprises or where site conditions or separation distances are such that conventional treatment systems release unacceptable levels of odor. These systems generally require more sophisticated design.

Aerobic manure treatment systems are helpful. Most common among these are oxidation ditches, aerated storage tanks, and aerated lagoons. By maintaining manure in an aerobic condition, odorous gas production is markedly reduced. For each of these systems it is important that adequate aeration capacity be provided and that management is sufficient to keep the equipment in top operating condition. Manure solids separation may be practiced ahead of each of these systems to minimize aeration demands.

Anaerobic digesters similar to those used in municipal wastewater treatment plants may be used for swine waste treatment. Anaerobic digesters represent a significant initial investment and an ongoing operational demand; however, they provide nearly complete control of the odorous gasses being released. Some cost recovery can be effected where it is feasible to use the biogas being produced to an economic advantage. Digesters do not provide complete waste treatment, thus are most commonly coupled with some means of effluent storage, either with or without aeration.

Flexible covers have been applied to anaerobic lagoons in situations where odor control is essential. These covers prevent uncontrolled escape of odorous gasses. The collected gasses may be burned or subjected to subsurface soil absorption. Lagoon covers require careful design to avoid premature weather damage and allow convenient gas removal.

Air scrubbing equipment to reduce odor levels within swine buildings has been studied and has been adopted in some European buildings. It is not currently manufactured in the U.S.A. Most building designers have been able to control odors within their units by other means.

Odor control chemicals are widely available. Little data exist concerning the effectiveness of most of these materials. Some have been effective under specialized conditions; others have been disappointing. The cost of using odor control chemicals is highly variable, but generally they are an expensive alternative. Liquid products are quoted at $10-20 per gallon and solid forms at $1-15 per pound. It is important that a trial be conducted with the control chemical to make certain it operates to your satisfaction before you buy large quantities.

Odor control chemicals are generally one of four types. *Masking agents* have an odor stronger and, it is hoped, more pleasant than the odor being masked. These chemicals may be applied by aerial spray or directly to the odor source. They are best used intermittently and only when anticipating severe problems. After prolonged use, neighbors may find the masking agents more offensive than the original odorous compounds. Odor-masking agents are perhaps the most predictable and generally the most effective of the odor control compounds.

*Odor counteractants,* are materials that interact with odors and result in less odor intensity. Owing to the great variability in odorous gasses these compounds have had limited success.

Laboratory and limited field trials with *odor absorption chemicals* provide some encouragement. These materials are most successful when the absorbent powder or granule can be applied to a solid surface to prevent the escape of target gasses.

*Enzymatic products,* designed to alter the biological pathways involved in manure decomposition, are available for odor control. Again, only limited data are available on these materials, and their success has been erratic.

Other techniques include perimeter spray systems and windbreaks to disperse the odors and shield the livestock enterprise from direct sight. These and other approaches may be tried where odor control is especially critical and the additional cost can be justified.

An important "extra mile" effort involves being a good neighbor and trying to influence your neighbor's attitude in a positive way. Practice good public relations by sharing some of the good things from your farm with neighbors. As an example, one pork producer treats neighbors to some whole hog ground pork at Christmas, plants extra sweet corn, has a neighborhood whole hog barbecue, and contributes to worthwhile community projects.

Additional information can be found in the following PIH fact sheets:

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| PIH-21 | *Systems of Runoff Control* |
| PIH-35 | *Legal Guidelines for Swine Waste Treatment* |
| PIH-62 | *Lagoon Systems for Swine Waste Treatment* |
| PIH-63 | *Flushing Systems for Swine Buildings* |
| PIH-67 | *Swine Waste Management Alternatives* |
| PIH-76 | *Methane Gas from Swine Manure* |
| PIH-91 | *Pumping Liquid Manure from Swine Lagoons and Holding Ponds* |
| PIH-95 | *Gravity Drain Gutters for Swine Manure Systems* |
| PIH-105 | *Scraper Systems for Removing Manure from Swine Facilities* |

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