What a Veterinarian Should Know About Swine Confinement

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year. It would really be something to be able to build a herd of cows in one year with each of them producing over 20,000 pounds of milk a year.

I have gone through a few of the advantages of this embryo implantation concept, but of course there are a few disadvantages. The Alberta clinic had an initial investment of $200,000 to get going with this program illustrating that capital would be necessary for private practitioners to get started. The surgery and technology are complex, but a non-surgical approach for successfully implanting embryos is possibly within reach in a few years. Overall, this is a concept that could offer as much to the cattle industry as A.I. if its exploited to its fullest extent.

BIBLIOGRAPHY

What a Veterinarian Should Know About Swine Confinement

by

Charles L. Christenson*

The veterinarian’s role in the food animal industry has changed significantly in the last few years. Instead of treating sick animals on an individual basis, he is called upon to establish herd health programs and consult with swinemen on their problems no matter what phase of their hog management is involved. With the trend toward confinement hog rearing, veterinarians in the Midwest are sometimes perplexed by the rapidity with which the industry is changing. Whether entering the swine industry for the first time or trying to maintain their position as a leading pork producer, swinemen today are confronted with the question of what type of facility is best for their operation. With a confinement set-up the producer can double his production volume with existing labor and free land for crop production that is presently tied up with pig production. As a swineman views the problem or newness of a confinement operation, he must decide whether he is going to remodel old facilities in making the shift or does he plan to construct a completely new physical structure in keeping up with the trends and needs. Many pork producers today want to know if the gases emitted from their confinement pits are toxic to their pigs and thus curtailing increased output. Also a big question is how will the new confined environment affect his disease problem.

The starting point is first to decide on a waste management system for your operation. Anaerobic lagoons, aerobic stabilized systems, and a new aerobic solid-liquid separation system are the three basic methods being used to process swine wastes.

Processing wastes by anaerobic decomposition in lagoons has come under criticism by environmentalists due to their extensive odor production.

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**The Anaerobic Process**

organic solids
↓
Short chain fatty acids
anaerobic bacteria
(methane formers)
$\text{CO}_2 + \text{CH}_4$

The bacteria involved in anaerobic decomposition are dormant in winter, and these facultative organisms become active quickly in the spring causing odor production. Increased amounts of fatty acids, especially butyric, are causing the odor. Reduced solids accumulation resulting in cleaning the lagoon every 7-8 years, very low energy input—no aeration, and the need for a lagoon with only small surface area and an increased depth of at least 12–20 feet make the anaerobic system particularly advantageous.

Aerobic stabilized systems are basically odor free, but the disadvantages are many. The aerobic lagoons are difficult to maintain in the winter with ice and foaming problems causing poor aeration. The problem with odors in the spring due to new bacterial propagation is a low-intensity, short-lived problem when compared to anaerobic systems. The need to insure an adequate oxygen source to aerobic organisms results in a large energy need for mechanical aeration equipment. Poor digestion of plant cell wall fragments like corn husks leads to the need for regular cleaning of solid material in aerobic lagoons. The bacteria in an aerobic system prefer soluble organic compounds as their source of nutrition when contrasted with anaerobes which hydrolyze, putrefy, and liquefy insoluble organic compounds as well.

The newest concept in waste processing is the aerobic solid-liquid separation and treatment system. With this system you need some type of settling basin to partition solids and liquids. The main drawback with this system is knowing what to do with the solids. Solids can be disposed by composting (quite expensive), piling and later land spreading, and refeeding. The ultimate disposal of any solid-liquid waste, treated or untreated, will be on land.

Agronomists agree that 250 pounds of actual nitrogen per acre is the maximum allowable from waste spreadings. The waste from 50 pigs per acre or the equivalent bovine waste (5 steers per acre) is within the present nitrogen tolerance limits. Phosphorous may be a limiting factor as a residue in land spreading of wastes. Excess selenium may also be a problem in some dryer areas. At present no efficient chemical means exists to treat waste. Incineration of wastes is not feasible either.

Many types of structures are available for the different stages of a pig's life cycle. For detailed information, contact the Agriculture Engineering office at ISU. Conventional farrowing stalls with twice a day combined exercise and feeding periods fit the smaller diversified livestock producer best. A large semi-slatted farrowing house used in combination as a nursery after farrowing to keep young pigs isolated for a strong start is quite popular with a strictly swine enterprise.

During the growing-finishing period, total slats have been popular in recent years, but are declining due to high cost ($60–$70 per pig capacity), ventilation problems, and a noted decline in pig performance as they hit the 125–150 pound range. The poorer performance is due primarily to inadequate ventilation. Gas production is somehow hindering growth. Enclosed facilities with partial slats are not recommended. A minimum of 40 per cent of the finishing area in slats is required if partial slats are used. Several types of slats including new perforated plastic, wood, steel, concrete, and aluminum slats are available. Wood slats are less abrasive than concrete slats, but have a life span of only 4–5 years. Steel slats corrode too quickly. A wide slat (6–8 inches) of the above materials with a one inch gap between slats adapts well.

A new confinement concept in the growing finishing period is the use of the flushing gutter facility. This unit has long narrow pens with a one per cent slope to a gutter running lengthwise along both sides of the house. The dunging gutters are about 30 inches wide and 4–6” deep sloping to the end of the building where the
effluent drains into a lagoon. The solids settle out and the lagoon water is recycled and used as flushing water for the dunging gutters. The flushing gutter system is not valid without recycled water. In Illinois one producer reported high nitrate levels in recycled water from his aerobic system. In the winter the nitrifiers do not function, but they become quite active in the summer. Another problem with recycled water is the reproduction of two types of enteritis in one operation. A closed herd with no feeder pigs brought in is a must for the flushing gutter approach. The ISU nutrition facility houses 700 pigs in a 140' x 60' building which uses 30 gallons/hour/100 pigs to flush the system. Advantages like cutting ventilation needs in half, needing little supplemental heat, and saving ten dollars per head pig capacity over a total slatted facility makes the system appear quite attractive. With this system a producer could go into his existing facility and convert it quite economically to a flushing gutter system. Pigs are kept spotlessly clean with this concept. Social behavior of the pigs is crucial. Floor feeding and the placing of waterers by the dunging channel is essential to this idea. Since running water and communication with other pigs enhances dunging, a permeable type of barrier in the gutter between pens is recommended. Pigs will not dung in feeding or sleeping areas so the long narrow pens and floor feeding keeps the pens clean and dry.

Many producers are caught with poorly functioning existing facilities and cannot afford to shift to the newer structural concepts. Several options are available to this producer, but remember to remove the manure from the building before processing it. For barns having pits under slats, more oxygen in the effluent will help alleviate the odor. Most researchers feel that the oxidation ditch cannot handle our high density waste with all the residual, undigested corn kernels and high fecal output of full-fed finishing swine. Too much horsepower is needed to agitate effluent to keep it in suspension and aerate it at the same time. The best advice is if possible to land spread waste and change your ventilation so that air is pulled in from outside sources in the roof area of the house, circulated down to the pits, and exhausted through vents near the surface of the effluent keeping harmful gases from reaching the pigs.

If a confinement facility is properly ventilated, a producer will have no problem with toxic gases. Poor ventilation can lead to decreased pig performance and possible death.

The most lethal gas present is hydrogen sulfide (H₂S) formed from the decomposition of organic matter containing sulfur. The gas is soluble in water and does not cause severe problems until manure pits are agitated to force the solids into suspension for better liquid spreading on open fields by slurry wagons. Fatalities occur rapidly after an exposure of 400 p.p.m. in swine. In cases where this amount of gas is inhaled, pigs may only take a few breaths before succumbing. The respiratory system fails and artificial respiration is not beneficial in H₂S intoxication. On necropsy the tissues are cyanotic with the lungs being edematous and gray. Deaths in swine have been reported from slatted floor finishing operations after a brief period of agitation in which the hydrogen sulfide concentration reached over 1,000 p.p.m. in the house.

Since methane is lighter than air, it tends to accumulate near the ceiling or in the upper corners of tightly enclosed manure pits. Methane is not considered a real toxic gas, but high concentrations can produce an asphyxiating environment. Concentrations of up to 1000 p.p.m. are tolerable in swine. If too many large particulate solids are present in manure, methane forming bacteria cannot play a real big role in anaerobic decomposition, thereby slowing the process. Researchers in Holland have reported that high levels of CH₄ increase the susceptibility of pigs to turbinate atrophy.

Ammonia is a colorless gas with irritating fumes and a pungent odor. It is lighter than air and highly soluble in water. Even though ammonia is soluble in water, protein is continually hydrolyzed in a pit from the NH₃ saturated excreta causing contin-

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ual release of the gas into the environment. At 100–200 p.p.m. ammonia can cause sneezing, salivation, lack of appetite, and pigs express their irritation by shaking their heads and extremities. Prolonged exposure may make the pigs more susceptible to respiratory disease and turbinate atrophy, but under most conditions discomfort in the pigs is the only obvious affect of this gas. 12

Carbon dioxide is another gas considerably heavier than air and highly soluble in water. Most of the gas in bubbles emanating from stored liquid manure, from lagoon or oxidation ditches is CO₂. Growing-finishing swine can tolerate concentrations of CO₂ up to 200,000 p.p.m. for 1 hour. Failure of ventilation equipment caused by power failure is the most common cause of CO₂ toxicity developing. Some Holland research has indicated that a buildup of CO₂ can increase tailbiting. 8

Carbon monoxide is not produced by bacterial decomposition, but several cases of CO poisoning have been reported to the Iowa State Veterinarian Diagnostic Laboratory this winter. The usual situation is complete death of unborn litters from sows exposed to high levels of CO in farrowing houses. Apparently the gas is transferred transplacentally to the young pig causing lethal affects without producing clinical signs of toxicity in the mother. Incomplete combustion of hydrocarbons caused by inadequate ventilation in tight buildings produces the excess CO. The tissues and the blood of the young pigs become cherry-red which serves as an immediate aid in diagnosis. 9

Flame ionization and gas chromatography are methods used to identify complex gases. These tests are not feasible to use on the farm. Transportation of atmospheric samples from confinement houses to regional labs is difficult and many of these labs are not set up to do these routine single analyses on a day to day basis. 2

Fixed gases such as CO₂, CH₄, and H₂S can be detected and measured with simple color indicator tubes available on this campus. Color change indicates type and quantity of gas present when a given volume of air passes over the impregnated paper. Exact levels can not be measured this way, but comparative levels between locations and systems can be established. This type of analyses gives the producer information which may enable him to improve his ventilation system if needed. Predictions of how a producer's disease problems will evolve in confinement are difficult to make. If a person is a good manager in a conventional operation, he probably will have little problems in confinement. One obvious condition seen in many pigs on slats or solid concrete is what appears to be some type of arthritis. Arthritis caused by trauma to joints from confinement may be difficult to differentiate on live observation from erysipelas or mycoplasma arthritis. Susceptibility to some forms of infectious arthritis appears to be genetically controlled, so it is advisable to consider the history of breeding stock that you bring into your herd. Strongly boned crossbreeds of the landrace, yorkshire, and hampshire breeds with proper leg action and conformation adapt well to confinement. Pasture rearing seems to have a higher incidence of PPLO arthritis caused by Mycoplasma hyosynoviae. Part of the explanation for this phenomena is that sows are carriers of PPLO arthritis, but they do not transmit the disease to the young pigs until they are 7–8 weeks old. Since pasture-reared pigs are more widely dispersed, the young have no immunity built up and if they are exposed again around ten weeks of age they will break with the disease, unlike confinement reared pigs which undergo a mild infection due to their immunity. Greater management fluctuation plus a wide variety of surface types like muddy or frozen ground intensifies the arthritic problem. 10 Abrasions from concrete or slatted floors increases the prevalence of strep arthritis in baby pigs. 9

Respiratory disease problems are intensified with confinement. The respiratory tract has an extremely large surface area and irritation of this tract by gas and small dust particles may amplify an infection such as mild pneumonia. Some research indicates that the high humidity of con-
finement houses may have a beneficial affect by reducing the incidence or severity of some respiratory diseases. The speculation that some gases like NH₃ and CH₄ causing possible atrophy of the turbinates leading to secondary invasion by bacteria needs further investigation. There is evidence that a bronchitis may develop as an allergic reaction to fine particulate feed dust in confinement operations. Mycoplasma hyopneumonia appears to be a greater problem in confinement systems. Closer contact causes greater transmission. The environment varies, but stress may make pigs more susceptible. Humidity and temperature may influence severity. No difference in the frequency of Mycoplasma hyorhinis infections has been noted in the two systems of raising swine.

In young pigs from birth to six weeks old, diarrhea, once started, can be a real intense problem in confined swine. Some confinement systems appear to be naturally propagating disease problems. Hot water heating of concrete floors may eliminate part of the scours problem. T.G.E. appears to have no greater occurrence in confinement systems. In rearing young pigs, try to:

1. Keep the pigs warm and dry.
2. Keep the pigs clean at all times.
3. Insure an adequate milk supply to all pigs.
4. Use some supplemental heat to keep the pigs from underneath the sow.

In the last few years the most costly diseases of swine have been those affecting reproduction. Whether confinement rearing of pigs and the increased fertility problems of the swine industry are correlated needs more research. It may be that these developments just evolved at the same time. Pasture breeding of sows and gilts is recommended with confinement. The conception rate of sows bred in confinement appears to be lower.

The management of swine in confinement is no small task. The importance of the veterinarian as a liaison between the farmer producer and the researchers at our universities cannot be overlooked. New advances in swine management practices are advances for the industry only if they are put to effective and beneficial use on swine farms across the state. The veterinarian, pork producer, and all people in the swine industry are working toward one goal—efficiency in supplying America's pork needs.

**BIBLIOGRAPHY**


**CORRECTION**

The oral electrolyte formula intended for maintenance of hydration in diarrheic calves published in Vol. 33, No. 3, page 156 of the *Iowa State University Veterinarian* was incorrect. The formula as previously published was:

- Sodium chloride 117 gm.
- Potassium chloride 150 gm.
- Sodium bicarbonate 168 gm.

The correct amount of glucose for the amount of electrolytes given is 5000 gm., not 500 gm. Fifty six grams of the electrolytes-glucose powder is then added to each liter of water. This will provide 5.7 grams of the electrolyte mixture and 50 grams of glucose per liter. We regret the error.

Potassium phosphate 135 gm.
Glucose 500 gm.