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NON-MECHANICAL VENTILATION OF SWINE FACILITIES

by

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Swine facilities must be ventilated to control heat, moisture, dust, odors, pathogenic organisms and irritating, noxious or toxic gases. Our goal is to provide healthful conditions for animals and personnel and to control deterioriation of structural components and equipment. Given the widely varying climatic conditions of the central and northern plains states there is no system capable of fully satisfying all desirable aspects of a ventilation system. Consequestly, producers must select the system which best fits their management abilities and goals with the most acceptable set of compromises.

Both mechanical (with fans) and non-mechanical (without fans, also called natural) ventilation systems are widely used in modern swine installations. Non-mechanical ventilation (NMV) systems have been used extensively to ventilate dairy and beef facilities for many years. Increasing installation, operational, and maintenance costs and the advent of the modified-open-front (MOF) building (both gable and monoslope roof designs) for swine production have led to increased interest in NMV among swine producers. This paper is intended to set forth some of the more important design and operational requirements and techniques of NMV systems in swine installations. Extensive experience during the past 20+ years has shown that NMV systems are very appropriate for swine growing/finishing buildings. More recently, since 1979, NMV has been shown to be a viable option for swine nursery/grower units. Still more recently, since 1984, NMV has been used to provide ventilation of two MOF farrowing houses in Nebraska. The use of NMV systems in breeding/gestation facilities--especially those with individual crates--is still being evaluated but shows much promise.

In describing ventilation systems which do not require fans, the author prefers "non-mechanical ventilation" over alternative terms found in the literature (natural, gravity, etc.) to help emphasize the importance of design and management. Few people would argue that many poorly designed mechanical ventilation systems have been installed. Many others have been poorly managed. Unfortunately, the same statements apply to non-mechanical ventilation systems.

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BASIC REQUIREMENTS

The basic purpose of any ventilation system is to replace low quality air with fresh high quality air. Poor quality might be the result of contamination by any of the items listed in the opening sentence. Too often the effectiveness of a ventilation system is judged by air quality in the people zone -- 4 to 5 ft. above floor level. A more accurate assessment of ventilation system performance can be achieved by evaluating air quality in the animal zone -- 1 to 3 ft. above floor level.

The ventilation system must allow for variations in airflow as needs change due to seasonal climatic variations or animal numbers and size. In all cases the ultimate goal is to maintain animal zone conditions in the range of optimum feed intake and utilization and to maximize animal performance. The conditions provided must not pre-dispose the animal to stress, poor health or secondary infections and illnesses. This can be achieved by distributing the air to prevent "dead air" spaces without creating drafts. Excessive air velocity reduces the effective temperature ("wind chill" effect). Such air currents are considered a "draft" anytime they produce an undesirable side effect or reaction in the animal. Hovers are an effective way to allow animals with different metabolic rates and reactions to air currents and temperatures seek out conditions where they are most comfortable. Healthy comfortable animals perform well, are less susceptible to infections from opportunistic organisms and lead to maximum profits.

In designing and managing a ventilation system a basic principle to remember is that all ventilation systems require air inlets and air outlets. Except with large openings, air cannot simultaneously enter and exit through the same opening. Recognition of that single fact would eliminate many of the problems encountered with installations across the U.S. A second principle is that a cold environment with low relative humidity is far more healthful than a warm humid environment.

DESIGN REQUIREMENTS

While it is not my goal to de-emphasize the importance of total production system design, there are basic components of different building styles which are necessary to assure manageability of the finished installation. The listing which follows can be used as a basic checklist for design and troubleshooting.

A. Gable roof building

1. Roof slope--4:12, east-west orientation

2. Roof line--insulated; plastic vapor barrier; smooth finish (no protruding beams); no ceiling

3. Ridge opening--continuous full length of building; 2 inches of opening width per 10 ft. of building width; equipped with device to allow partial closure under adverse weather. Ridge opening should never be closed completely.

4. Eave openings--continuous full length of building; one eave with single row of pens or both eaves with two rows of pens; 1 inch of opening height per 10 ft. of building width; equipped with device to allow partial closure under adverse weather especially if building is on an exposed site. Eaves should never be closed completely.

5. Sidewall openings--continuous full length both sides; 2 ft. minimum clear open height; increase height of panel (or curtain) opening by 1 ft. for each 10 ft. of building width over 20 ft.; insulated panels (with interior curtain for mild weather if desired) on north wall; insulated panels or double curtain on south wall.

B. Monoslope "Nebraska" style MOF

1. Orientation--high side towards south (±20°)

2. Roof slope--2:12 minimum, 2 1/2:12 preferred; 3:12 for nurseries and farrowing

3. Building "depth"--28 ft. preferred; 30 ft. maximum; 24 ft. for nursery/grower and farrowing.

4. Roof line--insulated; plasic vapor barrier; smooth finish; no protruding beams for roof slopes less than 2 1/2:12

5. North wall--3 inch baffled eave inlet for early spring and late fall; continuous panels at least 2 ft. clear opening for summer

6. South wall--3 inch baffled air outlet at top of wall (be sure flashings and fascia do not restrict continuous upward airflow pattern); minimum of 4 ft. clear opening for summer; with top opening curtain, provide air inlets within 32 inches of floor or add deflector to direct incoming air down towards dunging area; with bottom opening curtain start opening within 32 inches of floor level.

7. Controls--provide separate controls on south wall ventilation panels or curtains for growing and finishing parts of building

8. Partitions--provide partition from north wall out to gutter or slats between growing and finishing units. If either resultant section is less than 40 ft. in length, provide openable panels in partition to reduce ventilation problems in pens adjacent to partition during warm weather.

SUMMARY

Good design will allow an energy effecient non-mechanical ventilation to be used in buildings for any phase of swine production. Good design also results in an easily managed system capable of providing healthful conditions for the pigs year-round. Good management means healthy pigs, efficient production and improved profits.

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