Ventilation Systems for Swine Production

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Ventilation Systems Affect:

- Air temperature
- Moisture level
- Air temperature uniformity
- Air speed across animals
- Airborne dust and disease organism levels
- Odor and gas concentrations
- Combustion fumes from unvented heaters
- Moisture condensation on surfaces
How Important is Ventilation?
Actual Case in Hamilton County

• 30 % death loss
  – Cohorts at ½% death loss

• Complete new ventilation system
  – ½% death loss

• 200 pig nursery – losing 60 pigs/turn
  – Worth $35 each - $2100 loss each turn
  – Paid for in one turn
Negative-Pressure Ventilation Systems

• Exhaust fans
• Air inlets
• Controls

• Total [HVAC] system
  – Heaters
  – Evaporative cooling

Vacuum or “negative pressure”
Terminology

- **cfm:**
  Cubic feet of air exhausted per minute

- **fpm:**
  Air speed in feet per minute

- **inches of water:**
  Static pressure (difference between indoor and outdoor air pressure)
# Recommended Ventilation Rates (MWPS)

<table>
<thead>
<tr>
<th>Category</th>
<th>Minimum</th>
<th>Hot weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sow &amp; Litter</td>
<td>20 cfm/sow</td>
<td>500 cfm/sow</td>
</tr>
<tr>
<td>Nursery 12-30#</td>
<td>2 cfm/pig</td>
<td>25 cfm/pig</td>
</tr>
<tr>
<td>Nursery 30-75#</td>
<td>3 cfm/pig</td>
<td>35 cfm/pig</td>
</tr>
<tr>
<td>Finishing 75-150#</td>
<td>7 cfm/pig</td>
<td>75 cfm/pig</td>
</tr>
<tr>
<td>Finishing 150-250#</td>
<td>10 cfm/pig</td>
<td>120 cfm/pig</td>
</tr>
<tr>
<td>Gestating</td>
<td>12 cfm/sow</td>
<td>150 cfm/sow</td>
</tr>
<tr>
<td>Breeding</td>
<td>14 cfm/sow</td>
<td>300 cfm/sow</td>
</tr>
</tbody>
</table>
Example Design: 500 head nursery

- Pigs enter at 12 lbs, exit at 60-70 lbs.
- Minimum Ventilation
  - 500 pigs x 2 cfm/pig = 1000 cfm
- Maximum Ventilation
  - 500 pigs x 35 cfm/pig = 17,500 cfm
- Steps between?
Choosing Exhaust Fans
## Fan Test Data

<table>
<thead>
<tr>
<th>Static pressure in. H2O</th>
<th>Speed rpm</th>
<th>Airflow cfm</th>
<th>Efficiency cfm/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>1,642</td>
<td>2,150</td>
<td>9.2</td>
</tr>
<tr>
<td>0.05</td>
<td>1,638</td>
<td>2,020</td>
<td>8.5</td>
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<tr>
<td>0.10</td>
<td>1,635</td>
<td>1,840</td>
<td>7.7</td>
</tr>
<tr>
<td>0.15</td>
<td>1,653</td>
<td>770</td>
<td>3.5</td>
</tr>
<tr>
<td>0.20</td>
<td>1,641</td>
<td>650</td>
<td>2.8</td>
</tr>
</tbody>
</table>

BESS Lab
Fan Types

Pit Fans

Wall Fan

Pit Fans
# Example Fan Selection

<table>
<thead>
<tr>
<th>CFM goal</th>
<th>Fan No.</th>
<th>Model</th>
<th>CFM rating</th>
<th>Control Method</th>
<th>Total CFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 to 1500</td>
<td>1</td>
<td>14” Acme</td>
<td>2030</td>
<td>VS</td>
<td>2030</td>
</tr>
<tr>
<td>4000</td>
<td>2</td>
<td>14” Acme</td>
<td>2030</td>
<td>VS or SS</td>
<td>4060</td>
</tr>
<tr>
<td>8000</td>
<td>3</td>
<td>20” Del Air</td>
<td>4210</td>
<td>SS</td>
<td>8270</td>
</tr>
<tr>
<td>17,500</td>
<td>4</td>
<td>36” Airstream</td>
<td>9900</td>
<td>SS</td>
<td>18,170</td>
</tr>
</tbody>
</table>
Fan Layout

- 20 pens of 25 pigs
- 8’ by 10’ pens
Air Inlets
Primary Roles of Air Inlets

• Distribute air throughout room as intended
• Help maintain desired conditions in animal zone [microclimate]
Proper Air Distribution at Minimum Airflow Rate

End view of room
Figure 3. Air Intake Velocity and Static Pressure Relationship

Velocity, Feet per Minute (fpm)
Manometer
(measures static pressure)
Air Inlet Open on One Side
Inlet Layout

- Maximum 18,000 cfm
- Need 15 inlets rated at 1200 cfm each
- Use 16
Attic Air Intake

• Port of entry for fresh air
• Must be *effective* opening
Attic Opening Needed

• Attic air intake (sq. ft.) = total hot-weather ventilation (cfm)/400 fpm

• Said another way…
  – Provide 1 square foot of opening for every 400 cfm of airflow

• Example: Given 18,000 cfm
  – 18,000 cfm/400 = 45 sq. ft. of opening
Unacceptable Air Intake
Inlet Layout

- 350 btu/hr-pig
- ~175,000 btu/hr
- Use 2 heaters
Controller
1 Variable-Speed & 3 Single-Speed Fans
Heater offset [1.5 °F] ensures heater is off when 1st stage fans are functioning
Tunnel Finishing
Tunnel – Pit Fans
Tunnel Endwall Curtain
Tunnel – 300 fpm “wind”
Inlet Openings
Ventilation Curtain
Curtain Controller
The Right System?

• Tunnel
  – Creates a “fake” wind
  – More Fans
  – More Electrical Usage
  – Cooling Potential
  – More Prescriptive Management
  – Backup Needed

• Curtain Sided
  – Uses natural weather patterns
  – Curtains vs Fans
  – More LP Usage?
  – Calm Days Difficult
  – Transition Difficult
  – Curtain Drops
Questions??

Good Resource for further information:

www.mwps.org