An Online Confined-Space Manure Ventilation Design Tool Using SolidWorks Flow Simulation

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What is the Online Tool?
1. An online, web-based computer simulation program for custom designing manure pit safety ventilation systems
2. For manure pit designers and field engineers
3. Can simulate stand-alone manure pits
4. Can simulate airflow through barns with manure storages located underneath
   • Tunnel, natural, or mechanically cross ventilated barns
Assumptions
1. Simulation based on ideal conditions – gas monitoring is still necessary!
2. Assumes uniform initial gas concentrations throughout manure pit
3. Assumes only air in the barn airspace above
4. Assumes the manure pit is empty (less than 6 inches of manure remaining)
5. No pit agitation, no gas generation

How does it work?
1. You enter airflow parameters, initial gas concentrations, and critical dimensions for the manure pit and barn
2. The Online Tool configures a 3D Computer Aided Drafting (CAD) model based on your input
3. Computational Fluid Dynamics (CFD) simulation is performed using your CAD model and the airflow parameters you entered
4. Results are generated for your simulation

What can you do with it?
1. Easily create many different configurations of manure pits and barns
2. Run CFD simulation for the pit + barn to determine how long the pit must be ventilated to evacuate toxic gases, and whether hazardous conditions will exist in the barn airspace
3. Perform “what if” scenarios for different manure pit safety ventilation system configurations
Online Ventilation Design Tool

- Makes it possible to quickly configure many combinations of common pit shapes and features:

<table>
<thead>
<tr>
<th>Shape</th>
<th>Cover</th>
<th>Obstructions</th>
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Examples of some simple pit configurations created using the online tool:

- Online Ventilation Design Tool

We also need to consider the airflow from the ventilated barn above the pit:

- Online Ventilation Design Tool
Login required for access

Simple data entry using web interface

Rated or measured air flow rate

The presentation is archived at:
http://articles.extension.org/pages/21819/chronological-webcast-archive
Optional Pit Features

Multiple Outlets

Slotted Flooring
Cross-Ventilated Barn

Naturally-Ventilated Barn

Attached buildings

Naturally-Ventilated Barn

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http://articles.extension.org/pages/21819/chronological-webcast-archive
Endwall Doors

Obstructions

Running the simulation

Click to solve when finished. Simulations may take several hours to solve depending on size and complexity of geometry.
User will receive email notification when simulation is complete. Log in to website to view your results.
Simulation Results

Simulation Results

Simulation Results
Simulation Results

Example animated results for H$_2$S

Manure Pit H$_2$S Gas Decay Curve

This is NOT at a single point

T$_{pel}$ = Time required to reach PEL (Permissible Exposure Limit)

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Manure Pit H$_2$S Gas Decay Curve

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Online Tool Training Videos
https://ventdesign.agsafety.psu.edu
Click on link Information about this online tool

- Introduction and Logistics
- Module 1: Overview
- Module 2: Standalone Manure Pits
- Module 3: Tunnel-Ventilated Barns above Manure Pits
- Module 4: Cross-Ventilated Barns above Manure Pits
- Module 5: Student Project 1
- Module 6: Naturally-Ventilated Barns above Manure Pits
- Module 7: Student Project 2

Questions or comments?