

**The Effect on Odor Emissions when Sprinkling Oil for Dust Control inside Pig Buildings
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Introduction

Odors generated from pig production units are a major concern for individual producers, their neighbors, the general public, and the pork industry. The sources of odors from production systems include: the buildings and facilities, the manure storage(s), and the period when manure is spread onto cropland. In the upper Midwest, odor from pig farms has been presumed to come only from the manure storage units. However, there is good evidence showing odor also is emitted from the buildings housing the pigs. A survey study determined that more odor complaints were received during a year that originated from building sources than from manure storage units.

Airborne dust is a major cause of poor air quality inside pig housing facilities. The poor building air quality has resulted in both human and pig health concerns. Since suspended dust particles can and often do absorb toxic and odorous gases, the reduction of the airborne dust concentrations inside the building may also lower odor and gas emissions into the atmosphere from these same pig housing units.

Objective and Project Description:

A study to evaluate the odor and gas reduction potential of sprinkling soybean oil for airborne dust control inside a pig nursery was done during the winter of 1997/98. Measurements of odor, gases, and dust concentrations were made and compared between a treatment and a control pig nursery facility.

Research Procedure

This study was done at two side by side off-site modular pig nursery buildings at the West Central Experiment Station (WCES) of the University of Minnesota in Morris, MN. The two barns or rooms were loaded with pigs at the approximately the same time, operated for six weeks per trial, and then emptied together as one group. Pigs weighed about 15 lbs. when entering and approximately 50 lbs. at the end of the stay. One barn or room was used for the oil treatment and the other unit as a control for two groups of pigs.

The treatment barn had soybean oil sprayed in the barn using the dosage suggested by the MWPS-AED-42 publication entitled "Sprinkling Oil to Reduce Dust, Gases, and Odor in Swine Buildings". Specifically this was 0.12 oz/ft² for the first 2 days, 0.06 oz/ft² for the next 2 days, and a 0.015 oz/ft² "daily maintenance level" for the remaining days that the pigs were in the rooms. For this sized facility, capacity of 180 piglets, the maintenance level was slightly more than a cup of oil. One day every two weeks a "surge" amount of 0.06 oz/ft² would replace the maintenance level. This spraying dosage program began the next day after the groups of pigs were put in the barns. The oil was sprinkled in the barn with a hand held commercial paint

sprayer during the “morning chores” and distributed as evenly as possible throughout the room, including pens and walk alleys. After the first few days, oil sprinkling in the walkways was stopped because of concern over worker safety with the floor becoming too slick. The oil application took roughly 10 minutes per room. No sprinkling of oil was done in the control barn.

Odor, gas, and dust measurements were made once a week in the treatment and control barns, starting approximately 4 to 5 days after oil sprinkling began in the buildings. Air samples were collected in a 10-liter tedlar bag each week from the ventilation exhaust air and inside the barns for odor measurement with an olfactometer (trained odor panel) at the odor laboratory in the Biosystems and Agricultural Engineering building on the St. Paul campus of the University of Minnesota. Hydrogen sulfide (H₂S), ammonia (NH₃), and carbon dioxide (CO₂) were measured from these same air samples with either an electronic (Jerome™) meter or colorimetric tubes. Total, inspirable, and respirable dust concentrations were measured using gravimetric (weighing filters before and after sampling) methods. The odors, gases, and dust room data were all collected over an approximate 6 hour time period (10 to 4 PM). The odor and H₂S fan data was a grab sample taken in the afternoon after the room samples were collected. Environmental parameters (temperature, moisture content, and fan operation) were monitored continually in both rooms using a data logger with remote data transfer via a cellular phone. Daily gain, feed intake, and feed efficiency were determined for the pigs during both trials.

Results:

The pig performance data for the two trials are summarized in Table 1. The nursery pigs performed well in the two barns for both trials. The treatment room did have a lower ADG and G/F in the first trial but during the second trial performance was almost identical as measured by ADG and G/F. Mortality was low, around 1 % for both barns in trial 1 and 3% and 0% for the control and treatment rooms for trial 2.

Table 1. Pig performance in both trials

| Trial/room | Trial 1 / oil rm. | Trial 1/control rm. | Trial 2/ oil rm. | Trial 2/control rm. |
|-------------------|-------------------|---------------------|------------------|---------------------|
| # of pigs in room | 100 | 155 | 166 | 158 |
| ADG, lbs. | 0.81 | 1.05 | 0.82 | 0.82 |
| G/F | 0.43 | 0.63 | 0.55 | 0.55 |
| Mortality, % | 1.0 | 1.3 | 0 | 3.2 |

The weekly odor, gas, and dust measurements collected, during both trials, are listed in Table 2. The dates of the first trial were Dec. 22, 1997 to Jan. 19, 1998 the second trial were from Feb. 9 to Mar. 9, 1998.

Table 2 Odor, gases, and dust levels from the two pig nurseries barns, oil treatment and control

| Date | Odor Units o.u. | H2S ppb | Ammonia ppm | CO ₂ ppm | Total Dust mg/m ³ | Inspirable mg/m ³ | Respirabl e mg/m ³ | Odor Units o.u. | H2S ppb |
|---------------|--------------------|------------|----------------|------------------------|---------------------------------|---------------------------------|-------------------------------------|--------------------|------------|
| Control | | | | | | | | | |
| | Room | Room | Room | Room | Room | Room | Room | Fan | Fan |
| 12/22/97 | 245 | 380 | 6 | 3000 | 1.568 | 2.924 | 0.716 | 277 | 430 |
| 12/29/97 | 191 | 280 | 10.5 | 2500 | 2.914 | 3.649 | 0.299 | 393 | 250 |
| 1/5/98 | 552 | 300 | 15 | 3700 | 4.717 | 5.215 | 0.862 | 463 | 350 |
| 1/11/98 | 419 | 210 | 7.5 | 4600 | 5.236 | 4.633 | 0.623 | 816 | 500 |
| 1/19/98 | 668 | 180 | 6 | 3500 | 5.113 | 7.118 | 0.694 | 341 | 230 |
| 2/9/98 | 449 | 460 | 21 | 4800 | 2.489 | 2.757 | 1.023 | 337 | 460 |
| 2/16/98 | 684 | 510 | 10 | 2500 | 3.928 | 4.15 | 0.651 | 651 | 590 |
| 2/23/98 | 738 | 730 | 10 | 2200 | 3.558 | 3.625 | 0.161 | 741 | 690 |
| 3/2/98 | 762 | 880 | 5 | 2100 | 3.449 | 2.819 | 0.387 | 1101 | 670 |
| 3/9/98 | 157 | 160 | 3 | 2900 | 4.297 | 5.875 | 0.709 | 174 | 170 |
| Oil Treatment | | | | | | | | | |
| | Room | Room | Room | Room | Room | Room | Room | Fan | Fan |
| 12/22/97 | 202 | 200 | 11 | 2500 | 0.534 | 0.979 | 0.621 | 112 | 260 |
| 12/29/97 | 131 | 170 | 10 | 2000 | 1.274 | 1.569 | 0.154 | 278 | 150 |
| 1/5/98 | 54 | 30 | 11 | 3100 | 1.255 | 3.063 | 0.468 | 79 | 49 |
| 1/11/98 | 70 | 35 | 11 | 3900 | 2.146 | 1.908 | 0.439 | 262 | 105 |
| 1/19/98 | 280 | 63 | 8 | 3900 | 1.061 | 2.549 | 0.329 | 420 | 56 |
| 2/9/98 | 129 | 200 | 15.5 | 3700 | 0.512 | 0.035 | 0.965 | 165 | 200 |
| 2/16/98 | 190 | 380 | 16 | 3500 | 0.024 | 1.417 | 0.241 | 377 | 330 |
| 2/23/98 | 448 | 390 | 12 | 2500 | 0.502 | 0.748 | 0.461 | 536 | 450 |
| 3/2/98 | 923 | 580 | 6 | 3000 | 1.047 | 0.493 | 0.263 | 500 | 350 |
| 3/9/98 | 237 | 200 | 7 | 2900 | 3.169 | 3.522 | 0.585 | 222 | 150 |

Pigs were placed in the two rooms for each trial at two or three different times from 4 to 7 days apart. Thus the pigs in both trials had a 1 week age differential. Although oil application started as soon as the first pigs were placed in the south room, collection of data was not begun until both rooms were filled. Since these trials occurred in the winter time, only a continuously running exhaust fan (variable speed) was used to provide ventilation air. Room temperatures were set at approximately 85 °F at the start of the trial and were decreased about 2 °F for every week of the trial. Air exchange rates per animal were similar for both rooms as seen by the carbon dioxide concentrations in Table 1.

The odor levels measured in both trial 1 (figure 1) and 2 (figure 2) show an overall reduction in odor units of the air in the oil treatment room compared to the control room. Trial 1 shows a consistently lower level of odor as measured by the odor panel and expressed as odor units (o.u.) with an average odor level of only 150 o.u. for the oil treatment and an average of 400 o.u. for the control. Trial 2 revealed lower odor units in the air collected in the treatment room compared to the control for the first 3 sampling times but not for the last two weeks. Odor units for both rooms were relatively high during the week 4 sampling and fairly low for the last week collection in trial 2. It is unknown why the odor levels changed so much during the last two weeks of trial 2 and why the oil treatment did not seem to be effective. There may have been some weather effect since this did coincide with a warming trend.

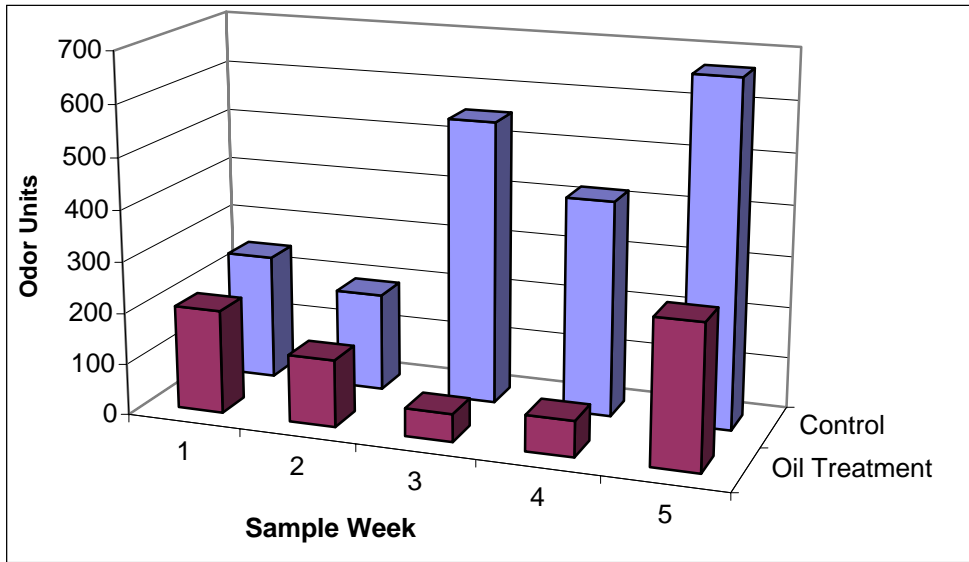


Figure 1. Odor levels during trial 1

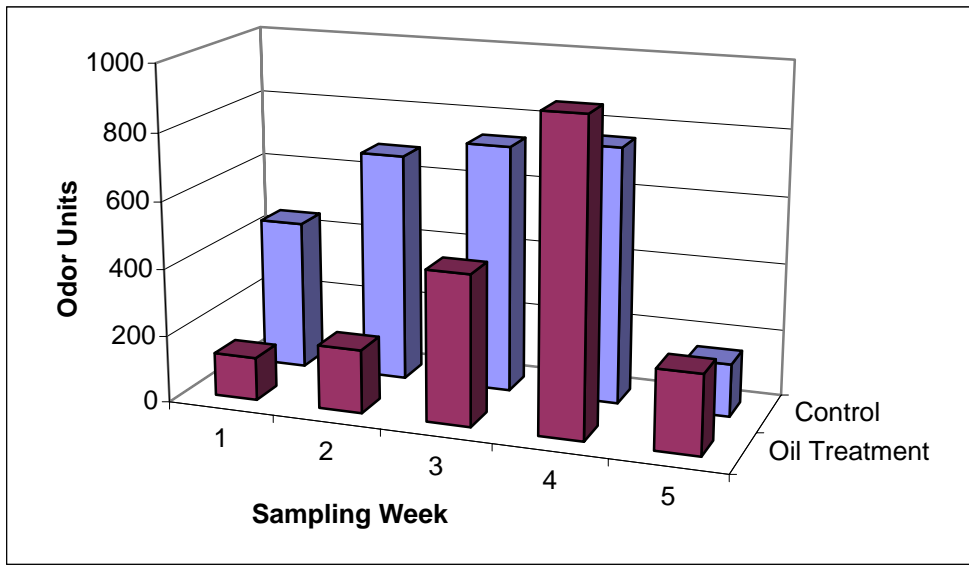


Figure 2. Odor levels during trial 2

The sprinkling of oil in the pig nursery barn did not have the same effect on individual gas concentrations as it did on odor levels. Hydrogen sulfide (H_2S) levels were reduced in the rooms sprinkled with oil as shown in figures 3 and 4 for trials 1 and 2 respectively. Average H_2S concentrations in the oil treatment rooms were 100 and 350 ppb for trials 1 and 2 respectively. The comparable H_2S levels in the control rooms were 250 ppb (trial 1) and 550 ppb (trial 2).

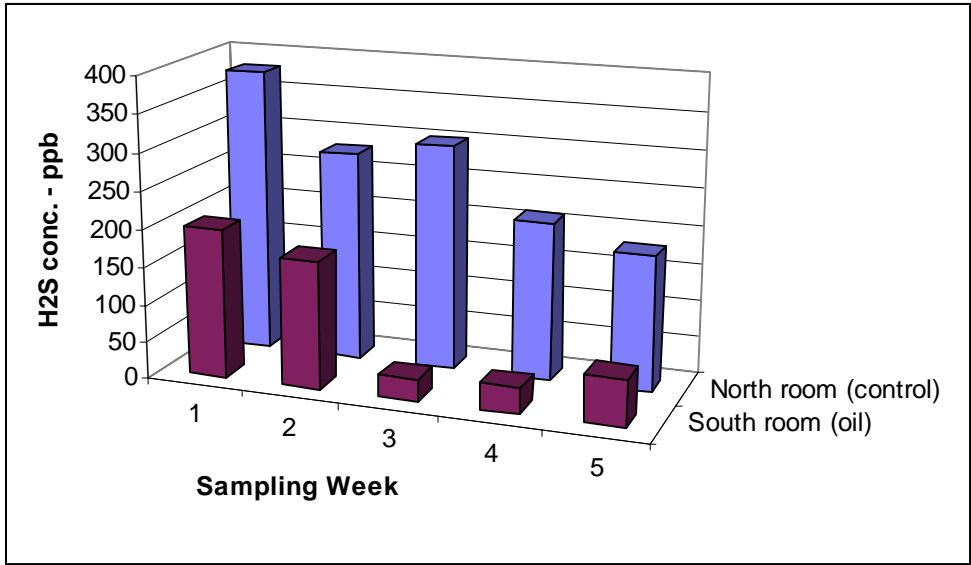


Figure 3. Hydrogen Sulfide concentrations in rooms during trial 1

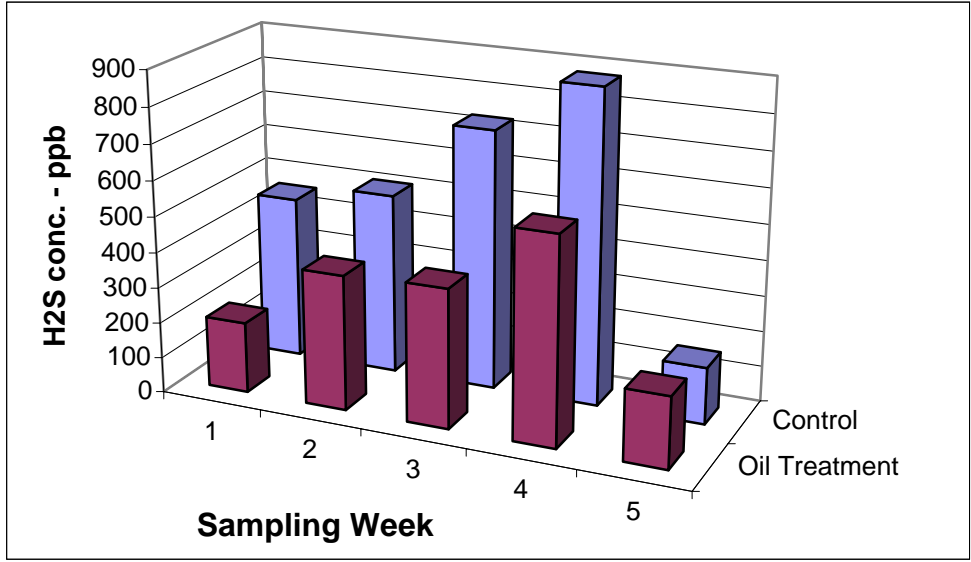


Figure 4. Hydrogen Sulfide concentrations in rooms during trial 2

Ammonia however, was not reduced by the oil treatment as seen in figure 5 for trial 1. The oil treatment room had an average NH₃ concentration of 10 ppm while the control room had an NH₃ level of 9 ppm. A similar response occurred during trial 2 with the control room recording an average NH₃ concentration of 10 ppm and the treatment room at 11 ppm.

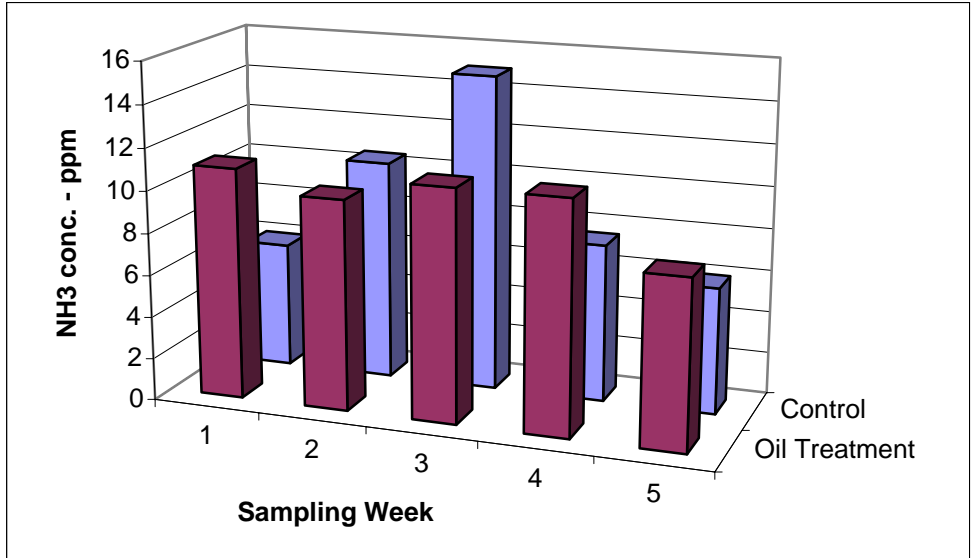


Figure 5. Ammonia concentrations in rooms during trial 1

Total and inspirable, portion that is inhaled by a person, dust concentrations (mg/m^3) were reduced due to oil sprinkling in both trials. Figure 6 shows, for trial 2, that dust levels in the oil treatment room (average of $1 \text{ mg}/\text{m}^3$) was only about 25 % of the dust concentrations in the control room (average of $4 \text{ mg}/\text{m}^3$). Respirable (fraction that reaches the human lung) dust levels however, did not follow this trend, showing somewhat similar concentration for both trials in the control and treatment rooms (figure 7). Reasons for the inconsistent results are difficult to determine but may be related to the fact that once-a-day sprinkling may only reduce the large particulate (feed and fecal) materials and not smaller airborne particles present inside and outside.

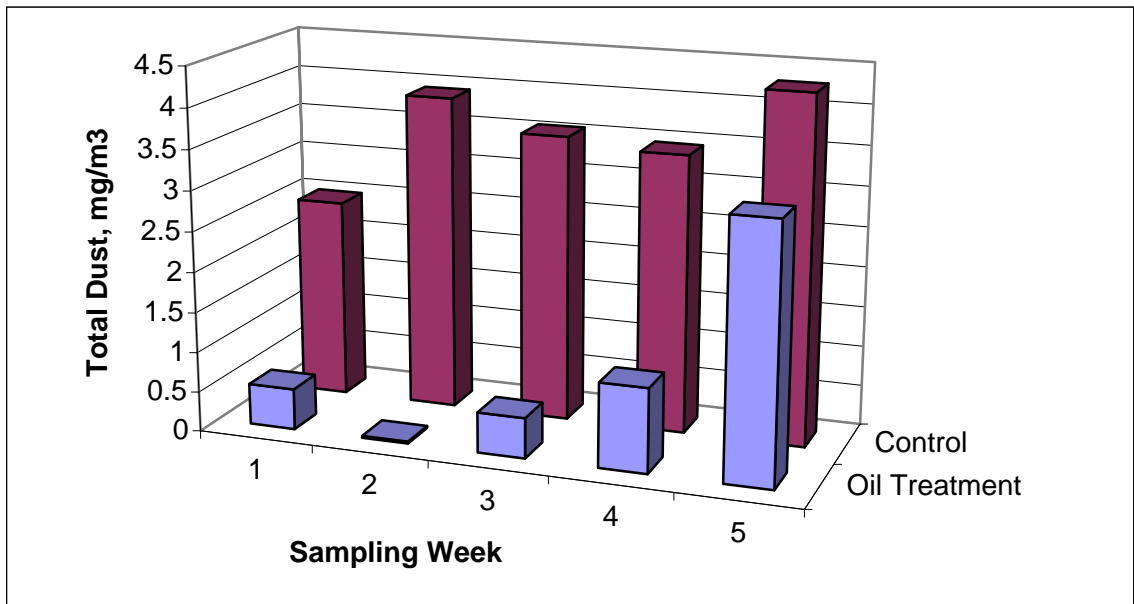


Figure 6. Total dust concentrations in rooms during trial 2

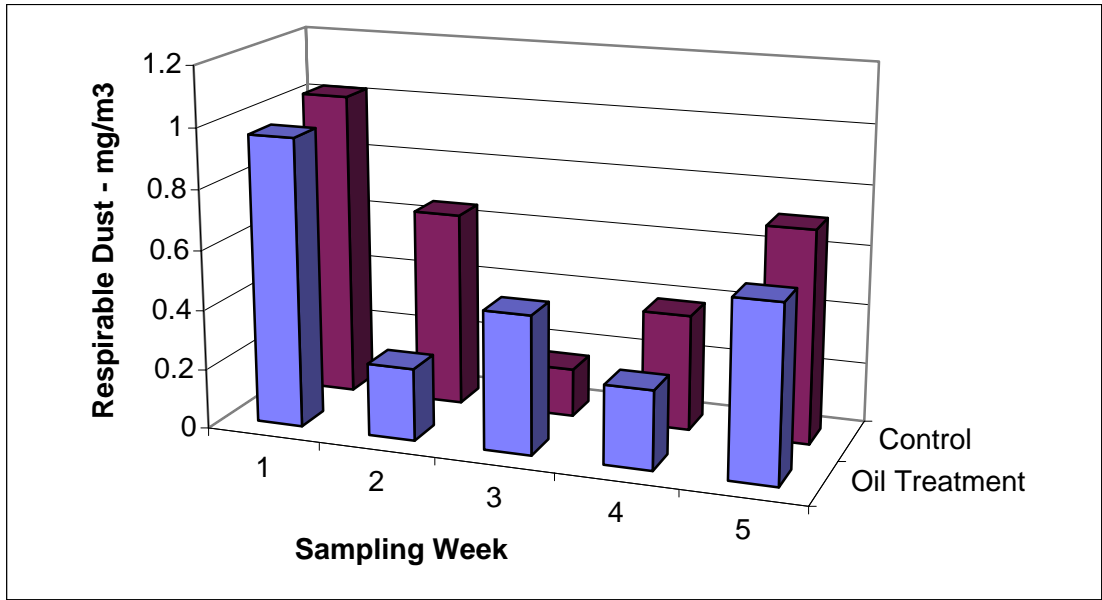


Figure 7. Respirable dust concentrations in rooms during trial 2

Also, the odor and H₂S measurements collected from the exhaust air during both trials, showed similar trends to those same airborne components collected in the rooms. That is, the oil sprinkling treatment reduced odor and H₂S emissions. Approximate emission rates could be calculated from these odor and gas concentrations and from the continuous measurements of air exchange rates during both trials.

It was also determined during the study that it took extra labor and effort to clean the oil treatment room compared to the control room after each group was moved out of the respective buildings. A presoak feature was added to the washing protocol, which did help with the clean up of the facility but did add to the wash time between pig groups.

Summary

Daily sprinkling of very small amounts of vegetable (soybean) oil inside a pig nursery facility reduced the odor, H₂S, and total dust levels of the air inside the barn and in the emission or exhaust ventilation air. Oil sprinkling, as outlined in MWPS-42, was not as effective in reducing ammonia concentrations or respirable dust levels inside the treatment barn when compared to a similar control barn.

Based on these results, future work is needed to demonstrate the consistent effectiveness of using this practice as an odor control technology. Oil sprinkling may be more appropriate for naturally or curtain ventilated pig facilities that have deep pit manure storage or other livestock units that are not fan or mechanically ventilated. Such buildings cannot use other odor control technologies like biofilters or other ways to treat or filter exhaust air.