

Bio-filter effectiveness on Ten-Stall Farrowing Building Pit Exhaust a Demonstration Project

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Summary and Implications

A demonstration project at the Kirkwood Swine Facility at Kirkwood Community College in Cedar Rapids is pleasing to both smell and sight. A biofilter was designed for the exhaust system at the college's 10-stall farrowing house to decrease odors and blend in visually with the surroundings. The biofilter was successful in reducing the pit fan odor to a smell of fresh turned soil. The biofilter design was acceptable to the college and facility manager.

Introduction

The idea of using a biofilter is to cut down or eliminate the odor from the pit exhaust fans. The pit fan from this farrowing house blows directly to doors from the shower and personal changing room for the facility. Because of the hog facility on campus and site location, the bio-filter needed to blend in with its surroundings. The objective of this project is to demonstrate the effectiveness of a bio-filter on farrowing room exhaust.

"Odors from livestock facilities are an issue for many communities and livestock producers. Odor sources for livestock production systems include buildings, manure storage, and land application of manure. Most complaints have focused on emissions from outside manure storages. Therefore, the current trend in swine production is to use deep pit manure storage beneath the slatted floor in the livestock building that then becomes the major odor source. Biofiltration is an odor reduction technique that can be adapted to reduce emissions from these mechanically ventilated facilities" (1).

After consultation with Richard Nicolai of the University of Minnesota's Biosystems and Agricultural Engineering Department his recommendations were used when designing this biofilter. The recommendations are available in a document called Biofilter Design Information at <http://www.bae.umn.edu/extens/aeu/baeu18.html>.

Results and Discussion

Building the biofilter wasn't a difficult process and the cost is relatively low when comparing other odor reducing techniques. It took three people a total of five hours to construct the biofilter. This demonstration project is a bit more costly because we chose to build a "box" to contain the biofilter material for its visible on-campus location.

Picture 1: Base of biofilter being constructed.



In picture 1, the Kirkwood biofilter base is made of a plywood floor and 2x6 boards on end. In picture 2, the 2x6 boards are covered with quarter-inch mesh wire. The fan housing and biofilter plenum is being attached. The building pit air is forced into the space below the mesh and through the biofilter material between the 2x6 boards. The wire mesh keeps the wood chips and compost material from falling into the area where the exhaust air enters the biofilter. In picture 3, the seams are caulked and a 12-inch strip of landscape plastic (6 inches up the side and 6 inches on top of the mesh wire) is placed around the bottom of the box. This is to keep the air from "escaping" up the side. The plastic forces the air away from the edge and into the filter. The plenum acts like a chimney to push the air through the filter material. Current biofilter material includes wood chips, composted horse manure, woodchips, and cornstalks. The mixture will vary according to what is available and how much moisture is contained within the material itself.

Results and Discussion

On a farm design, there wouldn't necessarily be a need for sides. Pallets could be used and covered with 1/2" mesh wire. A plenum could be constructed of plywood to distribute the air under the pallets and up through the

compost material. For best results about 75% compost and 25% wood chips should be available at little or no cost.

Picture 4 shows the filter being loaded with a mixture of 75% compost and 25% wood chips. The reason for the wood chips is to prevent compaction of the compost. The Biofiltration process involves bacteria and fungi that live on the media surface. “As the exhaust air passes by this biofilm on the media, the bacteria eat or oxidize the odorous gasses. Therefore, a biofilter is not like a dust filter, which fills up and must be cleaned; instead, it is a living ecosystem of microorganisms that continually feed on odorous gases. To support this living ecosystem, a biofilter needs the correct moisture content, oxygen level, temperature, and food source to stay alive” (2). This design requires about 1 inch of water sprinkled over the top per week. Learning how much moisture the biofilter requires is more experience than knowledge. The filter needs to stay moist, but over-watering causes the compost to compact. Compaction will not allow enough airflow through the biofilter. Cornstalks were added when the filter was over-watered, compaction occurred and airflow was severely restricted. Adding the cornstalks and mixing the filter material allowed the biofilter to again function properly.

Picture 2: Plenum being attached to exhaust fan housing.



Brennenman suggest a good rule of thumb is that you need about one square foot of biofilter material for every 10 cubic feet per minute (cfm) of ventilation. Your exhaust fan will need to operate against a higher static pressure when you're using a biofilter. This means your fan should be able to provide adequate airflow at least 0.25 inches and preferably up to 0.5 inch of static pressure. Replacing your fan with a more powerful one is where the cost comes in for a producer. However the specifications on your fan should be obtained to see if it would be adequate. Fan replacement cost is estimated at \$350-400.

Picture 3: Plastic inside filter forces air away from sides.



Picture 4: 75% compost and 25% wood chips added to the biofilter.



As shown in picture 5, the biofilter continued to work during the winter. No moisture is added in the winter, because the building generates enough humidity to keep the biofilter working properly.

Picture 5: Snow melted off in winter from exhaust heat.



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References

1. Nicolai, R. E. and K. A. Janni. 1997. Development of a Low Cost Biofilter on Swine Production Facilities. ASAE Paper No. 97-4040. St. Joseph, MI: ASAE.
2. Nicolai, R.E. 1998. Biofilter Design Information BAEU-18, Department of Biosystems and Agricultural Engineering University of Minnesota. <http://www.bae.umn.edu/extens/aeu/baeu18.html>