

Understanding Bedding Materials for Compost Bedded Pack Barns

By: Jeffrey Bewley, Ph.D.



"I can't get enough sawdust for my compost bedded pack barn. What can I use?"

Dairy producers, extension agents, and industry professionals have been asking us this question frequently. Certainly, reduced sawdust availability and increased sawdust demand have contributed to this concern. The current economic slowdown and resulting decrease in construction have contributed to less sawdust being available. At the same time, more dairy producers are housing their cattle in compost bedded pack barns. This has created a major headache for many dairy producers. Unfortunately, since this is a relatively new housing system, we still have more questions than answers about what will work and what won't work for bedding materials in compost bedded pack barns. Most of our knowledge has come through discussions with University of Minnesota dairy researchers Dr. Marcia Endres and Dr. Kevin Janni and Kentucky dairy producers.

Understanding Composting

First, we need to have a basic understanding of the composting process. Composting relies on microorganisms to break down organic matter and produce carbon dioxide, moisture, and heat. In a compost bedded pack barn, the manure and urine released by cattle provide the essential nutrients (carbon, nitrogen, moisture, and microorganisms) needed for composting. Composting is an aerobic process, meaning that oxygen, provided by adequate air flow and aeration, is required for success. Thus, how well the compost bedded pack works depends on maintaining the appropriate balance of oxygen, moisture, temperature, amount of organic matter, and size and activity of microbial populations. As long as the proportions of carbon, nitrogen, oxygen and moisture are balanced, the microorganism population will thrive and produce sufficient heat to dry the pack and kill pathogens, viruses, fly larvae, and weed seeds. In fact, the temperature of the pack provides a good indication of the level of microbial activity taking place. Ideally, we would like to see the temperature of the pack beneath the surface between 130 to 150° F, indicating that organic materials are broken down fairly rapidly. When the temperature is below this range, the composting process is too slow, but when it is above this range even the beneficial bacteria, necessary for composting, are killed. Temperatures near the surface of the pack will be closer to ambient temperature.

Moisture, provided by manure, urine, and microbial activity, content of the pack should be between 50 to 60%. When moisture is too low, the microbes won't have enough water, the compost will be too cool, and the rate of composting too slow. If moisture levels are too high, the pack becomes anaerobic (lack of oxygen), rate of microbial decomposition will slow, and the composting will again be too slow. A simple moisture check is to grab a handful of compost and squeeze it in your hand. If you can squeeze water out, the pack is too wet, but if you can't form a ball, the pack is too dry. When the pack is working well, the bedding material will appear loose and fluffy. On the other hand, compacted and chunky bedding material typically indicates that the pack is not working well. Generally, you will observe higher temperatures when the pack is fluffy because air promotes microbial activity whereas

compaction and excessive moisture will reduce temperatures. Although more challenging to measure on a practical bases, two other measures are C:N ratio (ideally between 25:1 to 30:1) and pH (6.5 to 8.0). If you can smell ammonia in the barn, the C:N ratio is likely below 25:1.

Bedding material requirements can be reduced if the compost process works. A producer should monitor management practices to determine if the composting process is working properly. The first principle of success relies on good stirring or turning of the top 8 to 12 inches of bedding. A tillage implement with sweeps that is mounted behind tractor wheels is the optimum configuration. This strategy increases stirring/aeration and prevents compaction of the bed. Compaction reduces aeration resulting in lower compost bed temperature which will then lead to higher moisture with the negative impacts already discussed. The second principle is good ventilation and circulation of air in the barn. Ventilation removes heat and moisture while circulation prevents the occurrence of hot or cold spots which impact both the compost bed and the animal comfort and maintain all areas of the compost bedded barn to be equally useful for the cows.

What Works

Researchers and dairy producers from Minnesota suggest that dry, fine wood shavings or sawdust, preferably from pine or other softwoods, are the bedding materials of choice in compost bedded pack barns. They theorize that such fine, coarse material provides a large surface area to volume ratio, is easier to till, and absorbs and holds liquids well. The size of bedding particles is particularly important for regulating microbial access to the food source. Additionally, shavings or sawdust have enough structure to be able to be easily stirred and remain fluffy enough to assure oxygen transfer within the bedding material. At the same time, the high lignin content of these wood materials provides some resistance to microbial breakdown which makes it last longer. Although kiln dried sawdust is preferred, as long as the moisture content for sawdust entering the compost bedded pack is less than 18%, the pack will perform well. Most green sawdust, though, is generally too wet.

In early research studies from the University of Minnesota, finely processed corn cobs and soy or flax straw, ground through a 3/4" screen, have also performed well. Some producers have reported success with wheat and rye straw, though others have reported that these materials do not work well. Using corn cobs or any type of straw, it is absolutely essential that these products are finely processed. Such fine materials may be used in a mix with sawdust to stretch sawdust supply. Some innovative producers are allowing the composting process to continue by stockpiling material after the pack is cleaned out for more complete composting. Then, this dry product is re-introduced to the pack along with new sawdust to stretch the sawdust supply. Used horse bedding has also worked well for some producers, though it is important to make sure the product is dry enough before being used.

What Doesn't Work

Sand and lime are inorganic materials; thus, they will simply not compost. Bedding materials with larger particle size do not work well at all. Corn stalks, waste hay, and oat, barley, and wheat straw tend to support bacterial growth and retain too much water. Difficulties may be observed in stirring and aerating the pack or creating a pulp with these bedding materials. Minnesota researchers indicated that corn stalks do not retain the structure necessary for proper stirring and composting. Though we have not heard experiences of producers using tobacco stalks, we are concerned that lack of structure would present a similar limitation. Paper and cardboard also do not have much structure and would absorb too much moisture to work well. The waxy coating of wheat straw makes it more

difficult for microorganisms to penetrate and less capable of moisture absorption. Among wood products, cedar should be avoided because it contains oils and organic materials that inhibit the microbial activity necessary for composting. Black walnut has been shown to cause laminitis in horses, though there is no research to support this theory in dairy cattle.

Moving Forward

As we indicated, we are still learning about what works and doesn't work in compost bedded pack barns. We are also interested in finding viable alternatives to sawdust or shavings. The best way for you to check whether something you are trying is working is by measuring the temperatures of the composting material. If the temperatures are in the 130 to 150° F range, the process is working. If not, you may not be killing the disease and mastitis causing organisms like you should be. If you have new ideas or would like to explore alternatives in your barn, please contact us (jbewley@uky.edu and jtaraba@bae.uky.edu) and share your thoughts.