

## Practice Guideline: How to Use Biochar in Barns



### Why Use Biochar in Barns?

Biochar can do a great job of reducing ammonia and other odors in barns, stables and poultry houses. There are other benefits too:

- Biochar is very effective at capturing nitrogen (N) that is otherwise lost to ammonia volatilization.
- Ammonia creates unpleasant odors in the barn, and harms the respiratory health of creatures who breathe it.
- As ammonia volatilizes, the nitrogen it contains is lost to the atmosphere. If retained, this N could have fertilized fields.
- As N is lost, phosphorus (P) is concentrated in the manure. When manure is applied at the appropriate rate for N, too much P is added to soil where it can leach into groundwater and contribute to environmental problems.
- Along with odor and ammonia reduction, biochar leads to fewer flies and pathogens, for improved animal health.

Biochar can be added to manure after it is cleaned from barns, but by then, it is often too late to maintain the N:P balance because too much N has already been lost. The most efficient process is to use biochar directly in the barn where it can capture nitrogen from urine and manure as it is generated. For even greater impact, biochar can be acidified in order to increase its ability to capture N. See below for some methods to acidify biochar.

### How to Use Biochar in Barns

A manure pack in the barn can be managed or unmanaged. An unmanaged pack is simply the accumulation of manure and bedding in the barn that is cleaned out at regular intervals. A manure pack may also be managed to accelerate composting in the barn. Typically this is done by a combination of acidifiers to prevent ammonia volatilization and regular rototilling of the pack to create more aerobic conditions for composting.

There is another, perhaps easier way to degrade manure in the barn that can avoid the work of rototilling. Pioneers in Asia have used a different decomposition pathway to digest manure in barns. This anaerobic pathway is based on lactic acid fermentation, the same process that produces pickles, yogurt and silage. It differs from anaerobic putrefaction by producing organic acids,

alcohols, sugars and other beneficial substances rather than ammonia, hydrogen sulfide and other harmful substances. The process requires moisture control and degradable carbon and it produces a low pH.

Scientists at the University of Hawaii developed a dry deep litter system for pig barns in Hawaii that is based on traditional Korean farming practices. The system uses at least 60 cm of high carbon bedding material mixed with charcoal and cinders. It is inoculated once with indigenous microorganisms (IMO), which include lactic acid bacteria. No tilling or stirring is required. Farmers using the system report healthier animals, almost no odors and no flies. Biochar is an essential part of this self-composting manure pack which can remain in place for up to a decade before cleaning. The lactic acid inoculant also serves to acidify the biochar and increase its effectiveness in absorbing ammonia. Ammonia tends to volatilize at a pH of around 9, yet biochar can have a pH of around 10.

We recommend EM-1 (Effective Microorganisms), a commercially available microbial inoculant that is available from several manufacturers in the US. EM-1 includes a consortium of species along with the lactobacilli. Some of these are facultative anaerobes, that is, they can survive either with or without the presence of oxygen by altering their metabolism. For more information about EM-1, where to get it and how to use it, see the Resource Links below.



Biochar packed into 55 gallon drums is fermented with bokashi (made from wheat bran, EM-1 and molasses) for several weeks, lowering its pH from 9.5 to about 6. The white growth on top is beneficial filamentous bacteria.

### **A Protocol for Using Biochar in a Dairy Goat Barn**

Willow Witt Ranch has a small herd of dairy goats. The goat barn has a manure pack that builds up over several months between cleanings. Along with some straw bedding, goats drop some of their alfalfa feed onto the floor as they eat. We tested two methods of applying biochar to the bedding. Both were effective.

#### **Method #1**

- Make biochar and crush to ¼" minus
- To lower pH and inoculate with microbes, prepare 10 gallons of bokashi (wheat bran inoculated with EM-1) and mix with 16 oz. of molasses diluted in two gallons of water.
- Mix bokashi and biochar on a tarp
- Pack mixture into 55 gallon drums to ferment for several weeks
- Sprinkle one 5 gallon bucket of inoculated biochar per 100 sf of barn area, once a week



## Method #2

- Make biochar and crush to ¼” minus
- Spread biochar to dry
- Sprinkle one 5 gallon bucket of dry biochar per 100 sf of barn area, once a week
- Use a dust mask while spreading dry biochar
- Make a solution of activated EM-1
- Spray one quart of EM-1 solution per 100 sf on bedding surface, once a week



After six months of adding biochar and EM-1 spray in the goat barn, ammonia odor is gone, even when digging into the pack.

## Biochar Is Also Helpful in the Barnyard

If you have outdoor pens and yards with manure that get wet and mucky, use biochar in those areas to help absorb the odors and moisture. No need to crush biochar to small particle sizes as you would for barn bedding, because the animals will crush it with their hooves and mix it with the muck.



Chunky, uncrushed biochar is perfect to add in the barnyard. In this cattle barn, animals have tracked biochar out into the yard where it helps control muck.

## Do Your Own Experiments

Every barn is different. Depending on the type and number of animals, the bedding, and other factors, your barn may need more or less biochar to control moisture, odors and pests. Take a look at the resources listed below for more information.

## Resources for More Information

### General information on biochar in barns:

The Natural Farming Concept: A New Economical Waste Management System for Small Family Swine Farms in Hawai'i: Most Frequently Asked Questions on the IDLS Piggery.  
<https://scholarspace.manoa.hawaii.edu/bitstream/10125/33209/1/LM-23.pdf>

Making Waste Our Greatest Resource, by Paul Olivier  
<http://www.esrla.com/pdf/landfill.pdf>

Use of Bamboo Charcoal to Remove the Bad Smell of Manure  
Food and Fertilizer Technology Center  
<http://www.ffc.agnet.org/library.php?func=view&style=type&id=20110801174821>

Biochar: Helping Everything from Soil Fertility to Odor Reduction  
<http://ecofarmingdaily.com/biochar-poultry-farming-unexpected-uses-biocarbon/>

Ohio Heifer Center recycles manure, saves \$800,000 on bedding  
<https://www.progressivedairy.com/topics/manure/ohio-heifer-center-recycles-manure-saves-800-000-on-bedding>

### Information on bokashi, EM-1 and other inoculants:

EM-1 Application Manual – this will tell you how to make activated EM-1 and bokashi  
[http://www.7springsfarm.com/content/EM1\\_APPLICATION\\_MANUAL.pdf](http://www.7springsfarm.com/content/EM1_APPLICATION_MANUAL.pdf)

Natural Farming Hawaii – Odorless Pig Technology <http://naturalfarminghawaii.net/learn-natural-farming/odorless-pig-technology/>

An introduction to Asian Natural Farming  
<https://www.echocommunity.org/en/resources/d8397abc-c85f-47a8-96a3-a25c6660e3a5>

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