

Principles of Composting Pig Waste in American Samoa



Basics of Composting

Composting is a natural process where bacteria and fungi decompose organic material in a predominantly aerobic environment. During the composting process, microorganisms break down organic materials such as pig waste into a stable mixture called compost. The compost resembles humus, and is an ideal soil amendment.

Under controlled conditions, composting is usually done in two stages, primary and secondary composting. In the primary stage, a high rate of biological activity results in rapid composting and high temperatures in the pile. This is where most of the organic breakdown occurs. The secondary stage has lower biological activity resulting in slower composting and lower pile temperatures. The secondary stage allows the compost to complete the biological activity and stabilize, also called curing.

While composting occurs naturally, the process requires proper conditions to occur rapidly, minimize odor generation, and prevent nuisance problems. Conditions that must be controlled in the composting process are the material mix, moisture levels, porosity, and temperature.

Material Mix

The proper compost mix requires both carbon (C) and nitrogen (N) at the proper C/N ratio. The proper C/N ratio will result in a composting process that generates little odor, yet offers an environment where microorganisms can flourish. Generally, a C/N ratio that is higher than 25:1 is satisfactory. Most waste materials like pig waste, have a C/N ratio that is too low to compost. In order to compost the pig waste, amendments that contain a high C/N ratio must be added. Plant materials such as wood chips, sawdust, or coconut husks are ideal amendments for on-farm composting. **TIP:** *If your piggery bedding or compost bins start having foul odors, that is an indication that carbon material like wood chips needs to be added.*

Moisture Levels and Porosity

Proper moisture levels and a stable porous structure for the composting mass are two other conditions required in the mixture of materials for proper composting. Like all living things, bacteria need water. To encourage bacterial growth and rapid composting, the mixture should be 50 to 60% moisture. If the mixture feels moist, yet when a handful is squeezed no water drips from it (*hand moisture test*), the mixture probably has adequate moisture.

Second, the bacteria that are encouraged to grow in a compost pile are aerobic (require oxygen). Open spaces must be maintained to provide oxygen and allow air to penetrate

and move through the pile. Ideally 35 to 50% of the pile volume would be small open spaces to allow air through the pile.

Temperature

The aerobic bacteria that are of interest for the composting process grow at two temperature ranges: mesophilic bacteria (middle temperature bacteria, up to 100°F), and thermophilic bacteria (high temperature bacteria, up to 155°F). As the bacteria begin to break down the materials in the pile, heat is generated and the pile heats up. As the pile warms up, different bacteria will flourish with higher temperatures. As temperature increases, the mass of composting material will be more active and be broken down faster. Above 155°F, the rate of composting will decrease as bacteria are inactivated, or even destroyed by the excessive temperatures.

As the pile heats up, warm air within the mixture will rise and move out of the pile, while fresh air will be drawn in to replace it. This process exhausts carbon dioxide (CO₂) created in the pile, and maintains an aerobic environment for the bacteria. In addition, temperatures that remain above 130°F for three days will destroy disease causing bacteria (i.e. Leptospirosis) within the pile. Internal pile temperature is an indication of the current biological activity within the mixture and how well the pile is composting.

The composting process will generate and regulate its own temperature. However, to maintain high temperatures, the compost bins or piles must be operated properly.

Compost Bin Operations

American Samoa's hot and humid climate provides ideal conditions for composting. However, keeping the compost protected from heavy rainfall is required in order to maintain these conditions. Compost bins constructed of hog panels and wire mesh are an effective way to manage composting piles. Most piggery operations require 3 to 4 bins to complete the composting process. The composting material needs to be rotated between the bins every 2 weeks. Here in American Samoa, if properly managed the composting process is completed in 8 weeks.

Maintaining optimal moisture levels in your compost bins is very important to the composting process.

Here are a few clues your compost is too moist:

- Temperatures are too low or too high (Composting temperatures should be in the range of 130-155°F)
- There is water seeping out the bottom or sides of your bin
- The top layers are clumped or matted together
- Your pile may start have a slight ammonia smell (also an indication of too many nitrogen rich materials like manure, and not enough carbon rich materials like wood chips)

If the compost pile is too wet, the water in your pile begins to deprive the microorganisms from the oxygen they need to keep working. The microorganisms essentially start to drown in the bin. An easy solution to this problem is to aerate your pile really well. Try turning the compost with a pitchfork or shovel to make sure the moisture is distributed evenly throughout the pile or bin. Then make sure not to add any more water until the moisture levels even out a bit. You may also consider adding carbon-rich materials like dry leaves, wood chips, or newspaper to absorb some of the excess moisture.

Here are a few clues your compost is too dry:

- Temperatures are too low
- Hand moisture test fails (see page 1)
- It looks more dusty than like fresh soil
- There are ants in the pile

If your compost pile is too dry, this means that the microorganisms are going to start slowing down their process for lack of water. Just like they can't live in too much water, microorganisms cannot live without water either. Having some moisture in the mix is essential to creating compost.

A simple solution to a compost bin that is too dry is to add water. Be careful when watering your compost bins, though, because you do not want to drench the pile entirely. Instead, try showering your pile to evenly distribute the water throughout the pile. If your pile is extremely dry, you may need to take the top few layers off, water the bottom half and gradually add the layers back while moistening them down, too. Adding water when you rotate the bins is the most effective way to maintain moisture in the compost.

In both scenarios it's important to not over-compensate when trying to alleviate the problem. It may take a few days for your compost to start cooking again if it has been too dry or too wet for a while.

Screening & Use

After a 2-month period, the compost should be ready for removal and use. Good compost should be dark brown / black in color. If possible, screen the compost - use a simple angled wood frame with wire mesh (1/2" rat wire). All oversized (screened) material should be re-used in another compost bin. The compost can be used as a source of fertilizer, a soil amendment, or mulch. Caution should still be taken when handling the material, as there may still be pathogens in it from the manure. Always wash hands thoroughly after handling compost. Additional technical information regarding composting can be found at:

<http://www2.ctahr.hawaii.edu/oc/freepubs/pdf/HH-13.pdf>

<http://www.mastercomposter.com/>

<http://www.vegweb.com/composting/>

<http://www.attra.org/attra-pub/farmcompost.html>

Record Keeping

Starting a log book to maintain consistent records will help insure that the composting process is completed and will also provide you with a tool to develop and improve your piggery composting operations. At a minimum, composting bin temperatures and the volume of wood chips added to pens weekly should be recorded. This data will allow you to calculate the amount of wood chips required per pen to achieve a good compost mix specific to your operations.

Finally, it's important to remember that composting is a very simple process that only needs a little help from us to be successful. Using composting to manage your pig waste not only addresses both health and environmental risks associated with piggeries, but also yields a value added product, an organic fertilizer that can offset the cost of imported chemical fertilizers.