Whole Animal Composting of Dairy Cattle

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Even the most well-managed dairy operations experience animal loss due to weather, natural causes and/or illness each year. Rendering services currently pick up most carcasses from the farm. However, with the concern of Bovine Spongiform Encephalopathy (BSE), commonly known as Mad Cow Disease, feeding animal-derived protein to cattle is prohibited. This has decreased the need for animal rendering and increased the cost of removing carcasses from the farm. The abundance of stockpiled manure and old feedstuffs on dairy operations make whole animal composting a feasible alternative to carcass disposal. Objectives of this publication are to outline factors that affect proper composting procedures and discuss how to compost cow carcasses on the farm.

PROPER COMPOSTING PROCEDURES

Composting is the natural decomposition of organic materials by microorganisms that require oxygen (aerobic). Although many aspects of composting are not exact, there are several factors that affect the success of the composting process:

- carbon and nitrogen ratios (C:N ratio)
- moisture content
- particle size
- oxygen concentrations
- temperature

The proper mix of composting materials requires both carbon and nitrogen at a 25:1 to 30:1 ratio. With the proper C:N ratio, odor will be kept to a minimum, and the environment will be conducive to the growth of microorganisms. It usually is necessary to add plant materials, such as old feedstuffs or straw, to have the proper carbon levels in the manure compost mix. Sawdust is the preferred carbon source due to its highly absorbent characteristics and ability to make contact with the carcass. The compost mixture's moisture content should be 50 to 60 percent. Moisture concentrations of greater than 60 percent will generate odors and increase the chance of leachate (runoff) from the compost pile. Follow this general rule of thumb: If the mixture feels moist but no water drips from a handful when squeezed, the moisture level is adequate. To ensure aeration of the compost pile, particle size of composting materials should range between 1/8 to 1/2 inches in diameter. Proper particle size increases the pile's porosity (air space), which allows air to enter to maintain oxygen concentrations for optimal microbial growth. Aeration by turning also introduces air into the compost pile. Optimal composting temperatures range from 110 to 150°F. Compost piles need a layer of inactive material (approximately 1 foot thick) to insulate the pile and maintain high temperatures. Temperatures above 131°F for 72 hours are necessary to destroy human pathogens and most plant pathogens. Furthermore, weed seeds usually are destroyed at 145°F. Extremely high temperatures are detrimental to composting with microbial activity declining at temperatures greater than 160°F.

HOW TO COMPOST WHOLE COW CARCASSES

Contrary to popular belief and practice, simply covering carcasses in manure is not considered composting. An animal carcass generally is a mass with a low C:N ratio (high nitrogen levels with relatively low carbon), high moisture content and virtually no air. Consequently, compost materials must include high C:N ratios, moderate moisture and

Figure 1. Whole animal composting can be a successful, environmentally safe and economically feasible method to dispose of carcasses.

Figure 2. When temperatures fall below 145°F, the pile can be turned using a windrow turner.

satisfactory porosity for aeration. Proper composting consists of layering the carcasses with composting materials in a static pile until the soft carcass tissue has decomposed fully.

Site selection is important to the overall success of composting. The composting pile should be located to allow easy access, minimal travel, convenient handling of manure and straw/old feedstuffs, and it should be a proper distance from live cattle. Sites near neighbors and water sources or streams should be avoided. Make certain that surface runoff and other pollution controls can be implemented at the site. Good drainage of the compost pile also is necessary to prevent water from pooling. Ideal slope should be 1 to 3 percent for proper drainage. The composting pad should be firm but does not need to be paved. Sand or gravel at a depth of 6 inches is desirable when current soil conditions are not acceptable.

Compost pile construction should begin by placing on the ground a plastic liner (6 millimeter) 10 to 12 feet wide and the length of the pile or windrow (fig. 1). Next, place a base of compost materials (manure and straw/old feedstuffs) on top of the plastic liner approximately 1 to 1.5 feet deep. Manure screenings from solids separators are excellent for composting. A 50:50 ratio of manure and the carbon source generally is recommended. This ratio will vary with the chemical and biological characteristics of the manure and carbon source. Laboratory analyses of raw composting materials are necessary to get the optimal compost mixture. The carcass should then be placed on top of the base. To decrease composting time and to allow the carcass to be laid flat, the animal's body cavity should be opened; however, caution should be used due to possible disease transmission. Then water can be added. Finally, completely cover the carcass with 8 to 12 inches of the compost mixture. Apply subsequent layers as necessary until the pile or windrow is approximately 6 feet high. A thermometer should be placed 2.5 to 3 feet into the pile to monitor internal temperatures. When temperatures fall below 145°F, the pile can be turned using a front-end loader or windrow turner (fig. 2). Make certain carcasses remain fully covered after turning.

Large square hay bales can be placed around the pile's perimeter to protect from pests. Furthermore, if there is runoff from the compost pile, the hay will act as an absorbent.

In a properly managed compost pile, the core temperature of the pile should reach 145°F in 3 to 4 days. After approximately 2 weeks, volume of the pile will reduce to one-half its original size; the pile then should be turned. Decomposition of a mature dairy cow carcass generally takes 6 to 8 months with a few small bones remaining. The remaining bones will be soft and shatter easily when passed through a manure spreader during land application.

BOVINE COMPOSTING EXPERIMENT IN NEW MEXICO

Recently, 12 cow carcasses were used to initiate whole animal composting on a large (approximately 3,000 lactating cows), southern New Mexico dairy operation. Compost pile construction was established by spreading a sand/manure mixture on a level site to

Table 1. Composting mixture analyses prior to animal composting.

Nutrient	Sample #1	Sample #2	Sample #3	Average
Carbon (%)	42.8	47.8	43.8	44.8
Nitrogen (%)	4.2	3.4	.	3.8
C:N	10:1	14:1	.	12:1
Phosphorus (%)	0.01	0.01	.	0.01
Dry Matter	19.4	25.4	21.7	22.2
pH	8.5	8.4	8.0	8.3

Table 2. Composting mixture analyses after animal composting.

Nutrient	Sample #1	Sample #2	Sample #3	Average
Carbon (%)	17.9	18.1	28.9	21.6
Nitrogen (%)	2.3	1.3	2.3	2.0
C:N	8:1	14:1	13:1	11:1
Phosphorus (%)	0.01	0.01	0.04	0.02
Dry Matter	40.4	47.5	51.4	46.4
pH	8.6	8.7	8.2	8.5

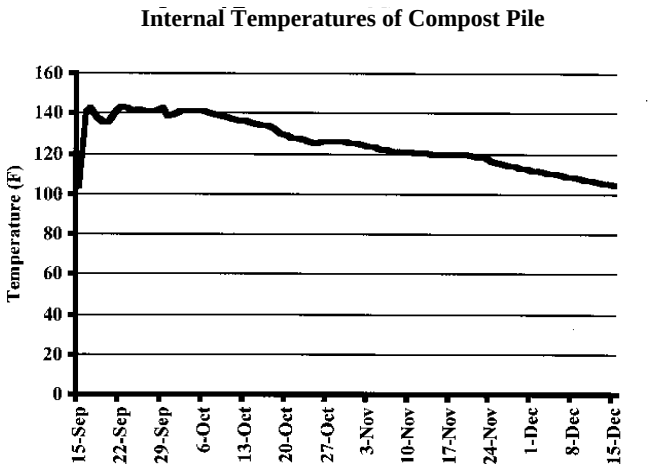

Figure 3. Compost pile temperatures reached a high of 142°F.

a depth of approximately 10 to 12 inches. A single carcass was then placed on the mixture and covered with the compost mixture to a depth of 1.5 to 2 feet. A similar technique was used to cover each carcass. Dimensions of the final pile were 14 to 15 feet wide and 6 feet high. A temperature data logger was placed 2 feet into the pile to record internal temperatures. Rainfall totaled 2 inches at the dairy during the experiment, and no additional moisture was added. Samples of composting materials were collected prior to (table 1) and after (table 2) composting cows to determine changes in nitrogen, phosphorus, carbon, dry matter and pH. Carcasses were uncovered at 2 and 4 months to determine time needed to decompose cows. Compost pile temperatures reached a high of 142°F approximately 3 days after pile establishment (fig. 3). At 2 months, carcasses were 60 to 65 percent decomposed. The bones were clean, and the flesh was 90 percent decomposed. After 4 months, carcasses were somewhat difficult to find with only several small bones (7 to 10 bones/carcass) remaining. The C:N ratio was 12:1 prior to composting and 11:1 after composting. Carbon and nitrogen percentages were reduced by approximately one-half after composting. It should be noted that the pile was not aerated nor were other carbon sources added. The goal was to mimic what would actually take place on a dairy operation. It is obvious from this study that the addition of moisture, aeration and other carbon sources would have decreased composting time but would have increased dairy producers' labor and cost.

SUMMARY

By following a few general composting recommendations, whole animal composting can be a successful, environmentally safe and economically feasible method for disposing on-farm carcasses. Cost of whole animal composting, which includes a synthetic liner, is estimated to be approximately $4 per carcass. Remember, composting procedures are not absolute and are somewhat forgiving. Trial and error accompanied with close monitoring of pile characteristics usually will produce successful results. Before implementing whole animal composting on your dairy, check local and state requirements regulating animal carcass disposal. The biological process of composting animal carcasses is similar to the processes of composting other organic materials. Carcass compost is an excellent source of fertilizer for crops used by the dairy farm. However, the compost generated from decomposed animal carcasses should not be given or sold as compost for off-farm use.

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