Precondition and Turn Approach to Composting Slaughterhouse Wastes

Abstract

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I. INTRODUCTION

In the winter of 2000-2001, the Maine slaughterhouse industry learned that the cost of their traditional disposal method for their by-products was increasing ten-fold. Due to a loss of markets for meat meal as a result of the ruminant to ruminant feed ban and to increasing costs of operation, the only renderer in New England, Baker Commodities was being forced to dramatically increase the cost of picking up offal from slaughterhouses, butcher shops and meat processors. There were also rumors that this service may not even be available in the future. This situation spurred industry leaders to approach the Maine Department of Agriculture for help.

In May 2001, the Department held an information gathering meeting with the industry and representatives of Baker Commodities. At that meeting, Baker Commodites explained the situation they faced and indicated that they intended to continue their service in the near future, but did not know what would happen if proposed further FDA bans on use of meat meal were to be implemented.

The Department offered industry representatives three possible options for managing their wastes. These were on-site burial, composting and pick up by another rendering company that was operating in New Brunswick. The first option pursued was the alternate rendering company. Negotiations throughout the summer of 2001, however, were unsuccessful in attracting another renderer into the Maine market. At that point, the Department decided to pursue composting to see if it could be done given the conditions and materials available in Maine. The Maine Compost Team was approached to conduct trials using slaughter wastes. The Maine Compost Team is an interagency collaborative, with members representing the Maine Department of Agriculture, Maine Department of Environmental Protection and the University of Maine Cooperative Extension.

One of the people in attendance at the May 2001 industry meeting was a farmer, Tom Campbell, who expressed interest in participating in any compost trials that might be undertaken. When it was clear, that compost trials would be needed, the Team approached Tom to do trials at his farm. A retired bunker silo behind the barn was selected at the site for the trials. The farm already had a tractor with a bucket loader and a skidsteer loader as well as a dump truck, so the basic equipment needed to conduct the trials was on-hand. The trials began in August/September, 2001.

II.TRIAL SETUP

SOFT TISSUE TRIALS

The Compost Team was aware that two distinctly different waste streams were produced by the slaughter facilities. The first was all the soft tissue, including the rumen, organs and other entrails. Along with this waste stream came a certain amount of paunch manure. The second waste stream consisted of the harder to compost materials, including the bones (with a certain amount of meat and connective tissue attached), heads, hides and hoofs. The first set of trials focused on finding the most appropriate method to manage the soft tissues.

The overall approach chosen for composting both waste streams was the 'pre-condition and turn' system. This is a hybrid between the passively aerated pile approach and a turned windrow system. It was felt that this approach offered the best opportunity for success due to the texture of the materials being composted, the difficulty of mixing this material with a bulking agent and the likelihood of significant odor, vector and nuisance issues if any were left exposed. In this system, the tissues would be buried in a pile of the dry bulking material and allowed to decompose to the point where it could be turned and mixed without problems. Part of the purpose of the trials was to determine how long the piles should be left undisturbed before the first turning.

Horse Bedding Trials

Horse bedding was chosen as the preferred compost media for these trials because it had some nutrients at the outset and a population of active bacteria, so that it would begin composting very quickly. Because most horse bedding in the area included sawdust and shavings as well as waste hay, it would provide excellent pile structure for aeration and moisture control. It was also a natural choice since it was in plentiful supply in the area.

Two approaches were tried in the initial trials. In both, a bed of horse bedding was formed about 18 inches deep, 8 ft wide and 15 ft long. The edges of this bed were mounded up to form a basin that would prevent fluids from escaping before the cover material had been added. Soft tissue was deposited in the basin by emptying the 55 gallon drums in which it was transported, directly into the pile. The soft tissue was then covered with approximately 18 inches of horse bedding. The difference between the trials was the provisions made for self aeration.

Each pile initially had roughly 6 cubic yards of horse bedding for each cubic yard of offal. The amount of offal added at the outset had to be limited due to the amount of liquid that accompanied the offal and the potential for additional moisture release as the material broke down. It was then sampled after the first turning to determine if sufficient nitrogen had been added to achieve the optimum C:N ratio in the mix. Additional offal was added based on the C:N ratio observed and the process started again. This was repeated until the C:N ratio of the mix was between 20:1 and 30:1. After all additions were made, the final mix was approximately 2 cubic yards of bedding for each cubic yard of offal composted.

With Aeration Pipes One pile was set up with three 4" diameter perforated PVC pipes laid parallel to each other on the pavement about 3 ft apart. A layer of hay was placed over the pipes to prevent the bedding from plugging up the holes, then the bottom layer of bedding was placed over the hay.

Without Aeration Pipes The second pile was made by laying the bedding directly on the pavement. Aeration in this pile would depend on the porosity of the horse bedding allowing air movement into the pile.

Hot Municipal Sludge Compost Trial

Later in the fall, the Team decided to try using hot municipal sludge compost as the medium for composting the offal. This material had been used successfully for composting whole carcasses in trials earlier that summer and so offered promise as an alternative to the horse bedding. The advantage of the municipal sludge compost was that it was already very active at the start and offered the potential for rapid pathogen kill in the event there was material suspected to have pathogen contamination.

BONE TRIALS

After the first successful trials using only soft tissues, the Team expanded the trials to include the composting of bones and other parts (collectively referred to as 'bones') that may be more difficult to compost.

No Grinding Trials

The first step in these trials was to simply bury the bones in a pile of horse bedding and allow them to 'cook' for 4 to 6 weeks undisturbed. The pile contents were watched to determine when most of the soft tissue (connective tissue, fat and meat) had been decomposed. At the end of this period, the Team dug into the piles to examine the condition of the bones.

Composting Material after Grinding

The first bone trials showed that the softer tissue connecting the bones would be eliminated during the first phase of the compost process, but that the larger bones survived with little change during that time period. This led to the bone grinder trials that were conducted at Highmoor Farm and reported elsewhere. It also led Mr. Campbell to obtain a large hammermill grinder on loan from a local company that was no longer using it to pulverize bark for mulch. Some of the pre-composted material was ground in the grinder and then repiled to continue the composting.

After grinding, one pile was left undisturbed while another was turned every 3 to 5 days. The resulting compost from each pile was then sampled and analyzed for the typical compost parameters. See Table 1 .

III. DATA COLLECTION

Because these trials were all conducted on a working farm, without staff dedicated to data collection, it was not possible to obtain detailed temperature data for the trials. Spot checks of temperature readings told the Team that the temperatures being generated were, in fact, consistently high enough to achieve pathogen reduction, especially after the initial turning in the soft tissue trials.

One of the purposes of the two initial trials was to determine how long the soft tissue should compost undisturbed before the first turning. Because of the nature of the material at the start and the potential for vector attraction and other nuisances, it was felt that the first turn should not happen until most of the soft tissue had decomposed and no longer had its original structure. Exploratory digs were made in each pile at 7, 14 and 20 days.

Sampling and Analyses The original piles were sampled after turning the first time and again after each addition of offal and turning. The process for collecting the samples was:

1. Seven samples were collected from different locations of each pile with a small spade and placed in a 5 gallon bucket.
2. Each sample was taken at a depth of about 12-15 inches from the surface of the pile.
3. The seven samples were mixed thoroughly for one minute.
4. A subsample was then taken from the bucket and placed in a one-gallon plastic zip-close bag.
5. The samples were then sent to the Plant and Soil Analytical Lab at the University of Maine.

The standard compost tests were performed on all the samples. These included:

Total Solids
Total Carbon
Total Nitrogen
Total Potassium
Total Phosphorus
Volatile Solids
pH
Bulk Density
C:N Ratio

The lab was also asked to test for:

Conductivity
Ammonium N (NH_4-N)

IV. RESULTS

SOFT TISSUE TRIALS

Both of the soft tissue trials showed that most of the material decomposed very rapidly. At 20 days, there was very little recognizable tissue left in either pile. The most striking remaining material was the paunch manure or partially digested feed. In some cases, when all the soft tissue around it had disappeared, there was a compacted lens shaped mass of grass that looked very much the same as the day it was eaten. As soon as this material was mixed with the surrounding bedding, it rapidly heated up creating a very active compost mixture.

The trials with and without aeration pipes performed very similarly. The pile without the pipes seemed to be slightly behind the one with the pipes in terms of initial heating and rate of breakdown. After the initial turning, there was virtually no difference between the two treatments. The aeration pipes, however, turned out to be a conduit for fluids to leave the pile and became breeding sites for flies. Based on this finding, the Team decided to proceed with additional trials without the use of the aeration pipes.

Hot Municipal Sludge Compost Trial

The municipal sludge compost trial results were similar to those observed for the horse bedding trials except that the material was drier initially and that it only required one batch of offal to reduce the C:N ratio to about 20:1. Looking at the changes to the analyses of the material before the offal was added and after it had been added and allowed to compost for 20 days showed that most of the parameters changed very little as a result of the addition of the soft tissue. See Table 3. The most significant change was in the moisture content as a result of the fluids and released water. But even with the added moisture, the moisture content of the material (56%) at this point was just enough to promote composting.

The municipal sludge compost material was hotter at the outset than the horse bedding, although the horse bedding eventually achieved similarly high temperatures (Both consistently were over 140°F within a few days of the first turn.) Paunch manure in the municipal sludge compost medium tended to dry out during the initial period prior to turning as did the rest of the compost medium itself. The process, when using the hot municipal sludge compost would have benefited greatly from addition of moisture during this stage.

BONE TRIALS

In the bone trials, the operator observed that the bones were free of soft tissue in 25 – 40 days. Some deterioration of bones was observed at this time as well, but the larger bones were still primarily intact. He also observed that the bone piles heated up more rapidly and to higher temperatures than soft tissue piles. There are several factors that probably contributed to this. The bone piles were generally larger than the soft tissue piles. The initial height of the bone piles was normally about 5 to 6 ft, while the soft tissue piles would usually be less than four feet high. The extra mass would allow more heating especially in colder weather. In addition to the size difference, the soft tissue piles routinely had more moisture associated with them, both from the fluid in the barrels and the release of moisture as the tissue broke down. There was also more nitrogen in the bone pile initial mixtures than in the soft tissue piles after the first batch of offal had been added. See Tables 1 and 2. Finally, the presence of rib cages and other larger bones resulted in a pile structure that did not collapse as much during the early preconditioning stage, allowing the piles to maintain better structure and aeration.

After the initial trials were concluded, the operator began incorporating some of the bone material into the soft tissue piles since this actually helped speed up the compost process for the soft tissue. The one drawback to adding the bones to this material is that it results in more material that needs to be run through the grinder.

Composting Materials after Grinding

There were some notable differences between the pile of ground bone compost that was turned regularly compared to the pile that was left undisturbed. See Table 1. The turned pile was much drier with 64.8% solids vs 42.3% solids for the unturned pile. The volatile solids content, total carbon and total nitrogen were all lower for the turned pile and the C:N ratio was lower. All these indicate a more advanced stage of the compost process in the turned pile than in the undisturbed pile.

V. CONCLUSIONS

The project organizers concluded that both the soft tissues and bone material from slaughterhouses can be successfully composted using either horse bedding or hot municipal sludge compost. They also concluded that the pre-condition and turn method is able to achieve the goals of minimizing the exposure of putresible material, generating temperatures sufficient to kill pathogens and optimizing the compost process. They concluded that even though the addition of aeration pipes may result in a slightly quicker breakdown for soft tissue, the resultant increase in loss of liquids and the creation of a breeding place for flies, make this option undesirable. Turning the piles after grinding the bone material appears to speed the compost process.

Table 1. Immature Bone Compost with and without Turning

Parameter	No Turning	With Turning	Comments
Total Solids (%)	42.3	64.8	
Total Carbon (%)*	39.7	32.0	
Total Nitrogen (%)*	1.51	1.41	
Total Potassium (%)*	0.38	0.47	
Total Phosphorus (%)*	1.45	1.67	
Volatile Solids (%)*	75.7	65.0	
pH	6.0	6.8	
Bulk Density (lbs/cu yd)	600	450	
C:N Ratio	26.2	22.6	
Conductivity (mmhos/cm)	4.4	4.5	
Total Calcium(%)*	3.87	4.90	
* Reported on a dry basis.			

Table 2. Soft Tissue Compost with and without Aeration Pipes.

Parameter	With Aeration Pipes	Without Aeration Pipes	After Second Batch of Offal
Total Solids (%)	41.1	43.8	34.2
Total Carbon (%)*	40.2	35.6	35.5
Total Nitrogen (%)*	0.84	0.75	1.19
Total Potassium (%)*	0.66	0.67	0.58
Total Phosphorus (%)*	0.28	0.21	0.27
Volatile Solids (%)*	78.2	82.4	75.1
pH	8.0	7.7	8.2
Bulk Density (lbs/cu yd)	500	450	650
C:N Ratio	47.7	47.3	29.8
Conductivity (mmhos/cm)	3.3	4.1	4.4
NH4-N (%)*	0.09	0.04	0.06
* Reported on a dry basis.			

Table 3. Municipal Sludge Compost before and after Addition of Offal

Parameter	Before Adding Offal	After Adding Offal	Comments
Total Solids (%)	61.1	44.2	Most notable change
Total Carbon (%)*	35.9	34.0	
Total Nitrogen (%)*	1.64	1.74	
Total Potassium (%)*	0.21	0.31	
Total Phosphorus (%)*	0.98	0.67	
Volatile Solids (%)*	72.1	67.8	
pH	7.6	8.1	
Bulk Density (lbs/cu yd)	550	650	
C:N Ratio	21.8	19.5	
Conductivity (mmhos/cm)	4.4	5.3	
NH_4-N(%)*	0.22	0.24	
* Reported on a dry basis.			