Composting of mink manure: How high can the temperature go?

A few facts about composting manure:

- Not all sources of manure are the same. Their contents (and smell) are related to which animal they come from and their diet.
- Mink manure is high in nitrogen (N) and phosphorus (P), because they are fed diets high in proteins. It is a rich source of nutrients and improves physical and chemical properties of soil.
- Composting is different from stockpiling. If done properly, you help microorganisms (bacteria) in the compost convert the material into a product which is odorless, easily handled, and possibly pathogen free.
- To thrive, composting bacteria need N, which comes from manure. They also need sufficient amounts of carbon (C), which must be added to the manure. On the average, a C:N ratio of 25:1 is needed for high bacterial growth and good composting.
- Mink manure has a low C:N ratio, therefore plenty of carbon sources, such as sawdust, wood shavings or chopped straw must be added (C:N is different from CN, Canadian National, which does not smell at all!).
- Many factors influence the length of time needed to make good compost, including the type of feed given to animals, the C:N ratio, aeration, moisture and frequency of mixing.
- Bacteria in the compost also require air to live and thrive. Mixing provides oxygen. Too much moisture means less air which results in low bacterial activity, increased odor, leachate and reduced maximum temperature.
- Temperature of the compost reaches its maximum within the first few days of compositing, and then declines. The maximum temperature and its profile depends on many factors. A compost needs several months to mature.
- If the temperature goes above a certain point, bacteria that are responsible for breaking the manure down will die. There is an optimum range for temperature and typically it should be below 65^{o}C.
- The effect of composting on reducing the pathogen load in the manure depends on the maximum temperature reached and the length of time the compost remains at that temperature.
- Most pathogens are killed if the temperature remains above 55^{o}C for several days.
- The Aleutian disease (AD) virus is said to be killed if compost temperature reaches 60^{o}C (Reference 1), but there is no published information to support this claim.

In an experiment on composting mink manure (reference 2), a maximum temperature of 64.8^{o}C was reached 8 days into the composting in one of the six trials, and temperatures in excess of 60^{o}C were sustained for 14 days. Maximum temperature in five other trials ranged between 57.2^{o}C and 29.5^{o}C. Temperatures were recorded only at the center of compost bins.

What a wide range of temperatures! Obviously, the maximum temperature achieved and the length of time that the maximum temperature is sustained is influenced by many factors. To get a clearer picture, we decided to compost mink manure and obtain data on what was happening in the compost and when. We were particularly interested in making composts that could generate the highest temperatures possible, and maintain the high temperature for as long as possible.

Trial 1.

This trial was set up in 2011 inside the AD Research Center (ADRC), which is an enclosed facility. Nitrogen and carbon contents of samples of mink manure were measured. Using wire meshes, a compost bin (0.7 m diameter, 1 m high) was set up by manually mixing mink manure, wood shavings from the nest boxes and chopped straw to achieve an estimated 25:1 C:N ratio. Compost temperatures were recorded at the top, center and bottom of the bin three times daily. Results showed that:

- The peak temperature of 67^{o}C was reached on the third day of composting in the center of the bin, which gradually decreased to about 16^{o}C on day 30 of composting. Temperature at the center remained above 65^{o}C for 2 days, and above 60^{o}C for 4 days.
- Maximum temperature in the top layer was 61.7^{o}C (day 5), and remained over 60^{o}C for 3 days.
- Maximum temperature at the bottom layer was only 54^{o}C, and remained at this temperature for 2 days (days 3 and 4).
- The bin was mixed and turned manually after the temperatures became stable (day 42), but the turning did not increase the thermal activity of the pile.

Trial 2

This trial started in May 2012 inside the ADRC. N and C contents of samples of mink manure were measured. Mink manure was manually mixed with softwood shavings and chopped straw to achieve an estimated 25:1 C:N ratio. Three compost bins (same sizes as in Trial 1) were prepared, filled with the mixture and pressed. Temperature probes were inserted in the top, middle and bottom of each bin. The results showed that:

- The top layer was the hottest of the three layers. The maximum temperatures were 68.8^{o}C (day 8), 65.7^{o}C (day 9) and 65.1^{o}C (day 10) in bins 1, 2 and 3,

respectively. The temperature remained at or above 65^{o}C for 9, 5 and 3 days in bins 1, 2 and 3, respectively.

- The middle was the second hottest of the three layers. The maximum temperatures were 66.1^{o}C (day 9), 64.3^{o}C (day 10) and 64.1^{o}C (day 10) in bins 1, 2 and 3, respectively. The temperature remained at or above 65^{o}C for 5 days in the bins 1, but did not reach this temperature in bins 2 or 3.
- The bottom was the coolest of the three layers. The maximum temperatures were 63.2^{o}C (day 9), 62.4^{o}C (day 10) and 60.8^{o}C (day 11) in bins 1, 2 and 3, respectively.
- The bins were mixed and turned on day 79, after the temperatures became stable at around 25-30^{o}C, but thermal activity of the bins did not improve.

Conclusions:

- Surprise, surprise! Compost bins looked alike but behaved differently.
- Temperatures were not uniform in different layers of each bin in either trial.
- The middle layer was the hottest in trial 1, but the top layer was the hottest in trial 2, possibly because the densities between bins were different.
- The bottom layer was the coolest in both trials. Air draft was possibly the reason.
- Maximum temperature in Trial 1 was reached earlier than in Trial 2, possibly as a result of material density.
- This is necessary information in order to see if these temperatures will kill the AD virus. The virus will be added to compost, separated from the compost materials, purified and tested for viability. We have plans to do this. Stay tuned.

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References:

1-Cochrane, L., J. Ferguson and K. Rouvinen-Watt. 2002. On-farm composting of mink manure. Factsheet. NS Agric. and Fisheries.

2-Ferguson, J.L. 2001. Characterizing the process of composting mink manure and pelted mink carcasses. M.Sc. Thesis, Nova Scotia Agricultural College, Truro, NS.

Irshad Hussain, G.W. Price, Cory Roberts, Hossain Farid

Department of Plant and Animal Sciences and Department of Engineering, Faculty of Agriculture, Dalhousie University. December 2012