Carbon Credits from Composting: Is Nitrous Oxide Emission a Lurking Laughing Monster?

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Obtaining carbon credits from the composting process is a lucrative option for us as composters. If we can demonstrate a net reduction in total greenhouse gas emission by composting as compared with the previous or standard practice, we can get money as carbon credits. The greenhouse gases that we need to consider are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), although under current greenhouse gas protocols, we can ignore N_2O because there is not enough science on it yet.

With plant derived carbon, we can safely ignore CO_2 emission; because the CO_2 is considered neutral (This carbon came recently from the atmosphere through plant growth, and is now going back into the atmosphere). However, if some of this plant derived carbon is returning to the atmosphere as CH_4, which is 21 times more powerful than CO_2, we have a net greenhouse gas effect. This means that if our food waste previously went to a landfill, and there were methane emissions from the landfill, composting the food waste using a process that emits no methane would mean a greenhouse gas reduction, and therefore we may be able to get some greenhouse gas or carbon offset credits.

We may get a good feeling thinking about getting some money for our composting process through carbon credits. Is the good feeling truly from helping our environment, or is the good feeling coming from our compost pile in another way. Nitrous oxide (or laughing gas) does have to be considered during the composting process. Even a small emission of nitrous oxide is significant because it has a greenhouse gas effect that is more than 200 times more powerful than CO_2 emissions.

What is the science behind nitrous oxide emissions and why is it important for us to consider in the composting process? If we look in some of the science text books, N_2O emission happens primarily during the denitrification process – which is an anaerobic process where nitrate (NO_3^-) goes back to atmospheric nitrogen (N_2). Denitrification is a very important process because it is the only process that returns atmospheric nitrogen fixed by plants or fixed by the fertilizer manufacturing process back to the atmosphere. We can fool ourselves by thinking that if N_2O emission happens during denitrification of NO_3^- under anaerobic conditions, it is not relevant to us because we have an aerobic process, and we have no NO_3^- in our composting process until it is far along in the curing process. Unfortunately this is not true. We need to more carefully consider the science of nitrous oxide emission.

Nitrous oxide emission during composting is correlated with intensive nitrogen cycling in the presence of readily available carbon, and may be a byproduct of heterotrophic nitrification. During my M.Sc. research in 1986, we measured nitrous oxide emissions during the denitrification process in soil under anaerobic conditions. During the course of the research, we made some interesting and relevant observations. We were seeing some N_2O emissions under aerobic conditions – which had been noted in the scientific literature before, but available carbon content appeared to be a significant factor in the N_2O emissions. We did some very basic experiments that showed that N_2O emission was higher under aerobic conditions in the presence of NH_4^+ and available C, than in the presence of NO_3^- and available C, or in the presence of NH_4^+ and no available C. We also found that N_2O emission was highly correlated with the nitrification process.

This has very significant implications for N_2O emissions during the composting process, because we have both high available carbon in the composting material, aerobic conditions, and NH_4^+.