T3-O-XX Controlled drum composting with limited climate impact – emissions and heat recovery

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Objectives

EU Directive 1069/2009 requires manure to be sanitised before being sold on the market. Approved sanitisation plants use a drum composter to reach compost temperatures of 52°C for at least 13 hours. This project examined release of ammonia (NH_3), nitrous oxide (N_2O) and methane (CH_4) from drum composting, including pre- and post-composting stages, and compared measures to reduce emissions.

Methodology

Two composting plants, both using mainly horse manure, were studied. For the drum composter and one pre-composting hall, air flow and gas concentrations were measured on-line with flow meters and by gas sampling and analysis with FTIR and FID. For pre-composting (duration 0.5-1 week) and post-composting (duration 2.5-3 months), NH_3 was measured with a micrometeorological mass balance method [1] and CH_4 and N_2O gas were sampled with a closed chamber technique [2].

Results

In plant 1, emissions of greenhouse gases and ammonia were limited and rather low compared with literature or default values. Pre-composting had the greatest impact on global warming, followed by post-composting, while drum composting had the least impact. The dominant GHG was CH_4, mainly originating from pre-composting, but also the post-composting step. Most of the N_2O was produced during post-composting. Total NH_3 emissions from the three composting steps comprised ~3% of total N in substrate (compared with 11% of total-N from frequently turned compost of horse manure with straw). Post-composting gave the highest NH_3 emissions (1.4-2.1% of total N), while losses from the drum composter were only 0.5-0.6% of total-N, corresponding to only ~290 kg N per year.

Potential energy in exhaust air for use by the heat exchanger amounted to ~54 MWh per year, while trapped NH_3 from the drum composter was 17 and 35% of total NH_3 discharged for plants 1 and 2, respectively.

Conclusion

In total, GHG and NH_3 emissions from the three composting steps were moderate. The climate impact could be reduced mainly by replacing heat from fossil fuel with heat exchanged from exhaust air from the drum composter.

References

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