Production of Non Methane Organic Compounds (NMOCs) During the Decomposition of Refuse and Individual Waste Components Under Various Operating Conditions

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Introduction and Research Questions

The production of non-methane organic compounds (NMOCs) during refuse decomposition is receiving increasing attention in the US. In addition to the New Source Performance Standards in the Clean Air Act, many state regulatory agencies require estimates of NMOC emissions as part of the landfill permitting process. However, our current understanding of the sources of NMOCs in landfill gas and the factors controlling their production are incomplete. As a result, there is the potential for regulatory agencies to overestimate actual NMOC production. The overall objective of this study is to quantify the production of trace organics from different components of refuse and under different operating conditions. To date, work has focused on the following:.

1. Measurement of NMOC production from different components of refuse including food, paper and yard waste.
2. Comparison of NMOC release under three different conditions for decomposition: aerobic, nitrate-reducing and methanogenic.
3. Evaluation of the relationship between refuse decomposition and NMOC production.

Experimental Design

Seven series of reactors plus a control were set up with the following treatments:

- aerobic operation for 44 days prior to the onset of anaerobic conditions
- traditional anaerobic operation
- traditional anaerobic operation with the addition of household hazardous waste
- operation under nitrate-reducing conditions
- anaerobic decomposition of mixed paper
- anaerobic decomposition of yard waste
- anaerobic decomposition of residential food waste
- control to measure background NMOC production from the leachate seed

Each series was tested in triplicate 7-liter reactors. All reactors were seeded with methanogenic leachate, operated under conditions of leachate recycle and neutralization, and incubated at 37°C to accelerate the rate of decomposition.

Results to Date

NMOC yields for the first 135 days are summarized in Table 1. As illustrated, the NMOC yield from food waste was the highest and the yield from paper was the lowest. This is consistent with the fact that paper has the most pure and narrow range of degradable organics. Comparing the different operating conditions, aeration resulted in the production of more NMOC relative to anaerobic decomposition. In future work, specific organic compounds present in the NMOC will be identified and quantified.

The data also indicate that high gas yields are correlated with high NMOC yields. In future work, experiments will be conducted to evaluate the relative significance of abiotic gas stripping and biological decomposition byproducts on NMOC yields.

Table 1 Average NMOC and Gas Yields Day 135[a]

Treatment	NMOC Yield mg C/dry-g	CH_4 Yield mL CH_4 @ STP/dry-g	CO_2 Yield mL CO_2 @ STP/dry-g	N_2 Yield mL N_2 @ STP/dry-g
MSW Components				
mixed paper	1.17E-02	56.8		
yard waste	2.33E-02	70.6		
food waste	3.52E-01	142.5		
Residential MSW				
traditional anaerobic	8.73E-02	60.6		
1st 44 days aerobic	2.33E-01		290.9	
nitrate-reducing	4.65E-02	33.5		23.1
added HHW	9.98E-02	50.6		
leachate control[b]	6.85E-04			

a. Data are the average of triplicate reactors.
b. NMOC Yield is in mg C /mL leachate. Data were corrected for background NMOC production associated with the seed.