Review of Emission Factors Commonly Used in Determining Regulations

WORC Annual Conference

Geoff Hill / Tim O'Neill

ECS

engineered COMPOST systems

Introduction to ECS

- Founded in 1999
- Located in Seattle Washington
- Providing the Composting Industry with:
  - Research
  - Air emissions expertise
  - Design & planning
  - Process technology
  - Facility support

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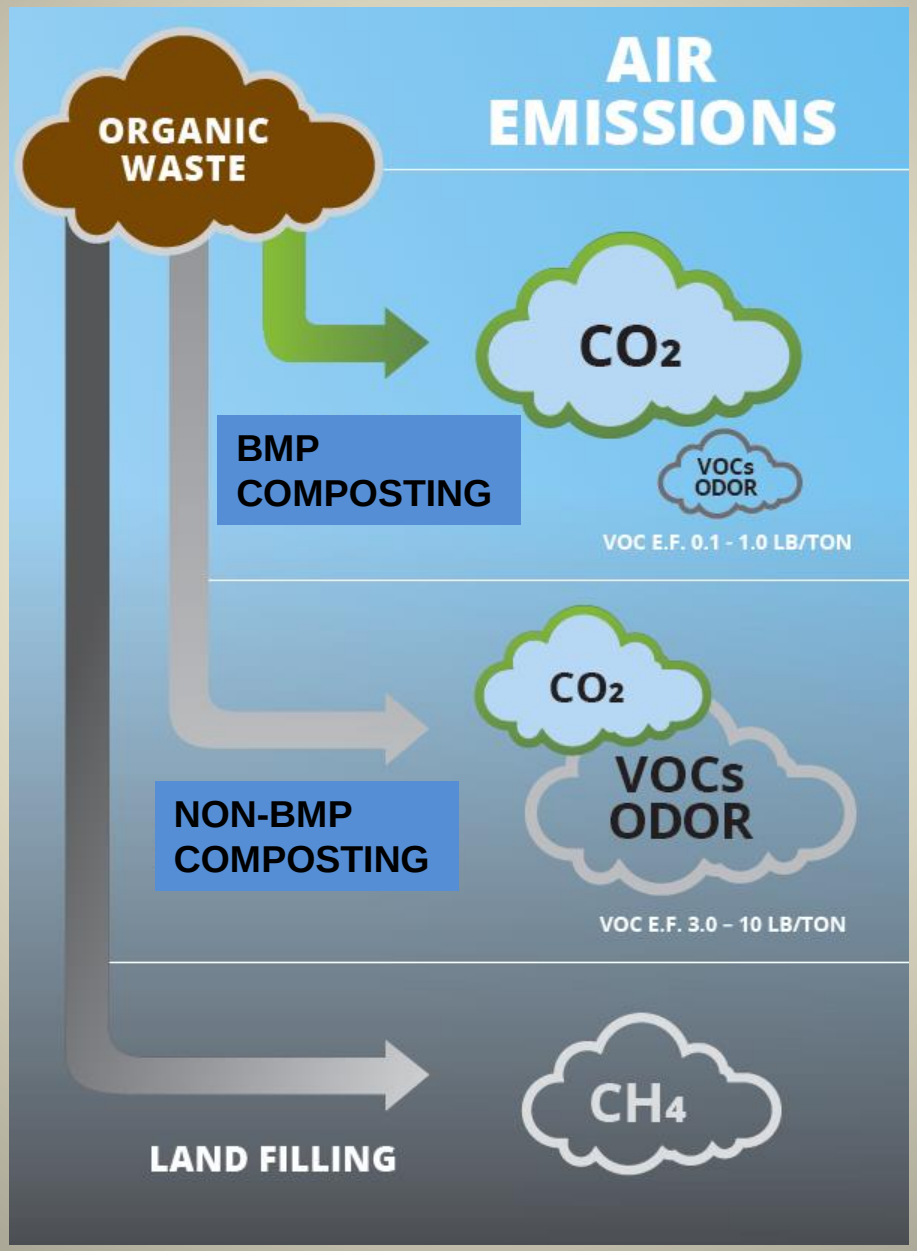
Outline

1. Definitions
2. Emission factor
3. Emission measurement
4. Origins of current emissions factors
5. Example emissions factor from modern facilities
6. Recommendations

Definitions

1. **Source test –** a sampling event where emissions from point or area sources are collected, analyzed, and totaled for a single site.
2. **VOC –** volatile organic carbon
3. **POC –** precursor organic carbon
4. **NMOC –** non methane organic carbon
5. **NMNEOC –** non methane non ethane organic carbon
6. **NH3 –** ammonia gas
7. **Flux –** rate of flow of a substance through an area and through time
8. **Title V –** major air polluter
9. **Emission factor –** amount of pollutants per wet ton of feedstock

How Will Degradable Carbon Be Emitted?



VOC and Title V

Table 1 – Lower Major Source Thresholds for Non-attainment Areas

Non-attainment Area Designation	VOC or NOx	CO	PM-10
Marginal	100 tpy		
Moderate	100 tpy	100 tpy	100 tpy
Serious	50 tpy	50 tpy	70 tpy
Ozone transport region (other than severe or extreme)	50 tpy (VOC only)		
Severe	25 tpy		
Extreme	10 tpy		

The Emission Factor

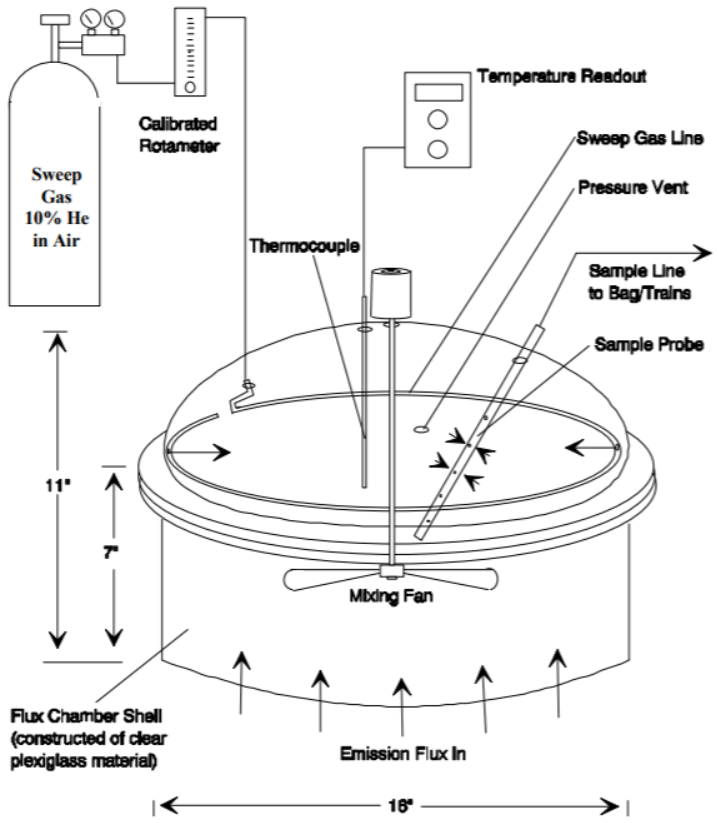
- Pounds gaseous pollutant per wet ton composted
  - NMNEOC lbs / ton
- Facility-wide value based either on:
  - A default value taken from another jurisdiction, or
  - An area weighted average from source testing (expensive)
- Impact of default EFs
  - High EF's can trigger a Title V designation at a modest facility
  - 35,000 tons/yr x 5.71 lb/ton = 100 tons VOC /year = Title V

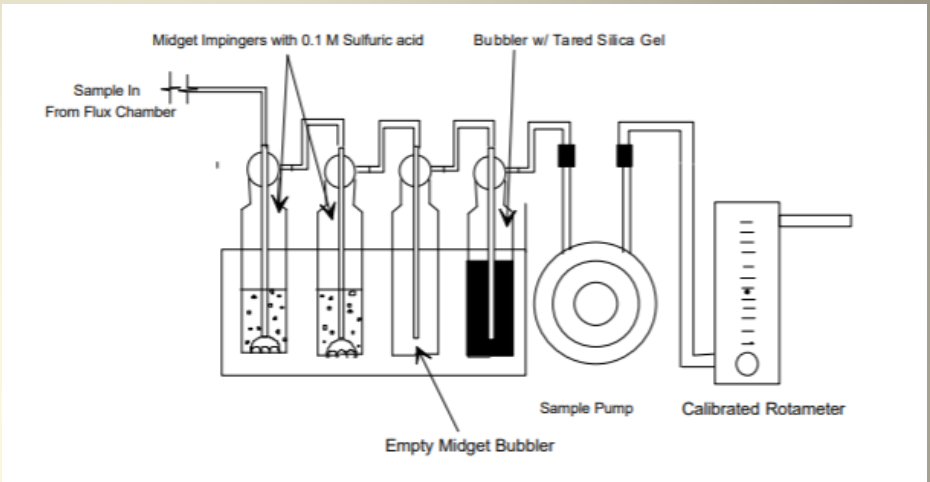
Emission Measurement: SCAQMD 25.3

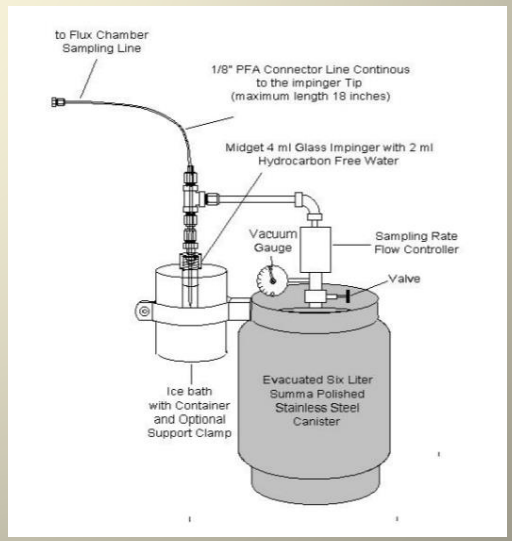
Emission Measurement: SCQAMD 25.3

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
21865 E. Copley Drive, Diamond Bar, CA 91765

Test No: 01-171 -17- Date: 9/27/01 & 10/4/01







EFs commonly vary by >100X across the pile surface

Sample #	Average Flux mg/m2/min	Truncate -1
1	84.404	80.00
2	29.426	30.00
3	101.122	100.00
4	94.399	90.00
5	8.372	10.00
6	25.115	30.00
7	1.377	0.00
8	1.189	0.00
9	7.470	10.00
10	11.304	10.00
11	5.308	10.00
12	1.870	0.00
Mean	**30.95**	**30.83**
	Difference	-0.11

Method is locally accurate but due to enormous spatial variability, this precision is wasted.

A method that covers greater spatial area (10-100x) and is less precise will be better at collecting the data from these large area emission sources

Compensating for Spatial Variability

- SCAQ<D 25.10 requires minimum 10 samples per ‘source’

OR

- Use a larger (cheaper) sample method including
  - Wind Tunnel (right) employed at ZBEST (BAAQMD)
  - Large hood on aerated surface (left)

b) Measurement setup at an open biofilter [DBFZ]

The History of EFs used in regulations

2.) Green Waste Windrow EF

Table 3: Green Waste Windrow VOC EF

Site	Sampling Age of Material	Season Samples Taken	EF (lb-VOC/wet ton/day)
CIWMB (Modesto)	Over the Active + Curing Phase (days not sampled were interpolated)	Spring	0.85*
Site X		Summer	6.30
NorCal Jepson Prairie (Vacaville)		Fall	5.65
Northern Recycling (Zamora)		Fall	10.03
Average			5.71

From ValleyAir.org, SJV APCD Compost Emission Factors, 2010

Three Intentional Outliers

- Pending air regulations incentivized owners to obtain high EFs
  - Grandfathered “right to pollute”
- Results skewed by process manipulation
  - Raw feedstocks left unmanaged before test
  - Wine filtrate pumice added (Zamora)
  - Testing done on a hot day
  - Piles spread to maximize surface area during test
- Results have inflated EF ever since

JPO Air Emissions:
High Measured EFs, Incredibly High Permitted EF

TABLE 1-2
SUMMARY OF ECS EMISSION FACTOR RESULTS
MAY 31 & JUNE 1, 2016

ECS System VOC Emissions Compost Stage	2016 lbs/ton	2014 lbs/ton	2012 lbs/ton	2010 lbs/ton
Blended Feedstock receiving[1]	0.0625	0.0625	0.0625	0.360
Covered Compost Zone Fugitive Emissions[2]	0.553	0.109	0.0155	0.037
Mixing Event Fugitive Emissions[1]	0.0701	0.0701	0.0701	0.0100
FG 1 & 2 Average Emissions (Biofilter Inlets)	2.89	2.76	1.46	2.53
Finished Product Storage Emissions[1]	0.0120	0.0120	0.0120	0.052
ECS System Total	**3.47**	**3.01**	**1.61**	**2.99**

Emission Factor Summary	VOC lbs/ton	Ammonia lbs/ton
ECS System Emission Factor	3.47	0.116
Greenwaste Windrows Emission Factor	0.332	0.713
Permitted Emission Factor	14.265	3.841

1. Permitted Emissions Factors from condition 13 of permit P-61-07(a5)

JPO 2010 - Far from BMP
ASP Emissions to BF =2.53 lbs/ton

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ASP Emissions to BF =2.53 lbs/ton

- Persistent low pH (4-5)
- Excessively wet/dense
- Uneven aeration
- Insufficient aeration supply
  - Had 1cfm/cy (needed >5cfm/cy)

CA ARB EFs: Biased By Bad Data!

Table II-1: Summary of Available Active Composting Greenwaste Emissions Test Data

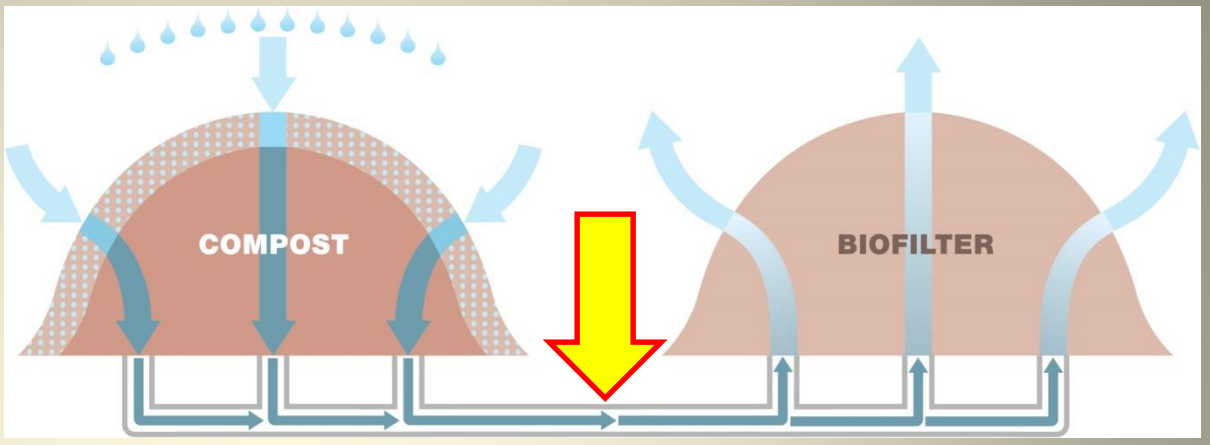
Site	VOC (lbs VOC/wet ton)	Ammonia (lbs NH3/wet ton)
SCAQMD Inland	1.56	0.26
SCAQMD Inland	2.25	0.63
CIWMB (Modesto)	0.85	N/A
CIWMB (Modesto)*	1.95	N/A
Site X	~~6.30~~	2.34
Jepson Prairie	~~5.65~~	0.24
Northern Recycling (Zamora)	~~10.03~~	0.45
City of Modesto	1.50	N/A
City of Modesto*	2.20	N/A
Average	~~3.58~~	**0.78**

*Source test contained 15% by weight foodwaste

Average 1.72

ARB Emissions Inventory Methodology For Composting Facilities, 2015

EFs from aerated static pile facilities



Facility	Feedstock Food/Green %/%	Air District	VOC EF (lb/ton) Pre biofilter	Source Test Firm
Fontana, CA	45/55	South Coast	0.25	Professional Environmental
Riverside, CA	35/65	South Coast	0.0055	Professional Environmental
Chino, CA	40/60	South Coast	0.41*	Horizon Air
Rainier, WA	0/100	Olympic Region Clean Air	0.025	Avogadro
Vacaville, CA	50/50	Yolo-Solano	0.16	TRC Solutions

* Only biofilter emissions were measured, value based on 90% biofiltration

Conclusions

- The 25.3 method is expensive and only measures a tiny portion of a highly variable surface. Cost-effective methods exist that solve this problem.
- EFs used in regulations are biased high due to incentives to maintain a “right to pollute”
- EFs used in regulations fail to consider process conditions (oxygen, temperature, mix quality, etc.)

Questions

- Why not use more modern and representative data to generate EF's?
- Shouldn't the EF's be updated and be based on the composting method used?
  - Forced aeration versus passive aeration
  - Positive versus negative aeration
  - Etc.

Questions?

geoffh@compostsystems.com

tim@compostsystems.com

206-634-2625

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