Research to Improve Compost Facility Air Emissions Permitting*

Co-PI's: **Dr. Tom Jobson, Washington State University**
Tim O'Neill, Engineered Compost Systems

Research Funded by:
*Environmental Research and Education Foundation (2021)
Washington State Department of Ecology (2022)

I still have a dream for this research

Provide the scientific basis for a permitting structure that:

1. Achieves the aims of the regulatory community, and
2. Imposes a productive burden on the composting community

The current state of regulating composting air emissions in WA (and the USA) impedes sustainability

- Inconsistencies between jurisdictions
- Too often adversarial
- Frequently includes non-productive conditions
- Commonly requiring long and complicated permitting negotiations with uncertain outcomes

Why I believe we can do better

- Regulators and composters have the same ultimate goals
- We'll much more progress working together
- When regulations, facility design and operations adhere to a scientifically valid set of principles (like the WWT industry), outcomes will improve for regulators, developers, operators and neighbors.

Why is the fix illusive?

- The science of composting and air chemistry are complicated
- The federal and state statues are complicated and are open to interpretation
- Regulators are not rewarded for taking risks
- There has been a lack of good data

How do we get there?

Get away from fixed "Potential to Emit" by class of feedstocks and adopt a more nuanced, process quality approach

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**

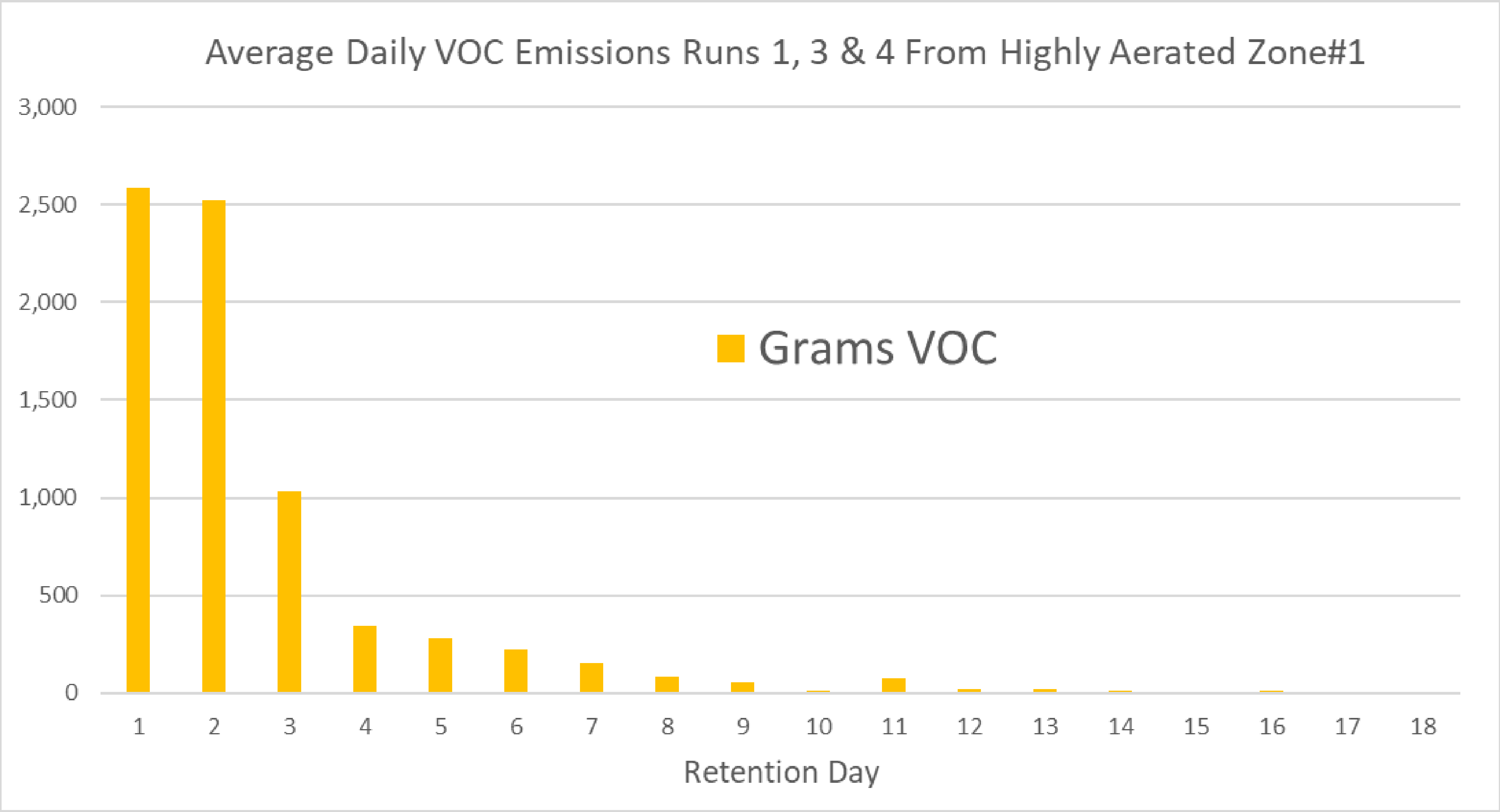
*Source test contained 15% by weight foodwaste

First Step: Define two classes of air emissions

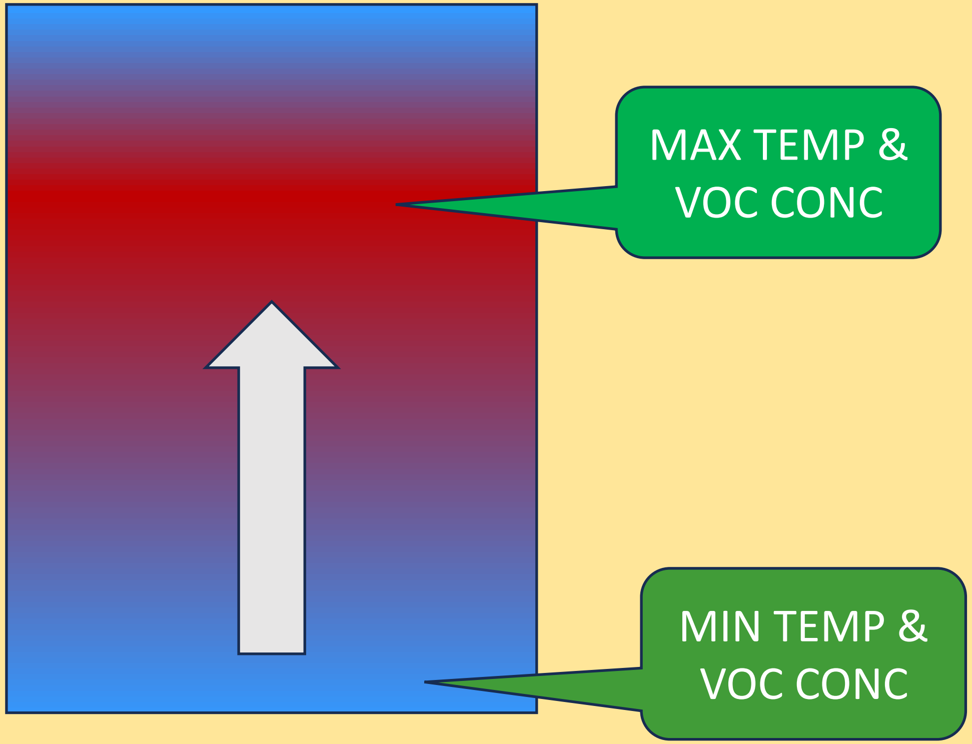
- Early: Compounds that come with the raw feedstocks
  - Short-lived
  - Largely managed with BMPs
  - Often cause a spike in emissions during first few days of heating/aeration

- Process: Compounds that are formed during composting/storage
  - The primary focus of most regulations
  - Emission rates are determined by process conditions
  - *The PTE of compost is determined by the stability of the material*

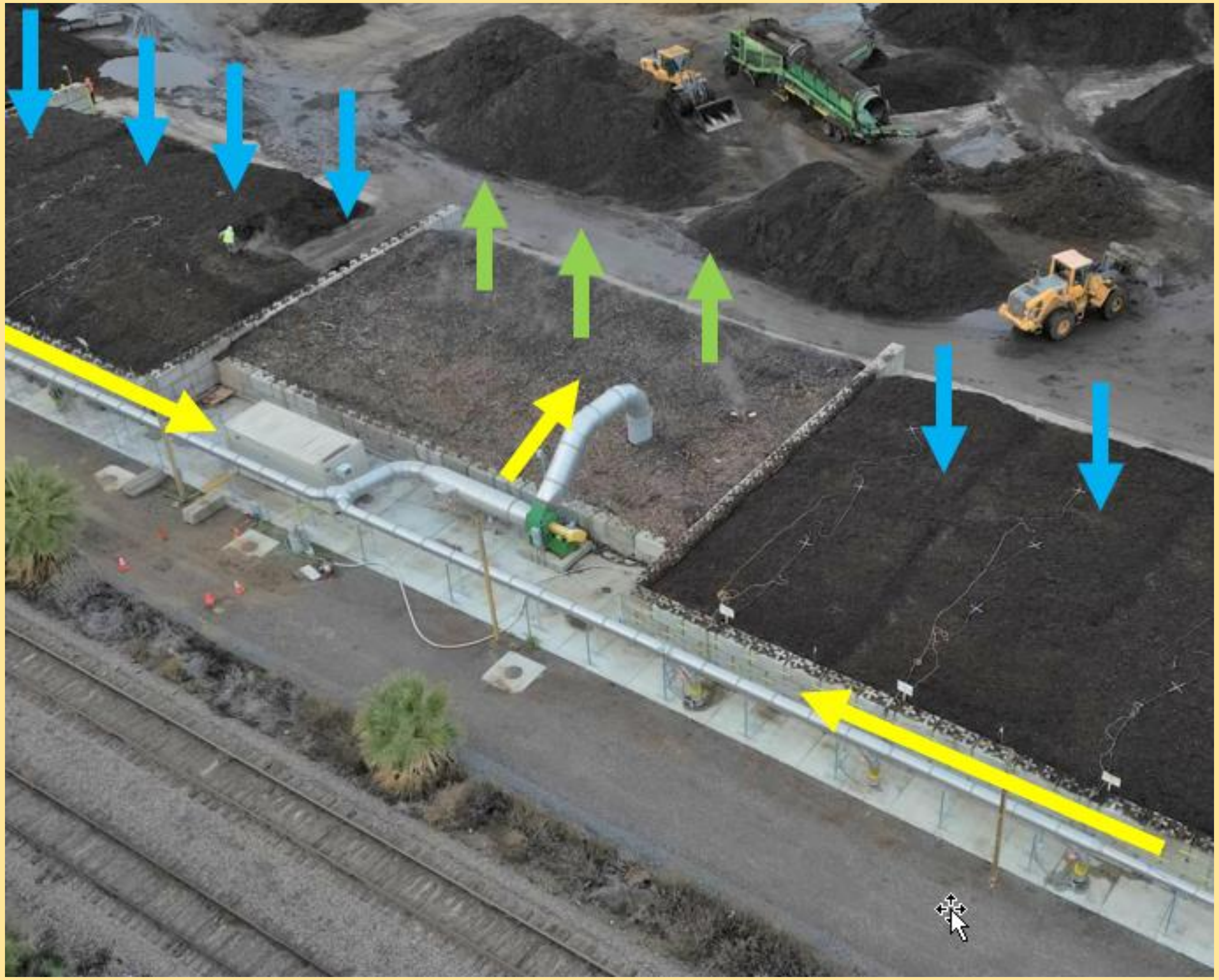
Early air emissions in an efficient process

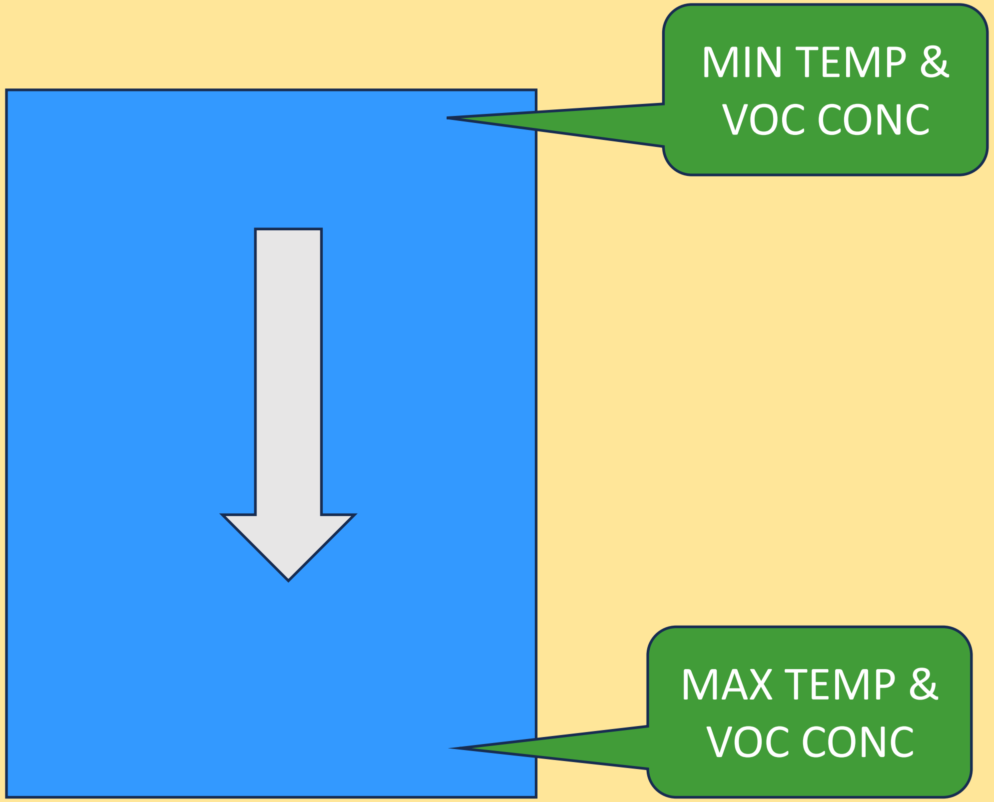


Mitigating early air emissions: Positive Aeration

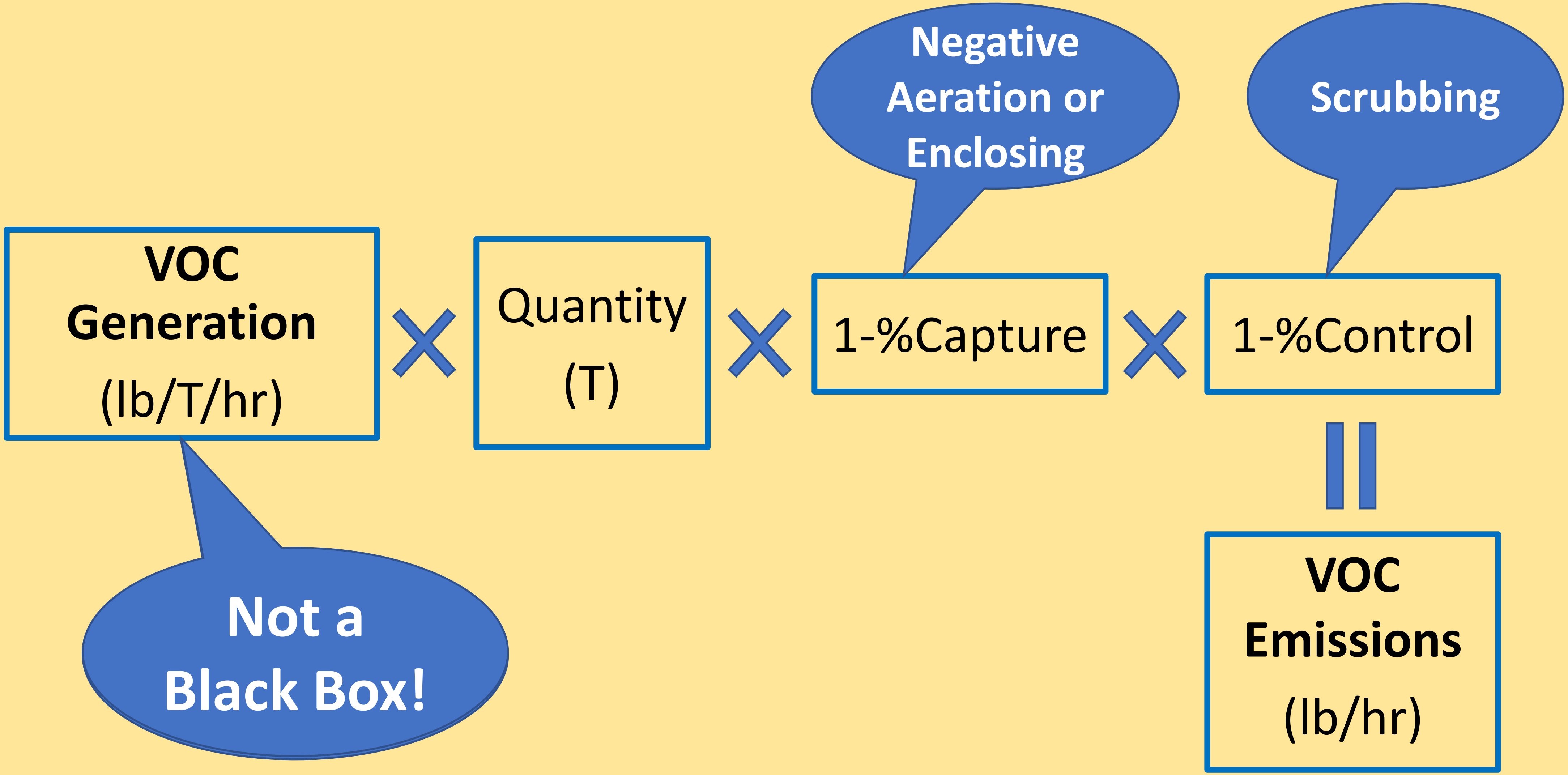


Mitigating early air emissions: Negative Aeration





Process air emissions aren't "fixed"



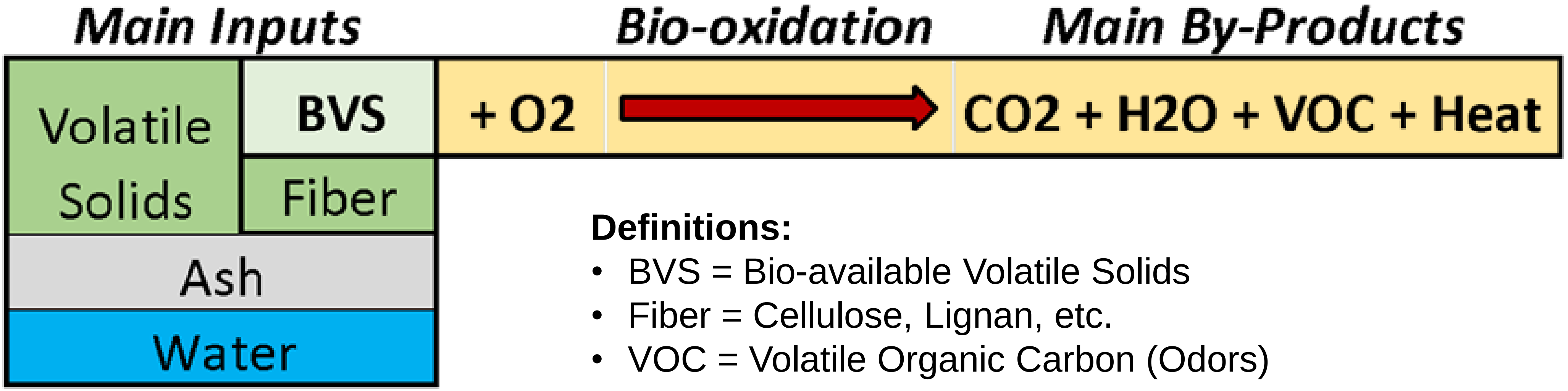
Process air emissions – Generation rates

The KPI's that control the rate of VOC generation are:

- Mix characteristics (%BVS, C/N, %MC, density)
- Temperature
- Oxygen availability
- pH

- These KPI's are controlled by process design & operations
- BUT….**these KPI's also control the rate of stabilization**

What is meant by “rate of stabilization”?



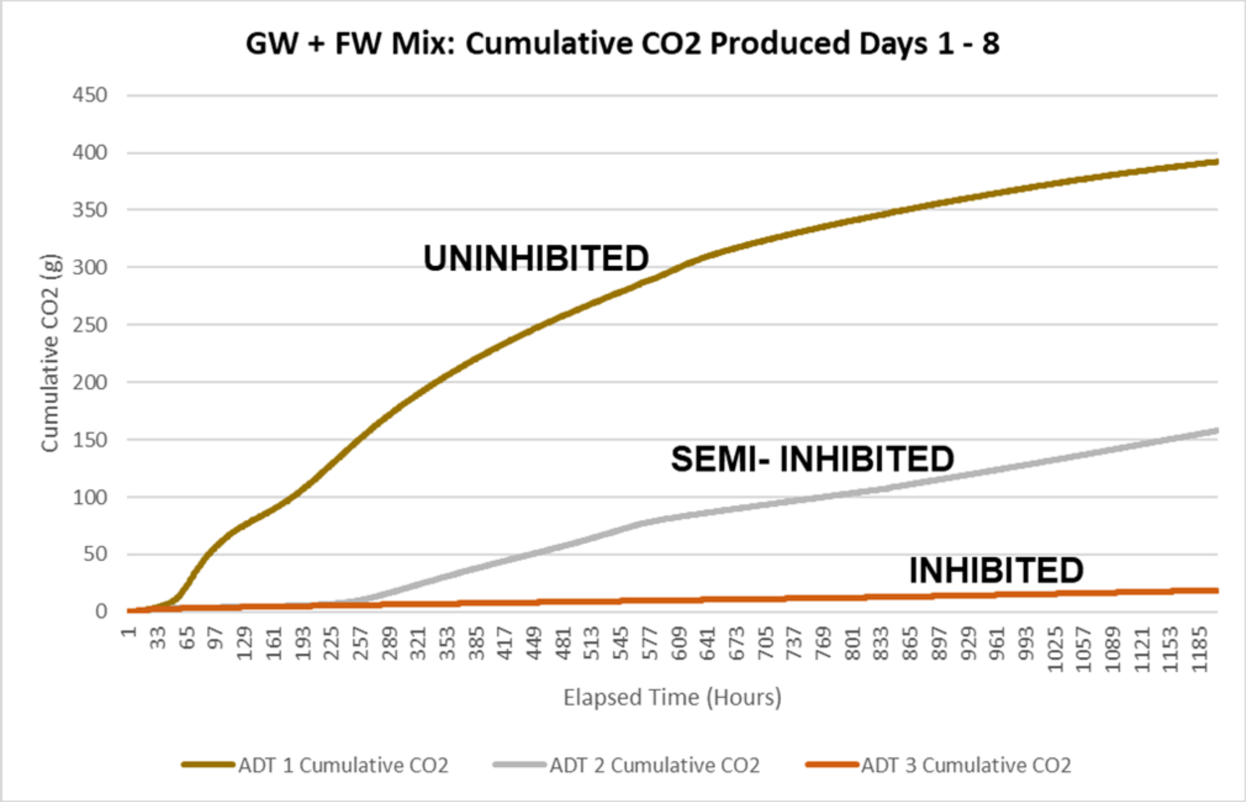
Definitions:

- BVS = Bio-available Volatile Solids
- Fiber = Cellulose, Lignan, etc.
- VOC = Volatile Organic Carbon (Odors)

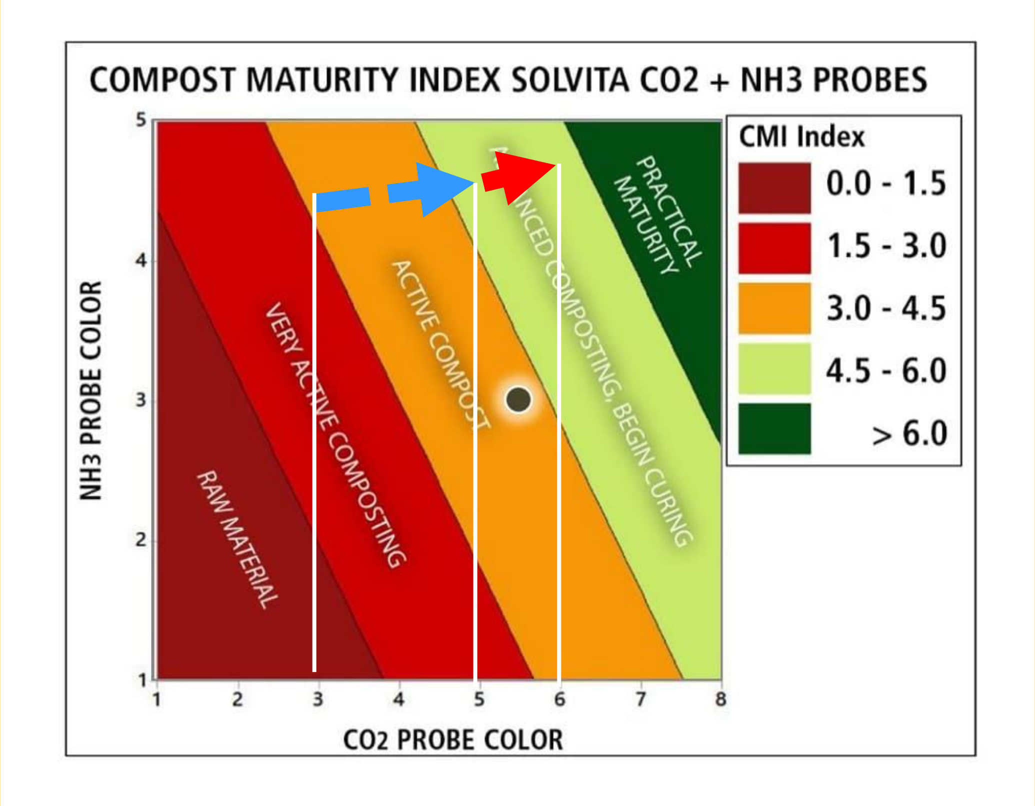
Answer: Rate at which BVS is converted to CO_2

What is meant by “rate of stabilization”?

The rate of CO2 generation over time is highly variably…depending on process conditions

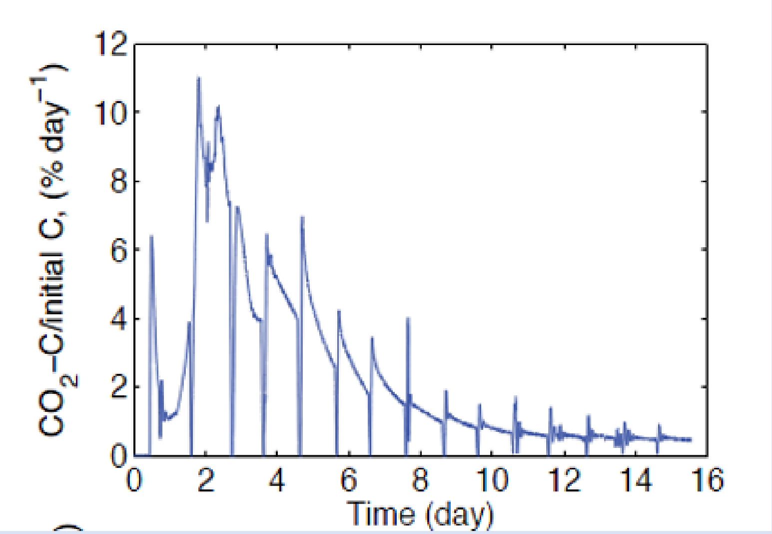


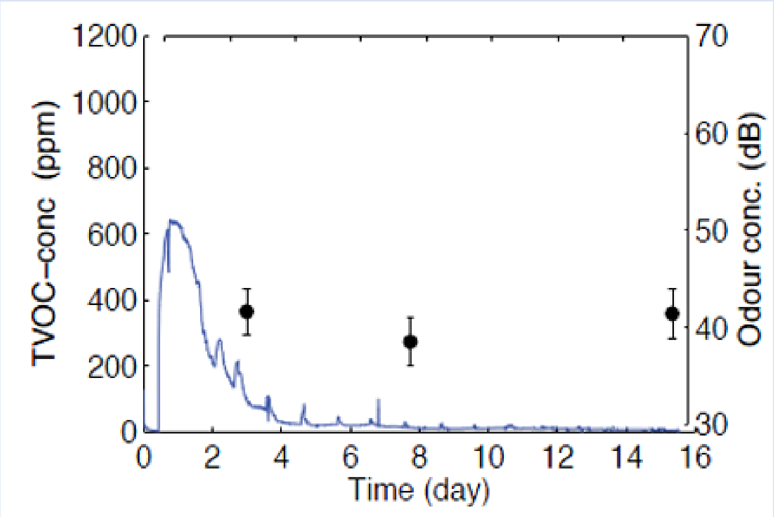
Compost stability is often assessed via CO2 generation rates. (TMECC 05.08-B & Solvita Index)



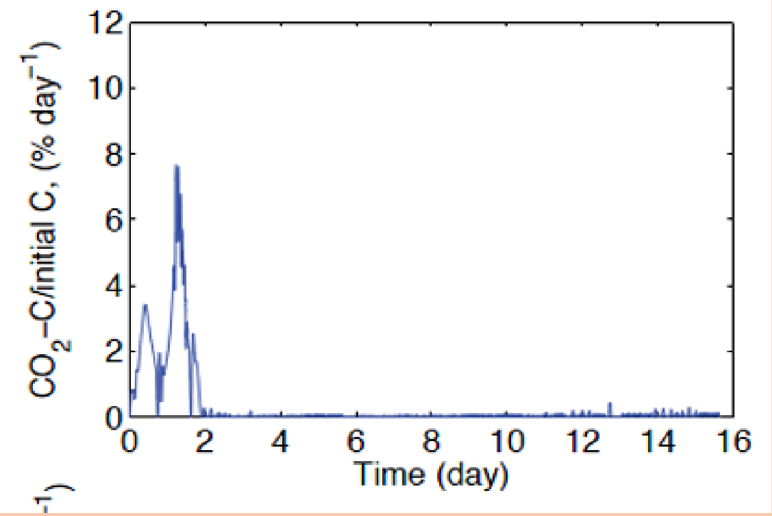
Fast stabilization correlates to low VOC generation

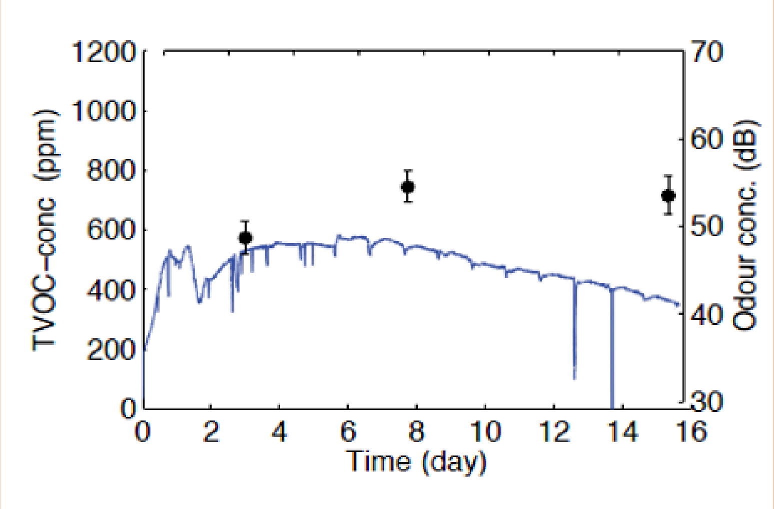
<u>Not pH Uninhibited</u>
Initial pH 4.5
Days 1 - 2:   40°C
Days 3 -16: 55°C





<u>Low pH Inhibited</u>
Initial pH 4.5
Day 1: 40°C
Day 2 -16: 55°C





Source:
Dr. Celia Sundberg

Field Data:

KPI's determine Stabilization determine VOC generation

Facility	Retention Days	Average pH	Average O2%	Typical Temp C	Ave Solvita CO2 Index	VOC EF (lb/ton)
SSO Phase 1	16	6.4	18.7%	45-65	5.3	0.18
SSO Phase 2	32	nd	nd	45	nd	0.08
Napa Phase 1	22	6.4	20.1%	45-65	5.7	0.12
Napa Phase 2	48	Uncontrolled Static Pile			6.2	0.19
WT Phase 1	27	5.6	6.6%	72.0	4.3	nd
WT Phase 2	42	5.6	7.0%	71.5	4.9	nd
WT Curing	>43	Turned Windrow				#
# Odor complaints from 1.4 miles away when windrows are turned						

Concept for a Tiered VOC Emissions regulatory framework

	Retention Day		
Solvita	**Tier 1**	**Tier 2**	**Tier 3**
>5.0	14	28	42
>6.0	42	70	>70
VOC PTE lb/ton	0.4	1.6	3.6

Next steps

- Short-term: Lobby to reduce default Potential to Emit emission factors.
- Continue the research further develop the data that correlates VOC emission factors with:
  - Levels of stability (respiration)
  - Rates of stabilization (retention time to achieve respiration milestones)
- Continue the research into speciation (concerns regarding HAPs) to establish threshold for TPY + Tier level to minmize costly source testing
- Continue to advocate for simpler source test methods

Questions?

Hard Science: Dr Tom Jobson tjobson@wsu.edu

Easier Stuff: tim@compostsystems.com