

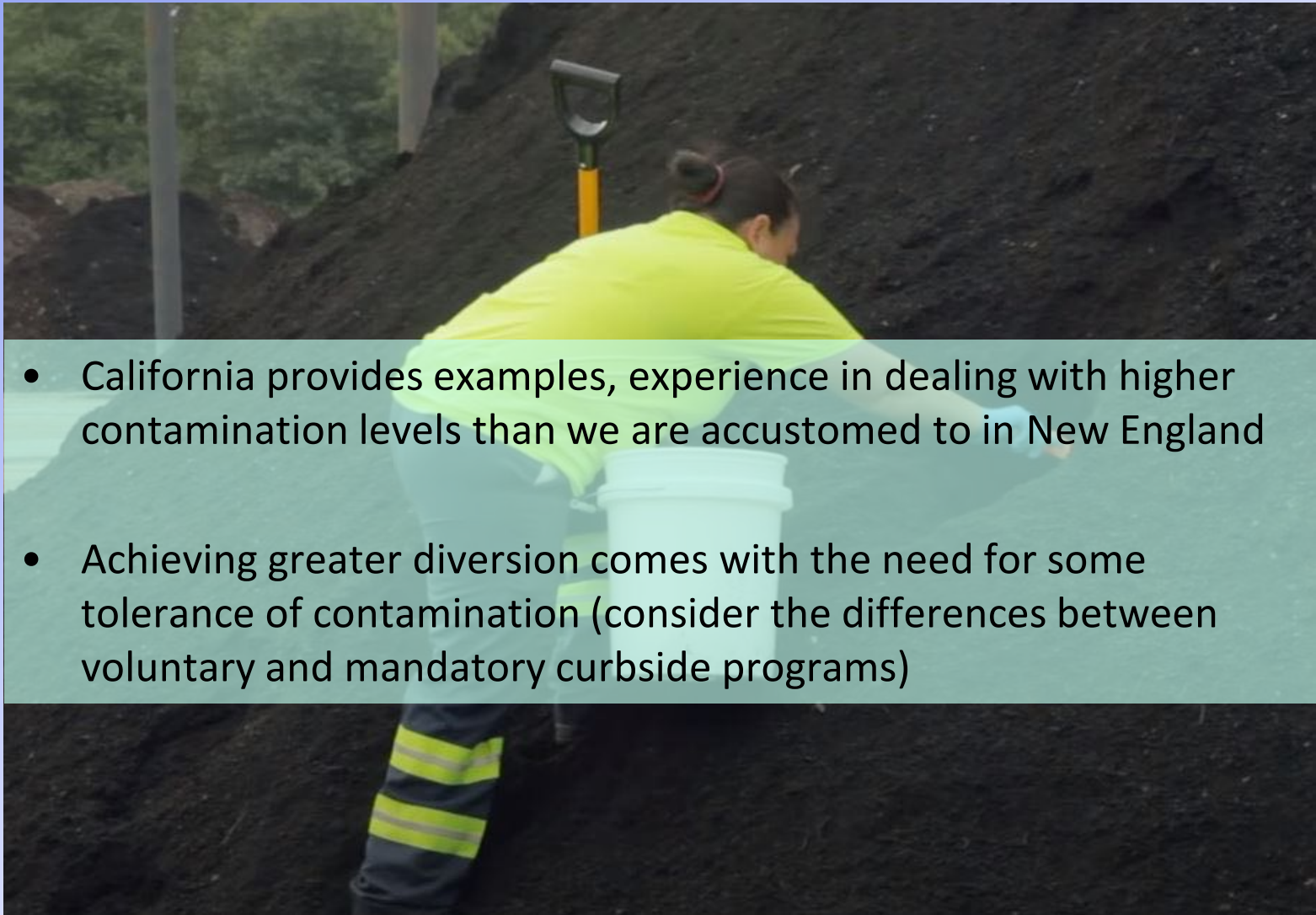
Potential Chemical and Physical Contamination Issues in Composting



Andrew Carpenter, Northern Tilth

2020 Vermont Organics Recycling Summit –
2020 & Beyond

Higher diversion can result in higher contamination



- California provides examples, experience in dealing with higher contamination levels than we are accustomed to in New England
- Achieving greater diversion comes with the need for some tolerance of contamination (consider the differences between voluntary and mandatory curbside programs)

PFAS in Assorted Media

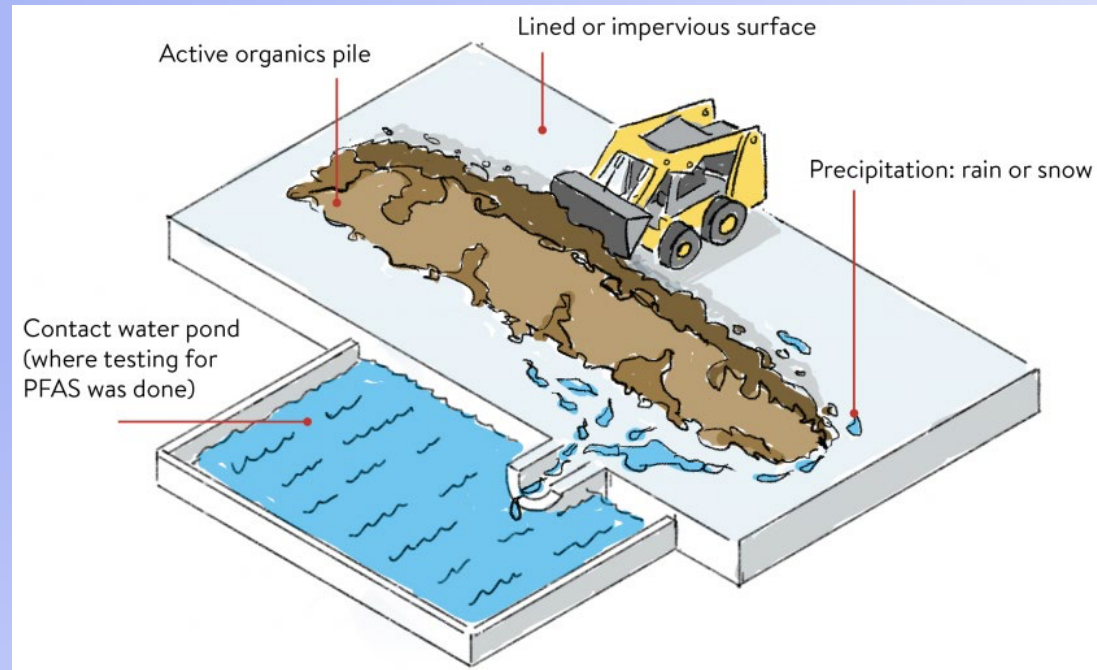
There has been a significant decrease in the concentration of PFOA and PFOS in the US population over the last 2 decades

		PFOA	PFOS
		<i>ug/kg (ppb) dry wt. basis</i>	
Human Blood - US population 1999 (CDC NHANES)		5	30
Human Blood - US population 2012 (CDC NHANES)		2	6
Dust in US Daycare Centers (Strynar and Lindstrom, 2008)		142	201
Household compost (Europe, Brandli et al 2007. J. Env. Monitoring)	median	6 (sum of PFAS)	
Vermont Background Soil conc. (Zhu et al 2019, by UVM for VT DEC)	Avg.	0.52	1.1
Concealer/Foundation cosmetic (Danish EPA 2018)	Up to	2370	

PFAS At Minnesota Composting Sites

Composters that accept

- only yard trimmings are not required to collect and treat water but those that
- Accept food scraps and compostable products are required to collect and treat contact water



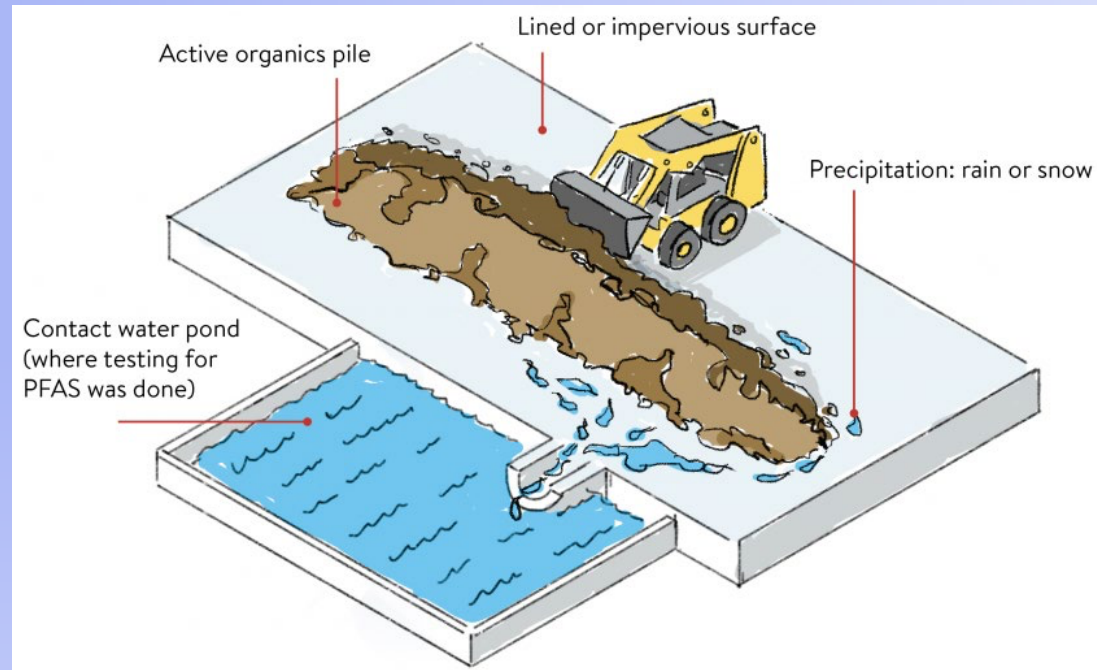
State releases findings of contact water testing at source separated organics and yard trimmings only composting sites: The study confirmed the presence of one or more PFAS chemicals at concentrations above intervention limits at all SSOM and yard waste sites sampled

PFAS At Minnesota Composting Sites

Composters that accept

- only yard trimmings are not required to collect and treat water but those that

- The composting process does not effectively degrade most PFAS compounds at

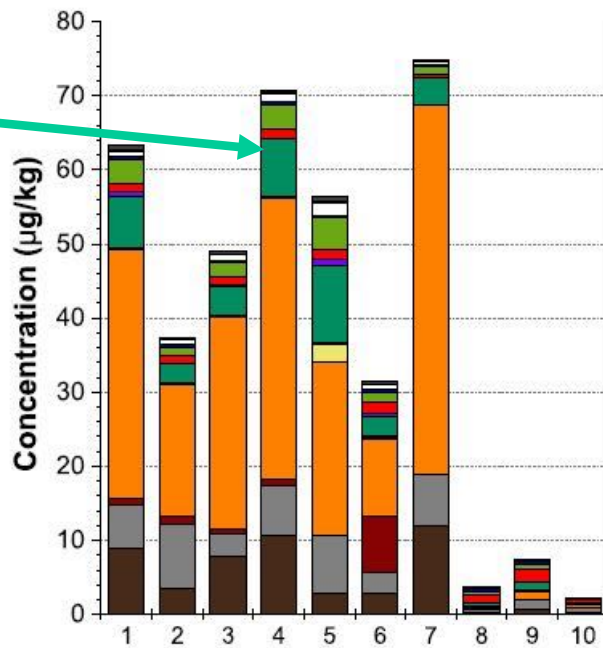


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Results from other media

From Choi et al. 2019. *Perfluoroalkyl acid characterization in U.S. municipal organic solid waste composts.* – supporting data provided by Dr. Linda Lee, Purdue University

Note that the PFOA level in several of these non-biosolids composts would be higher than the Maine screening standard of 2.5 ppb)



	Description
1	Municipal solid waste
2	Municipal solid waste and wood products
3	Residential and commercial food and yard waste, compostable food serviceware products
4	Res was
5	Mixi gro han
6	Res con
7	Foc shavings, coffee grounds and lobster shells, & compostable food serviceware
8	Leaves and grass waste from municipalities
9	Residential back yard compost bin
10	Leaves

source	PFOA conc. (µg/kg dry wt)
1	6.88
7	3.64
8	0.48
9	1.05
10	0.47

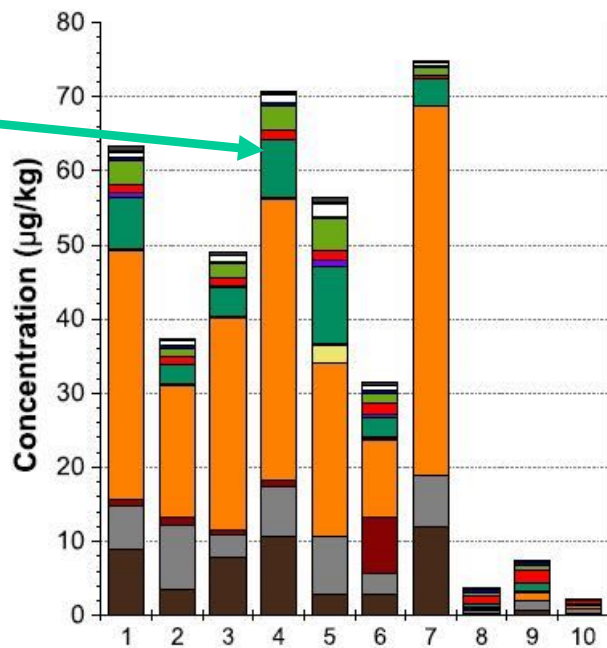
As we work towards recovering a greater percentage of our organic wastes, the likelihood of unintentionally capturing more PFAS-type compounds is likely

Figure 1. PFAA concentrations quantified (micrograms per kilogram oven-dried, <2 mm) in the compost (left) and the relative contribution (percent) of each PFAA to the total PFAAs quantified for composts 1–10 (right).

Results from other media

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	Description
1	Municipal solid waste
2	Municipal solid waste and wood products
3	Residential and commercial food and yard waste, compostable food serviceware products
4	Residential and commercial food and year waste, compostable items
5	Mixed food waste (residential, local grocers, restaurants, and commercial food handling facilities) and yard waste
6	Residential food and yard waste, & compostable food serviceware
7	Food waste, horse manure, wood shavings, coffee grounds and lobster shells, & compostable food serviceware
8	Leaves and grass waste from municipalities
9	Residential back yard compost bin
10	Leaves

source	PFOA conc. (µg/kg dry wt)
1	6.88
2	2.54
3	3.58
4	7.85
5	10.31
6	2.73
7	3.64
8	0.48
9	1.05
10	0.47

Figure 1. PFAA concentrations quantified (micrograms per kilogram oven-dried, <2 mm) in the compost (left) and the relative contribution (percent) of each PFAA to the total PFAAs quantified for composts 1–10 (right).

ME DEP Resumption of compost distribution

- Cumulative loading calculation for land-application on agricultural fields

PFOS Concentration In Soil Using Site-Specific Background	
Current Soil Concentration (ug/kg)	2.13
PFOS concentration in compost (ug/kg)	17.8
PFOS soil increase per year (ug/kg)	0.04
% background increase from 1 application	1.84
Number of Years Residual Applied	PFOS Conc in Soil After Application (ug/kg)
1	2.17
2	2.21
3	2.25
4	2.29
5	2.33

VT Background Soil PFAS Levels	
Compound	ug/kg (ppb) dry wt.
PFOA	0.52
PFOS	1.1

Mean concentrations from Zhu, W., Roakes, H., Zemba, S., Badireddy, A., *PFAS Background in Vermont Shallow Soils* (February 8, 2019)

PFAS Sampling Supplies & equipment



- Stainless steel bowls
- Stainless steel spoons
- Tile shovel
- Sample containers & COC from lab
- Nitrile gloves
- Field decon kit: tap water, distilled water, pfas-free water, alcanox solution, brush, sponge, Ziploc bags
- Coolers with ice
- A vehicle large enough to fit all of this crap

Speaking of recalcitrant synthetic organic compounds



Effects on Aminopyralid in
compost on Fava Beans

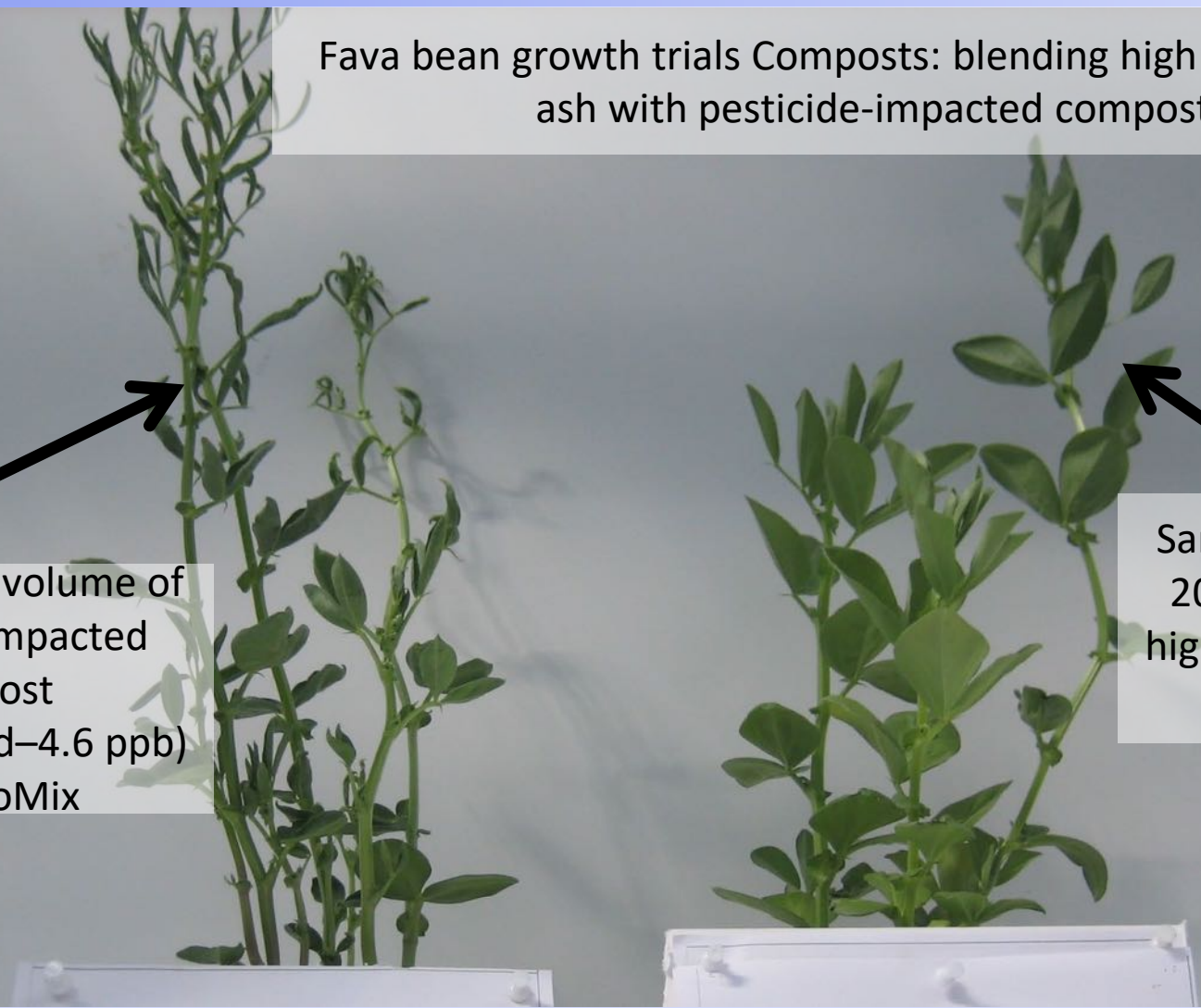
Injury Ranking Scale	Description of injury
0	no symptom
0.5	slight leaf curl, first observed level
1	less than moderate effect
1.5	moderate leaf curl noticeable
2	very noticeable leaf curl and slight distortion
3	pronounced leaf curl and distortion
4	close to total inhibition

High Carbon Wood Ash Use for Use with Pesticide Impacted Composts

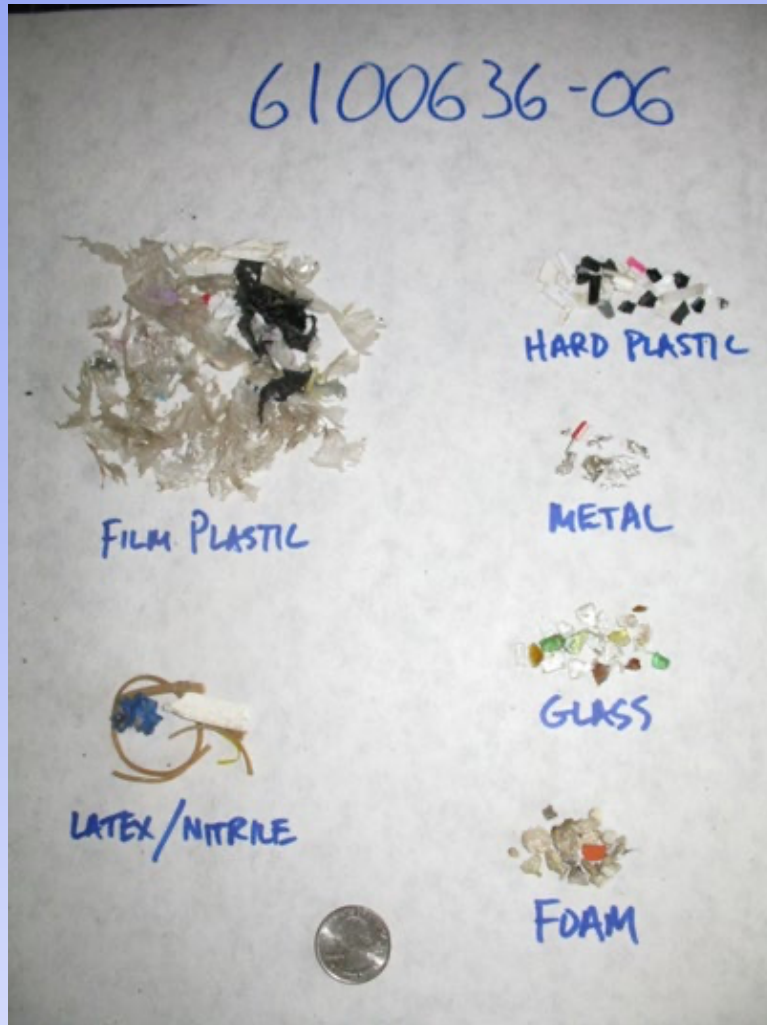
Fava bean growth trials Composts: blending high carbon wood ash with pesticide-impacted composts

1:1 blend by volume of pesticide-impacted compost (aminopyralid-4.6 ppb) and ProMix

Same blend with 20% by volume high carbon wood ash



Potential Physical Contaminants



- Film plastic
- Hard Plastic
- Metal
- Glass
- Unidentifiables!

As we do a better job of recovering the organic waste stream from the larger municipal solid waste stream, we will need to contend with greater levels of physical contamination

Regulatory Standards for Physical Contaminants in Compost

California standards

Quality characteristic	Test method ^a	Requirement	
		Fine	Medium/Coarse
Physical contaminants (% dry weight) Plastic, glass, and metal	TMECC 02.02-C	Combined Total: < 0.5	Combined Total: < 1.0
Film plastic (% dry weight)	TMECC 02.02-C	Combined Total: < 0.1%	Combined Total: < 0.1%

Ontario Canada standards

Table 3.3 - Maximum Concentration of Foreign Matter in Compost

Parameter	Category AA	Category A	Category B
Foreign matter	Total foreign matter greater than 3 mm shall not exceed 1.0%, calculated on a dry weight basis, and plastic cannot exceed 0.5%; and Compost shall not contain any foreign matter greater than 25 mm per 500 ml.	Total foreign matter greater than 3 mm shall not exceed 1.0%, calculated on a dry weight basis, and plastic cannot exceed 0.5%; and Compost shall not contain any foreign matter greater than 25 mm per 500 ml.	Total foreign matter greater than 3 mm shall not exceed 2.0%, calculated on a dry weight basis, and plastic cannot exceed 0.5%; and Compost shall not contain any foreign matter greater than 25 mm per 500 ml.
Sharp foreign matter	Compost shall contain no material of a size or shape that can reasonably cause human or animal injury.	Compost shall contain no material of a size or shape that can reasonably cause human or animal injury.	Compost shall have a maximum of 3 pieces of sharp foreign matter per 500 ml; and The maximum dimension of any sharp foreign matter shall be 12.5 mm.

Potential Physical Contaminants – Pre-processing

Picking Stations

ID problems with
compostable materials



Photo from Matt Cotton, Integrated Waste Management Consulting



Photo from Dirt Hugger Compost

Potential Physical Contaminants – Pre-processing

Mechanical Separators - Depackagers



Potential Physical Contaminants – Incentives to Minimize

Fees to municipalities/haulers for non-allowed items



Photo from Dirt Hugger Compost Facility

Potential Physical Contaminants – Post-Processing



Pneumatic Separation:
Vacuuming the light
fraction



Photo from Matt Cotton, Integrated
Waste Management Consulting

Photo from Dirt Hugger Compost

1 kilogram of contaminated dry compost



Quantifying Physical Contamination

Each represents 0.5% of the total dry weight of the 1 kg of contaminated dry compost

There are 2 TMECC methods for quantifying physical contaminants in compost

- Dry sieving (0308)
- Wet sieving (0306)



metal



glass



film plastic

Compost Sampling Video by CCREF



<https://www.youtube.com/watch?v=0C-m5zNCGQg&t=405s>

Summary

- Greater removal of organics from the municipal solid waste stream → greater physical and chemical contamination.
- Some tolerance is necessary to make higher recycling rates possible
- There are options related to collections, incentives, pre and post-composting treatment to minimize both physical and chemical contamination in the final compost.