



Feasibility of Using C&D Wood Waste in Biosolids Composting

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Background

- Edmonton Waste Management Centre receives C&D waste wood
 - 20,000 tonnes of clean wood (2012)
 - 25,000 tonnes of treated wood (2012)
- Treated wood has historically been landfilled
 - Chemicals used to treat wood include:
 - Lead (from leaded paints)
 - CCA: chromium, copper, and arsenic (from pressure-treatment)



Background

- Chemicals used to treat the wood may end up in the compost
 - Chipping wood increased exposed surface area
 - Microbial activity can release trace elements from the treated wood
- And possibly in the environment...
 - Trace elements may leach out of the compost after application

Question

- Can treated C&D waste wood be used safely and effectively in biosolids composting?





Study Objectives

- Determine whether treated C&D waste wood can be used as a bulking agent in biosolids composting operations.
 - Will the chemicals in the wood affect the composting process?
 - Will the finished product meet CCME guidelines for trace elements?
 - Where do the trace elements end up (wood chips, screened compost, or leachate)?

Methods

- Two pilot-scale trials composting biosolids in aerated static piles
 - Clean wood chips from C&D
 - Treated wood chips from C&D (painted and pressure-treated wood)
- Target mix was 1:1 biosolids: wood chips (mass)
 - Clean wood pile actual: 1: 0.98
 - Treated wood pile actual: 1: 0.8
- Composted for 7 weeks and cured for 20 weeks



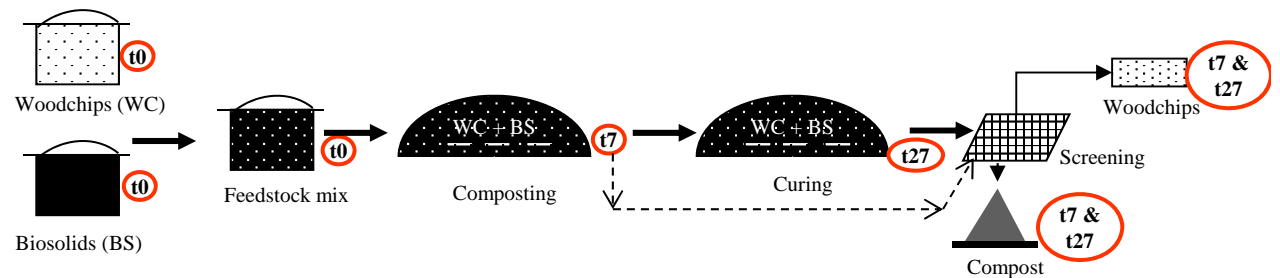
Process Monitoring


- Temperature
 - Every 30 minutes; average of temperatures at a depths of 0.3 m and 0.7 m reported
- Moisture content
 - Weeks 0, 7, 8, 9, 11, 13, 14, 18, 20
- Maturity by Solvita
 - Weeks 13, 18, 27



Sampling and Testing

Sampling date	Collected samples	Parameters
Initial, t_0	<ol style="list-style-type: none"> Biosolids Woodchips Mixes 	<ol style="list-style-type: none"> MC, trace elements, OM, fecal coliforms MC, trace elements MC, trace elements
After active composting, at 7 weeks, t_7	<ol style="list-style-type: none"> Mixes were collected and screened to obtain: <ol style="list-style-type: none"> woodchips; compost Absorbent pads 	<ol style="list-style-type: none"> <ol style="list-style-type: none"> Trace elements MC, PTEs, pH, EC, OM, fecal coliforms, and Solvita maturity test Trace elements
During curing at 23 weeks, t_{23}	<ol style="list-style-type: none"> Mixes were collected and screened 	<ol style="list-style-type: none"> CO₂ respiration test (screened material)
After curing at 27 weeks, t_{27}	<ol style="list-style-type: none"> Mixes were collected and screened to obtain: <ol style="list-style-type: none"> woodchips; compost Absorbent pads 	<ol style="list-style-type: none"> <ol style="list-style-type: none"> Trace elements MC, PTEs, pH, EC, OM, fecal coliforms, and Solvita maturity test Trace elements

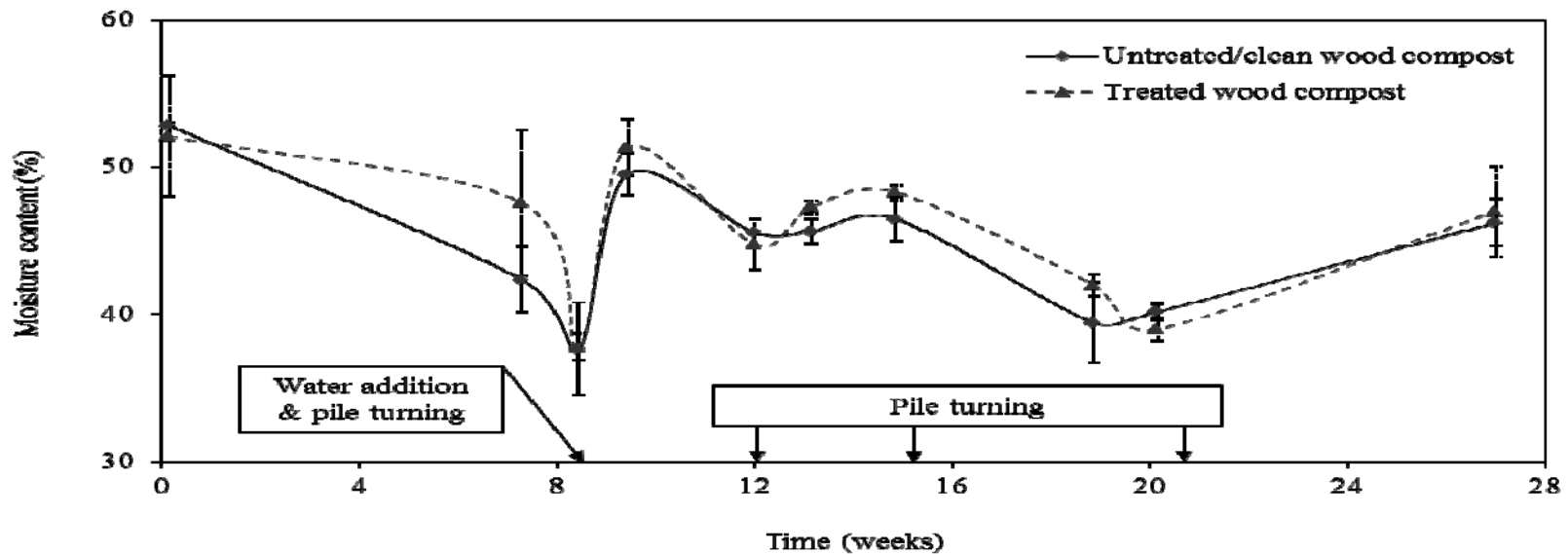
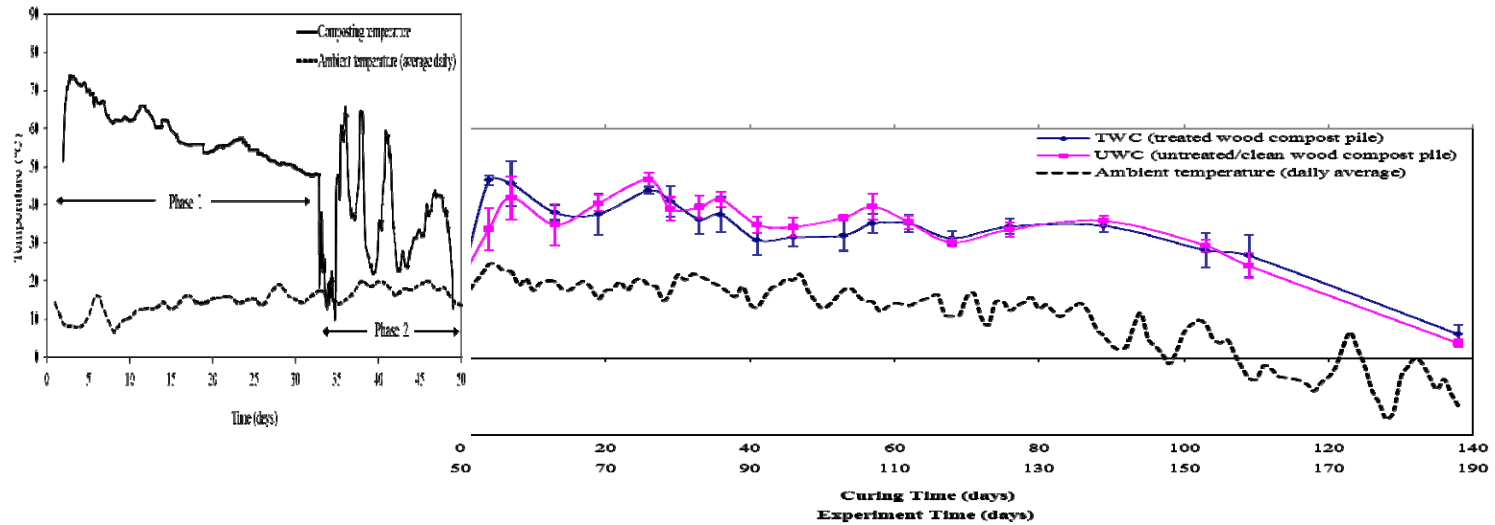




Sampling and Testing - Trace Elements

Trace Element	CCME compost product guidelines values (mg/kg)	
	Category A	Category B
As	13	75
Cd	3	20
Cr	210	1060
Co	34	150
Cu	400	757
Pb	150	500
Hg	0.8	5
Mo	5	20
Ni	62	180
Se	2	14
Zn	700	1850

Results - Process Monitoring



Results - Process Monitoring

- Similar C:N, pH, electrical conductivity, organic matter, fecal coliforms, and maturity (not shown) between treatments

Parameter	Units	Treatment	Initial	Week 7	Week 27
C:N	-	Clean	31.2 (4.2)	16 (0.0)	17.6 (1.6)
		Treated	29.5 (4.1)	16.5 (0.7)	16.3 (1.6)
pH	-	Clean	7.0 (0.1)	7.0 (0.2)	5.6 (0.1)
		Treated	7.0 (0.1)	7.0 (0.2)	5.6 (0.1)
EC	mS/cm	Clean	1.6 (0.1)	3.9 (0.1)	5.8 (0.2)
		Treated	1.6 (0.1)	3.4 (0.2)	5.8 (0.3)
OM	%	Clean	77.7 (3.1)	55.7 (5.5)	59.3 (4.2)
		Treated	77.6 (0.5)	61.5 (1.5)	60.1 (5.9)
FC	MPN/g TS	Clean	$10^{6.36}$	$10^{1.86}$	$10^{2.01}$
		Treated	$10^{6.44}$	$10^{1.92}$	$10^{2.04}$

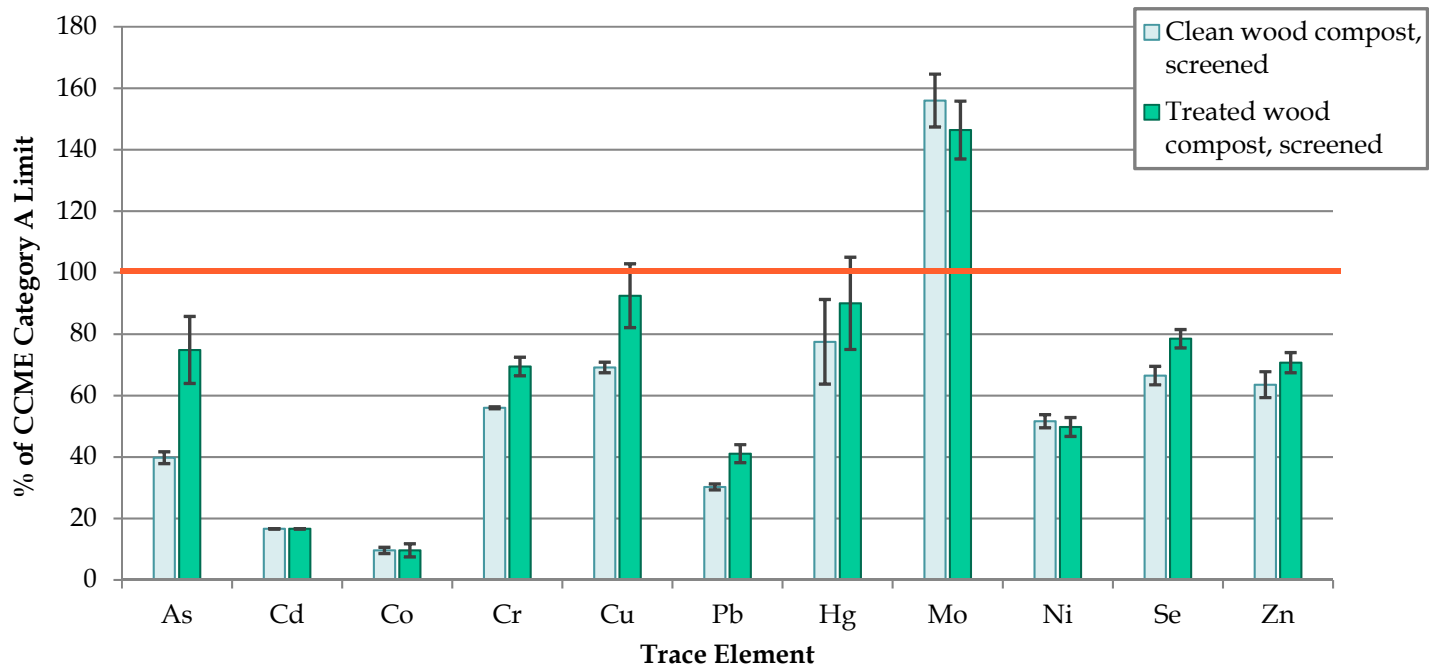
Results - Trace Elements (Feedstocks)

PTE	Biosolids (BS)	Woodchips (WC)		CCME compost guidelines values†	
		Clean	Treated	Category A	Category B
As	4.5 (± 0.2)	3.4 (± 2.7)	25.6 (± 34.8)	13	75
Cd	1.3 (± 0.1)	0.5 (± 0.0)	0.5 (± 0.0)	3	20
Cr	200 (± 4)	16.5 (± 8.2)	29.4 (± 40.8)	210	1060
Co	4.8 (± 0.1)	0.5 (± 0.0)	0.5 (± 0.0)	34	150
Cu	573 (± 10)	12.8 (± 2.2)	56.3 (± 46.2)	400	757
Pb	75.1 (± 3.2)	0.5 (± 0.0)	5.2 (± 4.6)	150	500
Hg	0.8 (± 0.2)	0.05 (± 0.00)	0.1 (± 0.0)	0.8	5
Mo	14.8 (± 0.4)	1.0 (± 0.0)	1.0 (± 0.0)	5	20
Ni	45.1 (± 0.3)	2.4 (± 0.6)	1.2 (± 0.0)	62	180
Se	3.6 (± 0.2)	0.5 (± 0.0)	0.5 (± 0.0)	2	14
Zn	748 (± 15)	16.0 (± 2.4)	28.4 (± 5.6)	700	1850

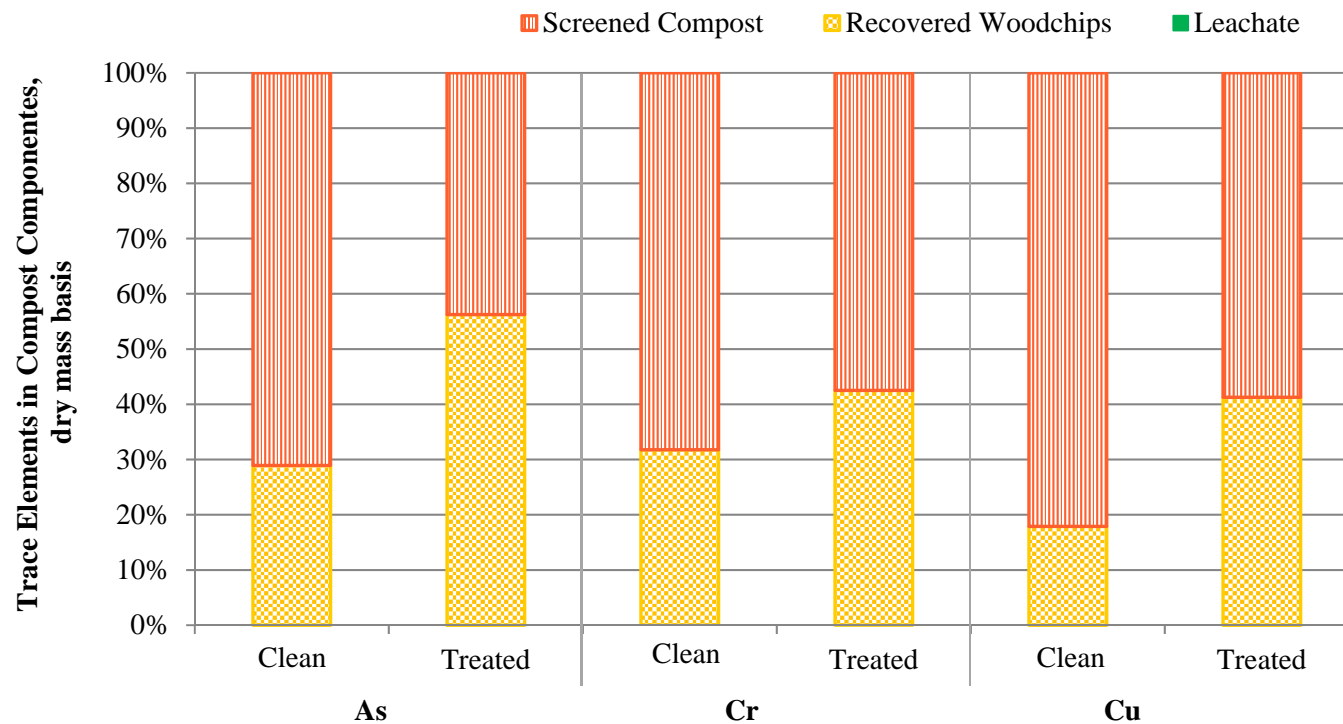
Results - Trace Elements (Product)

Trace Element	Clean woodchip compost	Treated woodchip compost	CCME Guidelines values (mg kg ⁻¹ = µg g ⁻¹)		Summary of clean wood compost Category A exceedances		Summary of treated wood compost Category A exceedances	
	Avg. conc. (µg g ⁻¹)	Avg. conc. (µg g ⁻¹)	Cat. A	Cat. B	no. (out of 3)	mean exceedance (µg g ⁻¹)	no. (out of 3)	mean exceedance (µg g ⁻¹)
As	5.2 (± 0.3)	9.7 (± 1.4)	13	75	0	n/a	0	n/a
Cd	0.5 (± 0.0)	0.5 (± 0.0)	3	20	0	n/a	0	n/a
Cr	118 (± 1)	146 (± 6)	210	1,060	0	n/a	0	n/a
Co	3.3 (± 0.4)	3.3 (± 0.7)	34	150	0	n/a	0	n/a
Cu	277 (± 7)	370 (± 42)	400	757	0	n/a	1	13.4
Pb	45.4 (± 1.4)	61.7 (± 4.4)	150	500	0	n/a	0	n/a
Hg	0.6 (± 0.1)	0.7 (± 0.1)	0.8	5	0	n/a	1	0.01
Mo	7.8 (± 0.4)	7.3 (± 0.5)	5	20	3	2.80 (2.3 - 3.05)	3	2.32 (1.95 - 2.85)
Ni	32.0 (± 1.3)	30.9 (± 1.9)	62	180	0	n/a	0	n/a
Se	1.3 (± 0.1)	1.6 (± 0.1)	2	14	0	n/a	0	n/a
Zn	445 (± 30)	495 (± 23)	700	1850	0	n/a	0	n/a

Results - Trace Elements (Product)

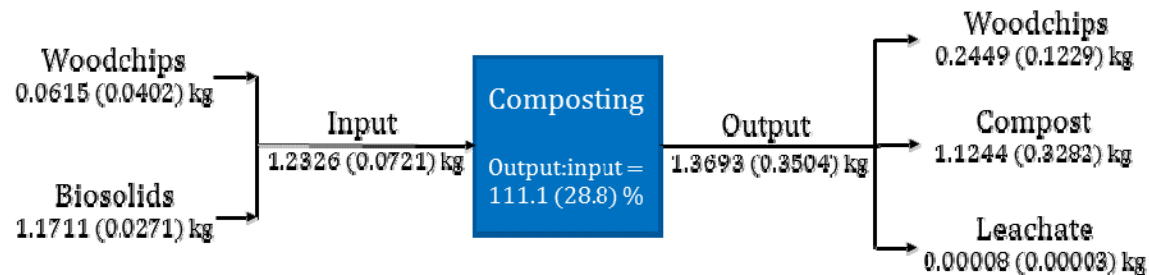


Trace Element Distribution After Composting



Trace Element Mass Balance

Cu balance for clean wood mix



Trace Element	Untreated woodchip compost			Treated woodchip compost		
	Input (kg)	*Corrected output (kg)	% Recovery	Input (kg)	Corrected output (kg)	% Recovery
As	0.041 (0.047)	0.030 (0.007)	72 (84)	0.083 (0.126)	0.049 (0.015)	59 (92)
Cr	0.487 (0.065)	0.701 (0.289)	144 (62)	0.461 (0.186)	0.630 (0.190)	137 (69)
Cu	1.233 (0.072)	1.369 (0.350)	111 (29)	1.123 (0.156)	1.580 (0.494)	141 (48)

*Corrected output was based on an organic/ volatile matter loss of approximately 18% plus an estimated loss of 5% during material transport.

Additional Wood Chip Samples

Trace Element	Clean Wood (n=6)	Treated Wood (n=12)	CCA-treated wood (n=1)	Pressure-treated wood - mixed (n=1)	Pressure-treated wood - layered			Painted wood (n=1)
					outer (n=1)	middle (n=1)	inner (n=1)	
As	6.24 (9.18)	14.5 (24.3)	488	BDL†	BDL	BDL	BDL	BDL
Cr	15.3 (12.6)	21.7 (35.9)	758	1.35	2.20	BDL	4.30	2.45
Cu	12.1 (7.9)	24.0 (29.8)	355	1840	8455	1834	765	7.3
Pb	1.53 (1.60)	4.78 (4.60)	BDL	BDL	3.50	1.35	10.8	2.45
Mo	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

All values have units of $\mu\text{g g}^{-1}$

† BDL = Below Detectable Levels ($1 \mu\text{g g}^{-1}$ for all elements except Mo, and $2 \mu\text{g g}^{-1}$ for Mo).



Conclusions & Recommendations

- Results of this study suggest that it may be possible to use treated wood as a feedstock for biosolids composting.
 - No detrimental effect on composting process
 - Molybdenum in biosolids is already high enough that it isn't possible to produce Category A compost
 - Even with addition of trace elements through treated wood chips, a Category B compost is still produced
 - It is recommended, if implementing this for the first time, that trace element testing be carried out regularly due to variability of trace element levels.



Conclusions & Recommendations

- However, there may be aesthetic issues
 - Painted and treated C&D wood may also contain nails, plastic, glass,
- City of Edmonton now uses painted C&D wood in their MSW composting operations.
 - Cost savings (reduced need for clean wood chips)
 - Beneficial use for treated wood waste
 - Used 9,000 tonnes in 2014; 15,000 tonnes in 2015
 - Meets CCME Category A



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