



AMERICAN WATER

Terratec Environmental

OPPORTUNITIES FOR BENEFICIAL USE OF SELECTED RESIDUALS IN ONTARIO

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INTRODUCTION

Ontario:

- One third of Canadian population concentrated near Lakes Erie and Ontario
- Intensive urban, industry and agriculture
- Vast amounts of residuals, e.g.,
 - Urban – sewage biosolids, municipal solid waste
 - Industry – food processing, paper fibre biosolids, other
 - Agriculture – animal manures, crop residues

OBJECTIVES

- Consider opportunities for beneficial use of selected urban & industrial residues in:
 - Agriculture
 - Tree nurseries
 - Land reclamation
 - Manufactured soils
 - Green energy

SEWAGE BIOSOLIDS

	TKN % ds	C:N % ds	Cd* mg/kg	Cu* mg/kg
An. Liq	4.7	5.6	1.1	489
An. Dew	3.2	8.0	1.4	621
Pellet	4.0	9.5	0.6	307
Comp.	1.7	23	<1	111
Alk. Ttd	1.1	13	5.9	122

*Acceptable Cd = 34 & Cu = 1,700 mg/kg

OTHER RESIDUES

	TKN % ds	C:N % ds	Cd mg/kg	Cu mg/kg
Paper Fibre Biosolids	0.5	61	1.0	301
Sugar Refinery Lime	nil	nil	<1	18
Mushroom Compost	1.9	15	2.7	51
Wood Ash	0.1	382	2.2	36

AGRICULTURE

- Sewage Biosolids – Liq. & Dew.
 - Provincial regulation
 - Supplied free-of-charge
 - Rates consistent with agricultural Best Management Practices
 - ~120,000 t yr⁻¹ ds on >15,000 ha
 - Max. 5 yr liq. application = \$500 ha⁻¹ fertilizer value (2008)
 - Current use saves Ontario farmers ~\$7 million yr⁻¹



AGRICULTURE

- Sewage Biosolids – Pellets, Alkaline Treated & Compost
 - Federal Regulation under Fertilizers Act
 - Available for purchase
 - ~60,000 t yr⁻¹ ds

 - Pellets: 1 t ha⁻¹ ds = \$200 fertilizer value (2008)
 - ◆ Component of commercial fertilizer blends
 - Alk. Ttd. (TKN 1.1% & C:N 13) - Primary use as soil liming agent
 - Compost (TKN 1.7% & C:N 23) - Doesn't meet guidelines for unrestricted use



AGRICULTURE

Sewage Biosolids Field Trials

	Plot 1	Plot 2	Plot 3
Treatment	Commercial fertilizer only	Heat Dried Pellets @ 1t/acre supplemented with commercial fertilizer	Dewatered Municipal Biosolids @ 3.2 dry t/acre supplemented with commercial fertilizer
Nutrients From all sources	N – 130 lbs/acre P – 90 lbs/acre K – 100 lbs/acre	N – 130 lbs/acre P – 90 lbs/acre K – 100 lbs/acre	N – 130 lbs/acre P – 90 lbs/acre K – 100 lbs/acre
Cost per acre for fertilizer	\$273	\$175	\$70
Savings per acre (hectare)	\$0	\$98 (\$242)	\$203 (\$501)

AGRICULTURE

- Paper Fibre Biosolids
 - Provincial regulation
 - Supplied free-of-charge
 - $70 \text{ t ha}^{-1} \text{ 5 yr}^{-1}$ wet wt = $\sim 40 \text{ t ds}$
 - C:N ~ 60 – immobilize soil N
 - Enhance soil OM and WHC
 - Excellent vineyard mulch (28 t ha^{-1} wet wt)



AGRICULTURE

- Sugar Refinery Lime
 - TKN = nil & C:N = nil
 - Valuable soil liming agent
 - ◆ Agr. Index = 90 (dolomitic lime = 75)
 - ◆ Value = \$650 ha⁻¹
- Mushroom Compost
 - TKN = 1.9% & C:N = 15
 - Meets guidelines for unrestricted use
 - Other markets more lucrative than agriculture
- Wood Ash
 - TKN = 0.1% & C:N = 382
 - Valuable soil liming agent (Agr. Index = 32)
 - ~1% ds K and OC (biochar?)



AGRICULTURE

- Combinations of Residues
 - SB, C:N <15 – N leaching
 - PFB, C:N >50 – N immobilization

SB (C:N)	40 t ha ⁻¹ PFB plus	
	8 t ha ⁻¹ SB	4 t ha ⁻¹ SB
Liq (5.6)	26*	35
Pellet (9.5)	26	39
Alk. Ttd (13)	47	53

*C:N = 25 – Good nutrient source

AGRICULTURE

- Combinations of Residues
 - Apply liq. / dew. SB central and pellets peripheral, to maximize field coverage
 - Apply residual lime before SB on fields with pH<6
 - Mix dewatered SB (<20% ds) 5:1 with PFB for safe transport and ease of application



AGRICULTURE

- Continue as large user of Ontario SB
- OMAFRA & MOE endorsement as standard farm practice
- SB valuable fertilizer soil conditioner
- Farmers satisfied
- Public acceptance improving post-Walkerton; pockets of resistance
- Continued PR efforts and research important



TREE NURSERY

- An. Liq. SB – 230 ha tree nursery in Durham Region
 - $60 \text{ m}^3 \text{ ha}^{-1}$ to base of trees
 - $\sim 45 \text{ kg ha}^{-1} \text{ N}$ applied 3 times in 5 years
 - Enhanced tree growth and soil tilth
 - $\sim \$200 \text{ ha}^{-1}$ fertilizer value per application
 - $\sim \$140,000$ value per 5 year approval period



TREE NURSERY

- Additional benefits
 - Reduced fertilizer and fossil energy use
 - “Green Cycle” of renewal – producers of SB benefit from trees for urban planting
 - Avoids human food-chain issues
- Opportunity for significant tree nursery use of Ontario SB



FORESTRY

- Possible residuals use – application rates related to tree nutrient requirements (gen. < agr. crop requirements)
- Avoids human food-chain issues
- New plantation – surface or sub-surface application
- Standing forest – access and application difficult
- Opportunity for significant forest use of Ontario residuals unlikely



LAND RECLAMATION

- Disturbed lands need nutrients, organic matter & water holding capacity
- Residuals can supply all of these in heavy application rates (eg. 100 t ha⁻¹ ds of SB)
- Land reclamation value of residuals proven internationally
- There has been limited land reclamation use of Ontario PFB
- Opportunity for significant use of Ontario residuals for land reclamation will require regulatory change to allow heavy applications



MANUFACTURED SOILS / MEDIA

- Greenhouse, container nursery & landscape industries use manufactured soils
 - Greenhouse - $\sim 300,000 \text{ m}^3 \text{ yr}^{-1}$
 - Container nursery - $\sim 75,000 \text{ m}^3 \text{ yr}^{-1}$
 - Landscape - $\sim 400,000 \text{ m}^3 \text{ yr}^{-1}$
- Media are made-to-order from various materials - not including SB



MANUFACTURED SOILS / MEDIA

- Greenhouse - peat moss, perlite, fertigation
- Container nursery – evergreen bark, peat moss, slow release fertilizer (successful use of PFB has been demonstrated)
- Landscape – screened topsoil & sand, peat loam, triple mix, mulch, wood chips
- Triple mix – 1/3 each of topsoil, peat moss & manure compost
- Opportunity for significant use of residuals in container nursery and landscape media



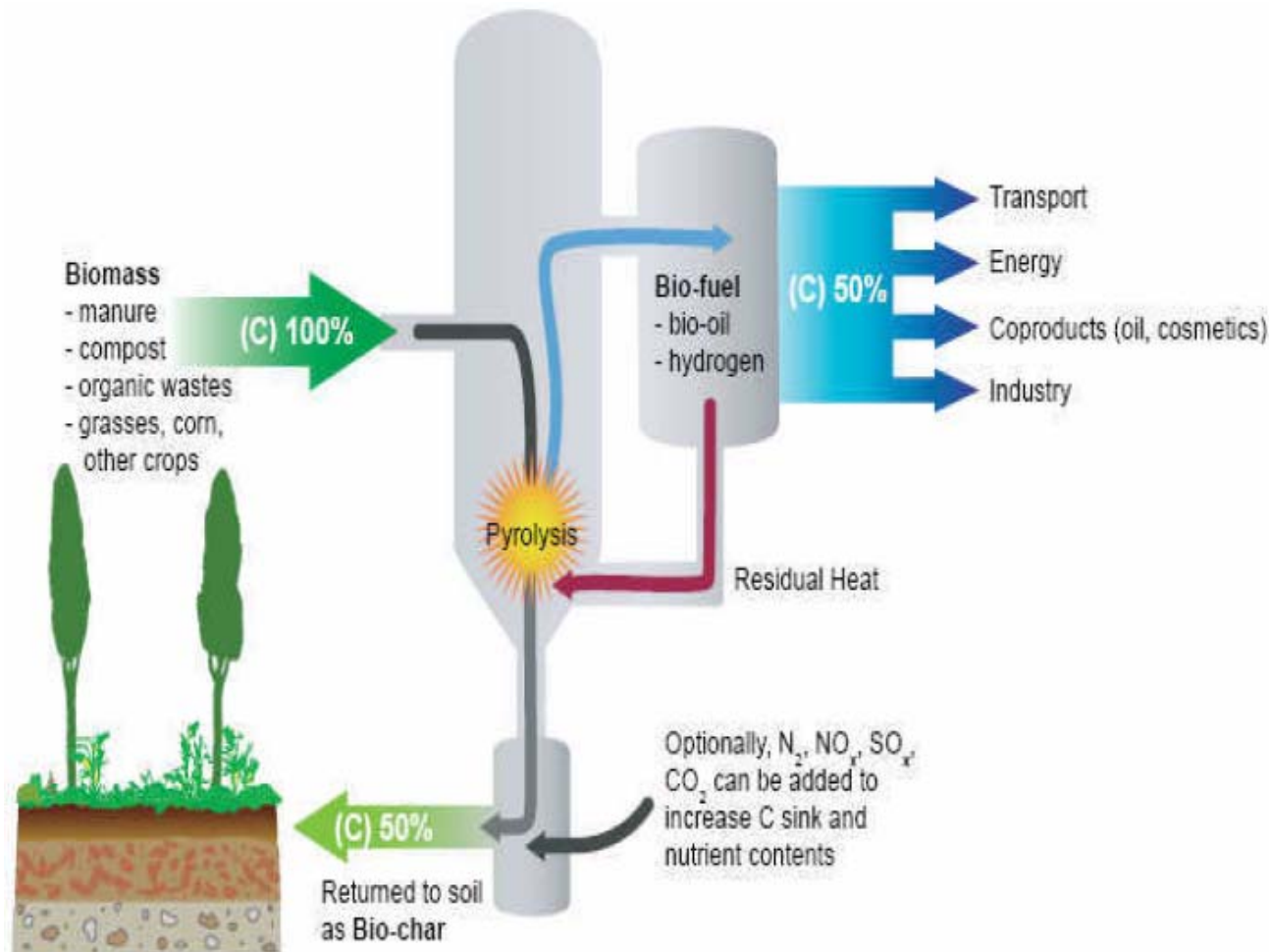
MANUFACTURED SOILS / MEDIA

Maximum permissible metal concentrations (mg/kg ds)
in manufactured soils/media

Parameter	Ontario	British Columbia		Quebec	
	Compost - unrestricted use	Class A compost	Biosolids growing medium	Fertilizing residuals - C1 metal conc'ns	Soil mixes
Cadmium	3	3	1.5	3.0	2.0
Copper	60	400	150	400	100
Lead	150	150	150	150	70
Nickel	60	62	62	62	52
Zinc	500	500	150	700	200

- Opportunity for significant use (~10%) of Ontario SB in triple mix - if regulations are changed

BIO-ENERGY



BIO-ENERGY

- SB pellets – Heat content (green energy) similar to soft coal
- Combine with coal to generate electricity
 - Ontario Power Generation recent call for “Expression of Interest” to supply solid biomass fuel
- Production of biogas (e.g., vehicle fuel, electricity)
- Opportunity for significant use of Ontario SB in energy production



CONCLUSIONS

- Opportunities for future beneficial use of Ontario residuals
 - Largest for agriculture
 - Significant for tree nurseries
 - Not significant for forestry
 - Significant for land reclamation
 - Some opportunity for manufactured soils / media
 - Significant for green energy
- Combinations of residuals may increase benefits



OPPORTUNITIES!

