2012 Remediation - Technologies Symposium

Ex-situ Treatment of Heavy Petroleum Hydrocarbons Via Composting, Biopile, Chemical Oxidation and Soil Washing

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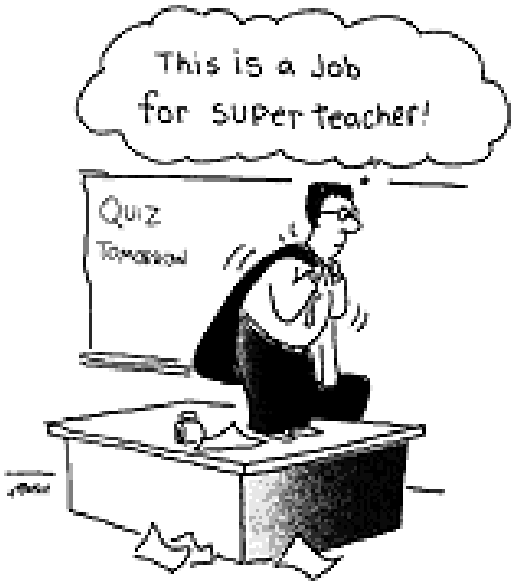
Golder, Montreal
October 17-19, 2012

Golder Associates

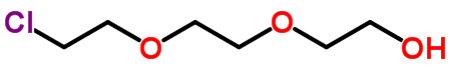
Presentation Outline

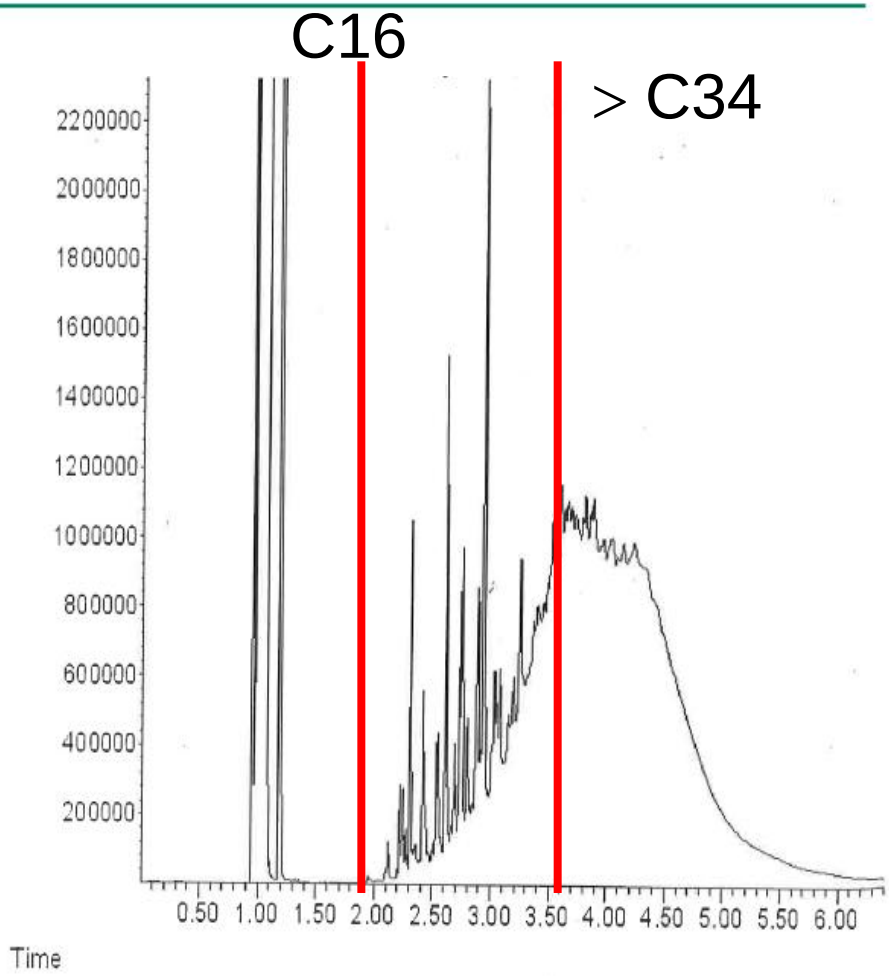
- Case study description
- Remediation options (GoldSET)
- Remediation approach
- Laboratory and pilot-scale results
- Conclusions



Project Site Description

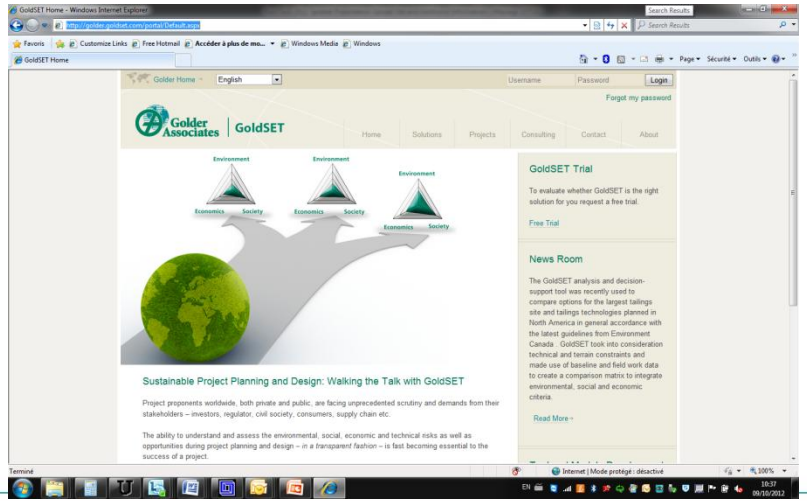
- Heavy industrial area
- Former petrochemical activities
- Underground/above ground utilities dismantled
- COCs : PAHs, heavy TPH, BCEE, heavy metals – Vadose zone
- 124 000 m^3 of impacted soil





GolderSET – What is the best remediation option?

- Semi-quantitative multi-criteria decision support tool based on the principles of sustainable development
- Balanced, impartial and exhaustive yet simple to use and refer to
- Sustainability “checklist” before undertaking a project



Sustainability

Decision

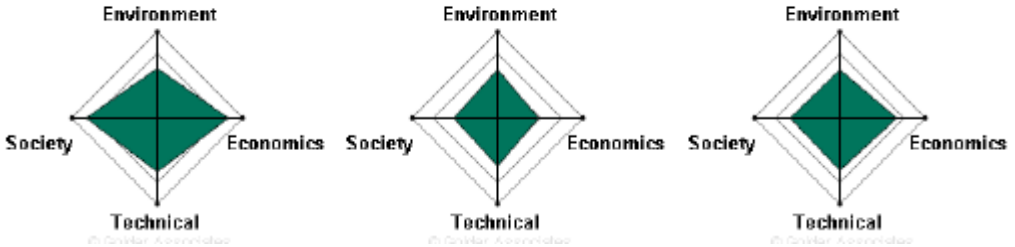
Support

Tool

Remediation Scenario

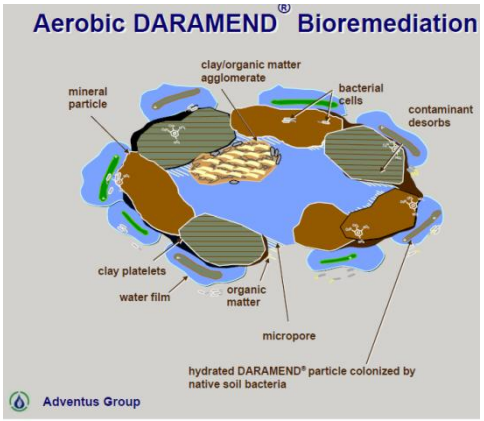
- Composting for biodegradable COCs
- Thermal dosorption for non-biodegradable COCs
- Phytoremediation for metals impacted soil

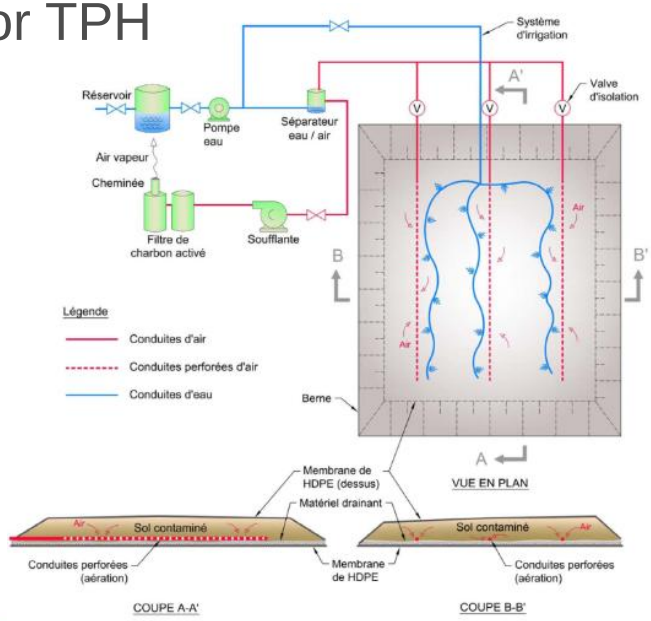
Ex-situ biological treatment		Ex-situ on-site thermal desorption		25% Bio and 75% Thermal on-site	
ENVIRONMENT	57%	ENVIRONMENT	56%	ENVIRONMENT	56%
SOCIETY	83%	SOCIETY	51%	SOCIETY	57%
ECONOMICS	83%	ECONOMICS	48%	ECONOMICS	66%
TECHNICAL	63%	TECHNICAL	55%	TECHNICAL	61%



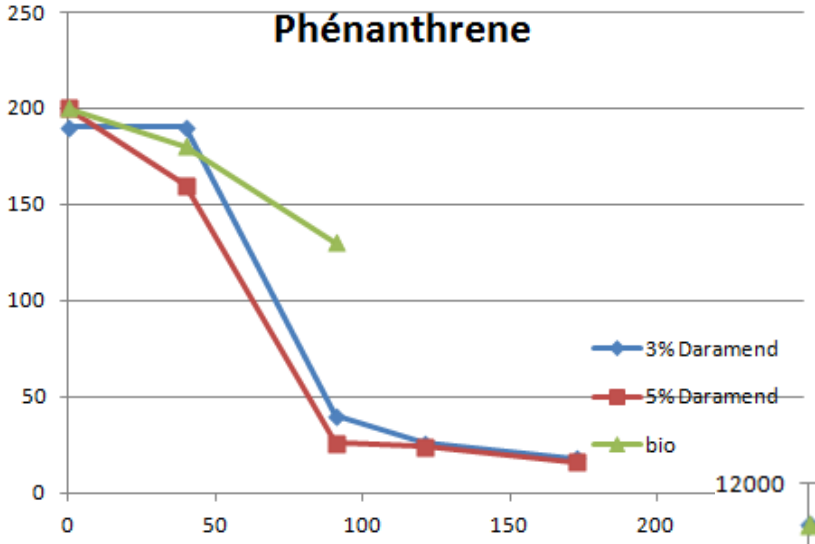
Biopile

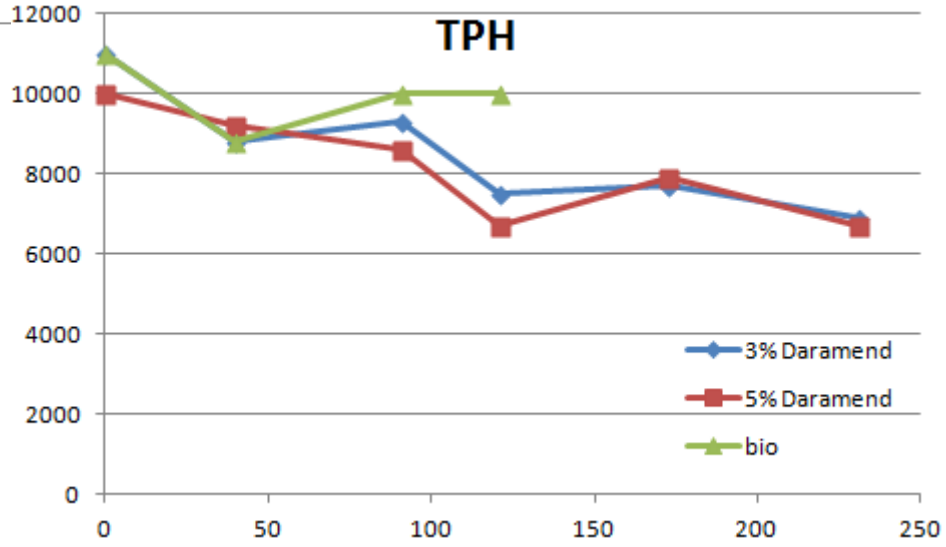
- 50-60 $/m.t.
- not efficient for heavy PAH
- 0.12 mg/kg/day for BCEE
- + Aerobic Daramend :
  - up to 6.5 mg/kg/day for PAH
  - ~30 mg/kg/day for TPH
  - 60-80$/m.t.





Aerobic Daramend (ppm vs day)

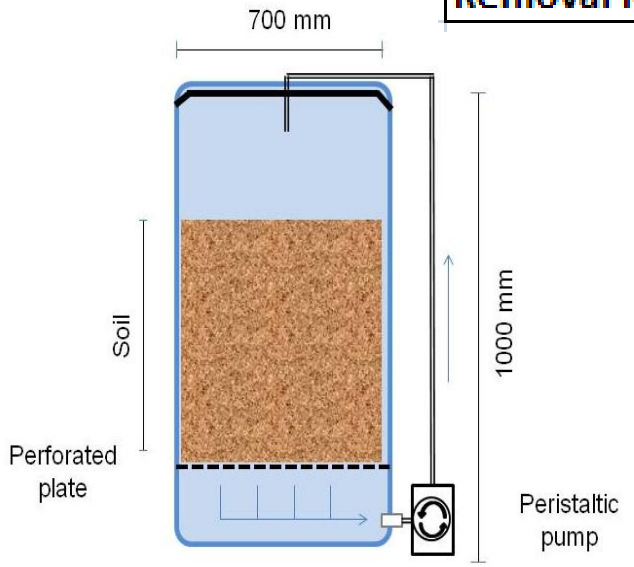




Soil Washing with a non-ionic surfactant

1.2 L/kg of soil
1-5% surfactant
80-100 $/m.t.

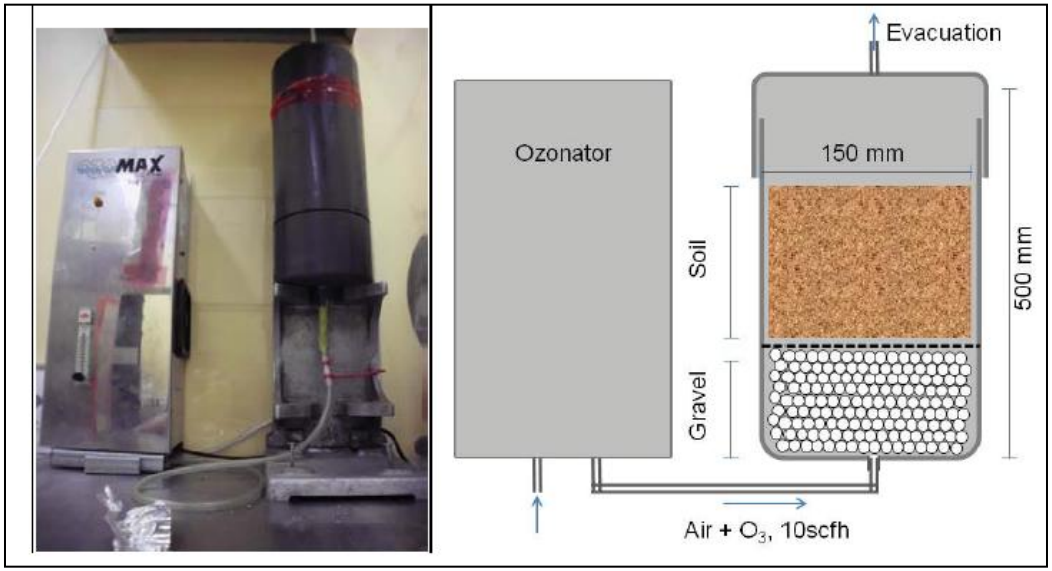
Parameters	Removal Efficiency	
	Column Test	Barrel Test
LMW PAHS	63%	35%
HMW PAHS	57%	32%
Total PAHs	60%	34%
C10-C50	52%	70%
Removal Rate (mg/kg/day)	1116	1967



Ozone Treatment

- Dosing : 9 g of O_3 per kg of soil
- Removal efficiency on TPH : ~ 30%
- Phenanthrene (↓ 76%), fluorene (↓ 65 %) and anthracene (↓ 45%), some ↓ three ring PAHs

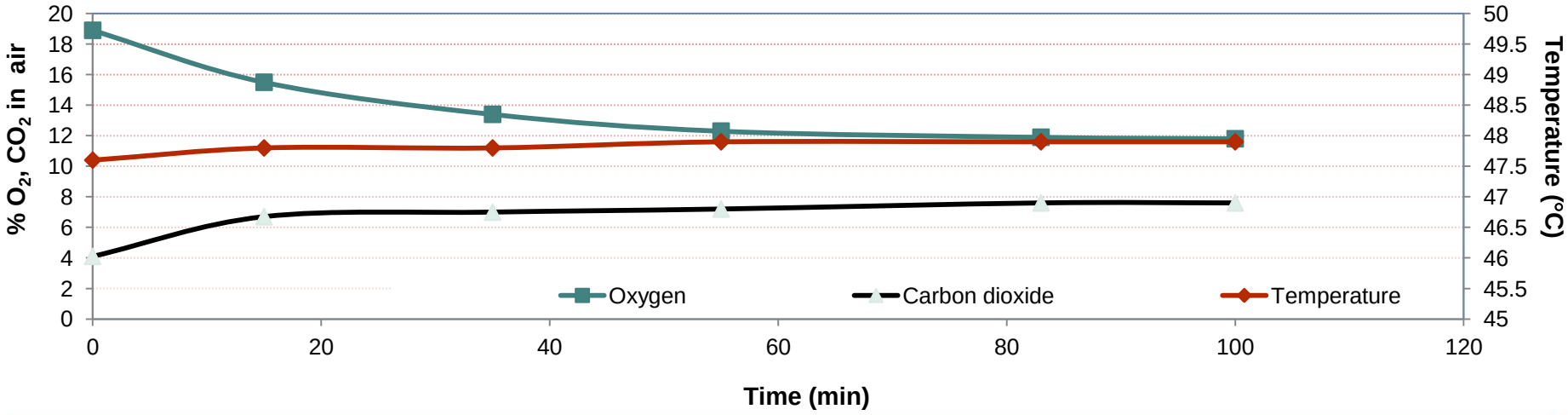
~ 400 $/m.t.



Composting

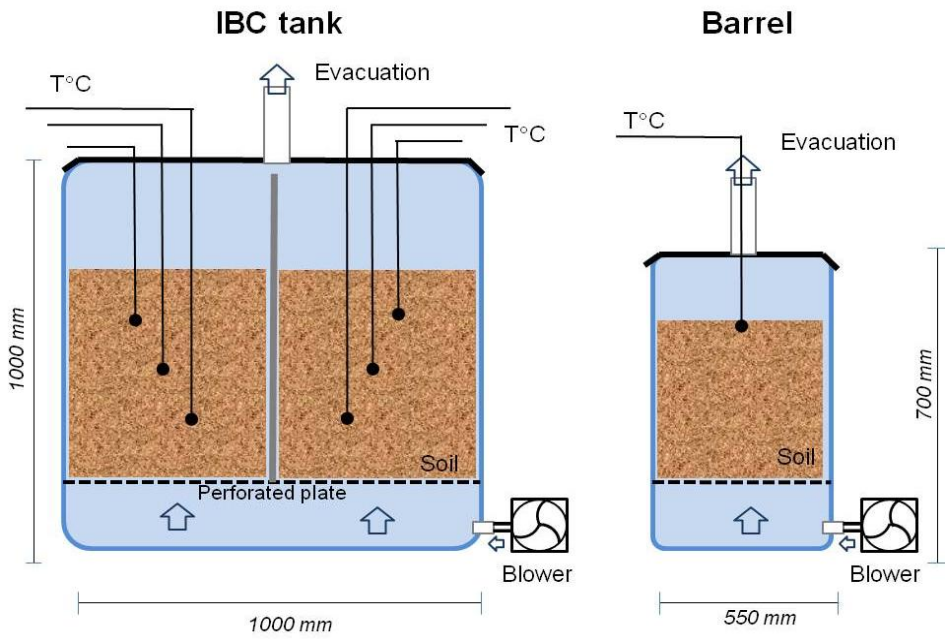
Composting is a process in which organic contaminants are degraded by microorganisms at elevated temperatures under aerobic and anaerobic conditions

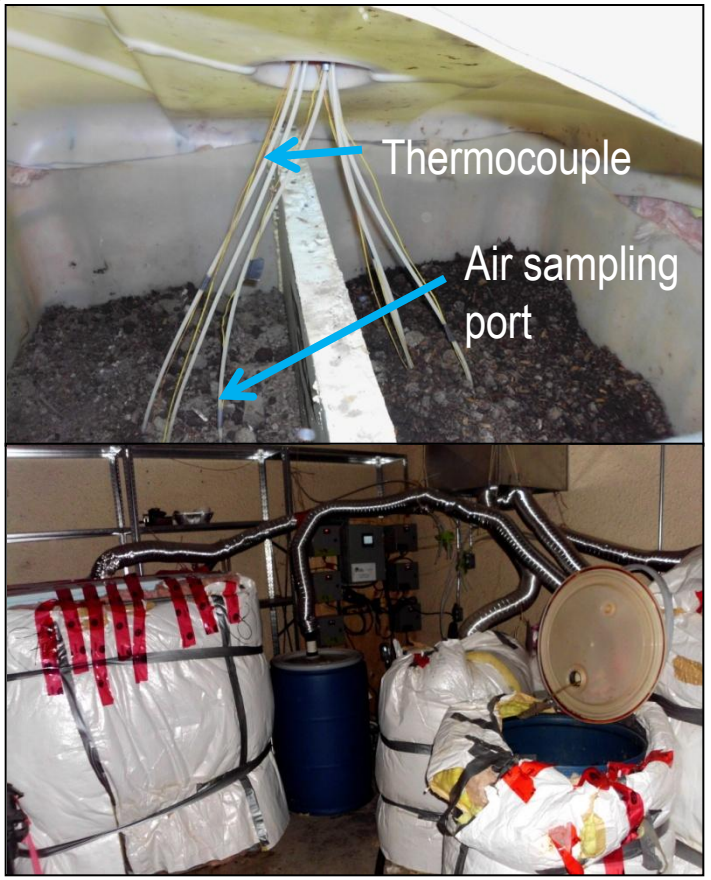
- Addition of organic substrate to soil + air + eau (~60% WHC)
- Typical temperature : 40-65 ^{o}C (rate of reaction x 2 every 10 ^{o}C)
- ↑ thermophilic +mesophilic bacteria
- ↑ solubility of organic carbon, ammonia nitrogen and P
- ↑ bioavailability of contaminants



Composting Testing

- Several mixes (horse, laying hens, roasters manure and wood shaving) and organic loading (25-75%) were tested

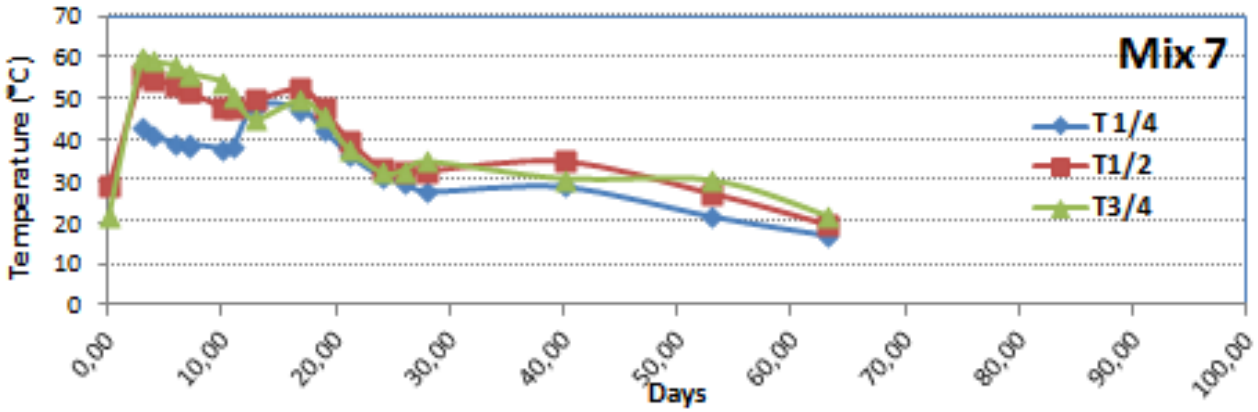




Some Results

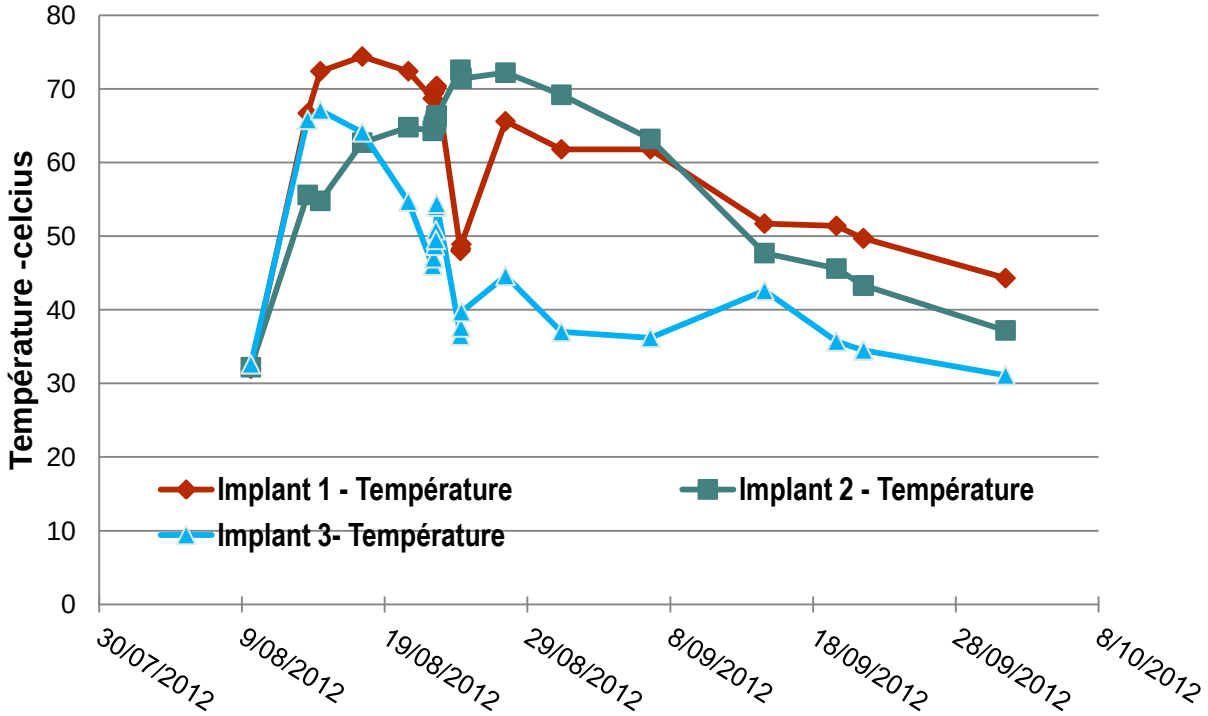
60-80 $/m.t.

Parameters	Removal Efficiency		
	75% organic loading	50% organic loading	25% organic loading
LMW PAHS	81%	53%	56%
HMW PAHS	34%	31%	41%
Total PAHs	61%	43%	49%
C10-C50	48%	31%	40%
Degradation Rate (mg/kg/day)	55,3	37,6	61,9

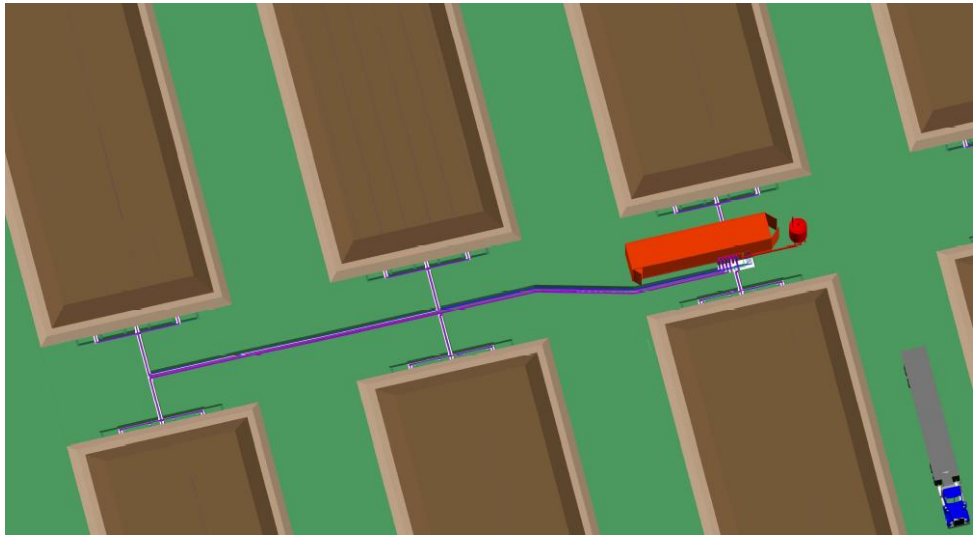


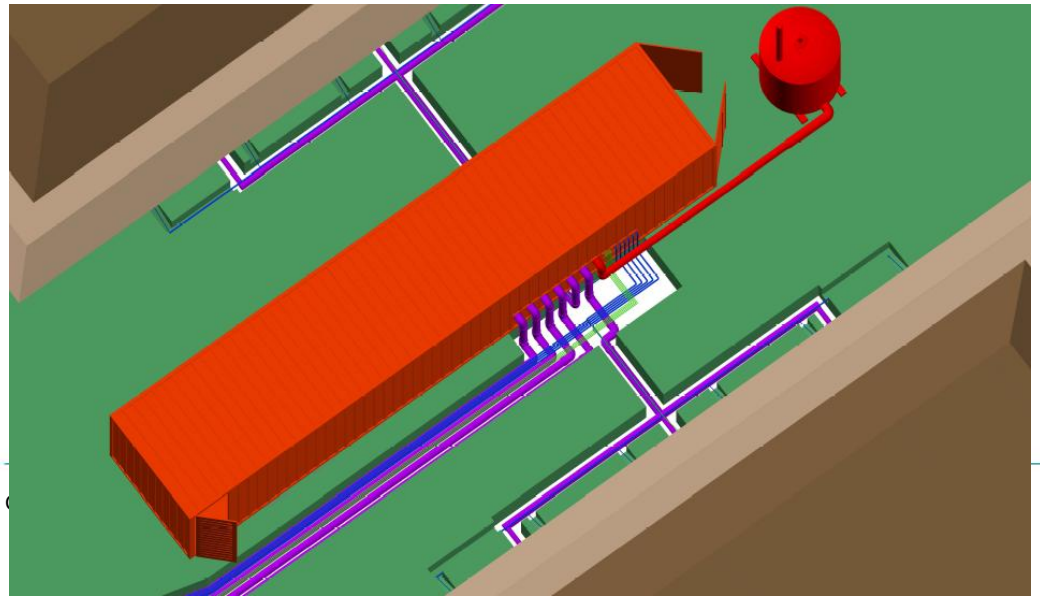
Pilot Testing

Respiration rate:
6.7%/hr
~ 100 mg/kg/day



The End





THANKS!

QUESTIONS??

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