Port of Port Townsend

Level 3 Response & Biochar Pilot Project

Managing Stormwater in the Northwest
Tacoma, WA
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Port of Port Townsend Boat Haven

Boat Haven Facility

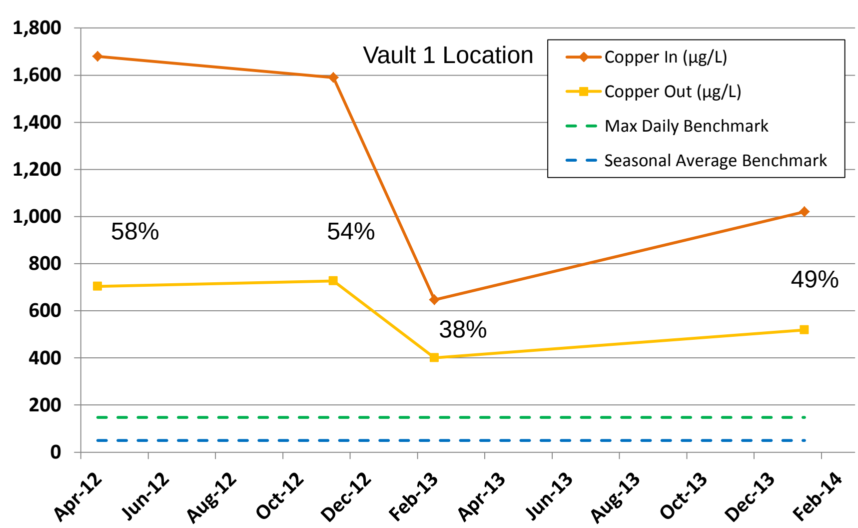
Boatyard Drainage Basins

Outfall Stormwater Sampling

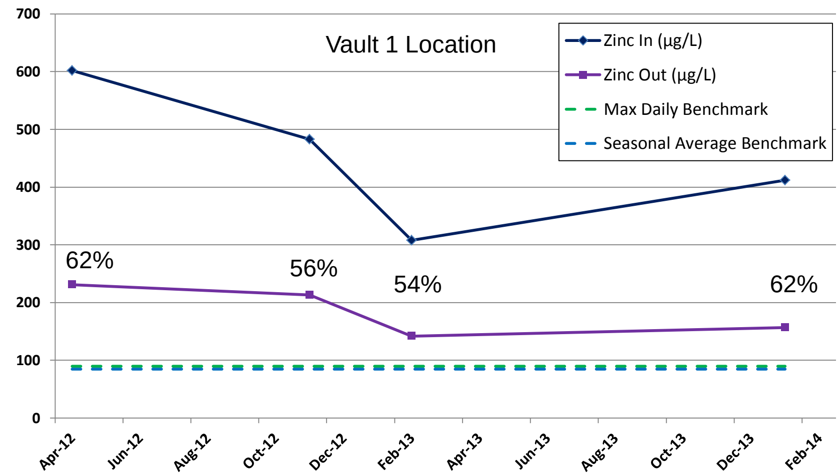
	Copper (µg/L)	Zinc (µg/L)
Maximum Daily Benchmark:	147	90
Seasonal Average Benchmark:	50	85
October 2011	NQSE	NQSE
November 2011	NQSE	NQSE
January 2012	NQSE	NQSE
April 2012 (total metals)	**1,380**	**519**
April 2012 (dissolved metals)	174	203
May 2012	93.5	**140**
2011-2012 Seasonal Average	**737**	**330**
October 2012	129	**133**
November 2012	NQSE	NQSE
January 2013	**536**	**184**
April 2013	70.3	**122**
May 2013	**300**	67
2012-2013 Seasonal Average	**259**	**127**

NQSE = No qualifying sampling event due to tidal conditions at Outfall

Copper Removal by Aquip® System



Zinc Removal by Aquip® System



Operational Issue #1: Source Control

Level 3 Source Control Responses

- Additional staffing for Saturday and Sunday BMP compliance patrols
- Development of a "full-court press" approach to monitoring Boatyard and marina activities by having Yard and Hoist staff and Maintenance and Moorage staff work in concert with the Environmental Compliance Officer
- Development of a team approach with the Port Townsend Marine Trades Association regarding BMP development, implementation, and monitoring
- Development of a simple tri-fold BMP handout for haul-out customers based on feedback from the Port Townsend Marine Trades Association and customers
- Using various media outlets to educate customers about BMPs, including the quarterly Port newsletter and the local newspapers
- Institution of a "three strike" BMP enforcement process

Spreadsheet of Shame

Record of BMP Non-Compliance and Port Actions	**Completed by: Al Cairns Title: Environmental Compliance Officer**				
BMP(s) Not Followed	Date of verbal warning	Date of 1st written warning	Date of Stop Work Order or Eviction	Was Owner/Contractor/Crew Aware of BMP?	
				Yes	No
Vacuum Sanding	9/2/2013			X	
Vacuum Sanding	9/2/2013				X
Vacuum Sanding		9/16/2013		X	
Vacuum Sanding		9/16/2013		X	
Oily bilge discharge	9/26/2013			X	
Vacuum Sanding	10/2/2013			X	
Vacuum Sanding	10/3/2013				X
Vacuum Sanding	10/16/2013			X	
Vacuum Sanding	10/24/2013			X	
Containment of airborne pollutants, washing of vessel hull	10/24/2013	10/25/2013			X
Vacuum Sanding	10/28/2013			X	
Vacuum Sanding, no tarp under vessel	10/28/2013	Eviction notice served. Vessel to be removed 11/16	Unlawful Detainer Notice served	X	
Vacuum Sanding	10/31/2013			X	

Level 3 Engineering Responses

1. Utilization of existing infrastructure
    - Media in Vaults 1, 3 & 4
    - Sandfilter Rehabilitation
2. Downspout Treatment
3. Biochar Field Trial

Biochar Pilot Project

- Assess field performance of two configurations:
    - Above-ground downspout tote
    - In-ground media filter
- To be installed by BioLogical Carbon, LLC in conjunction with OSU Optimization Project
    - PoPT Project will serve as first field installation

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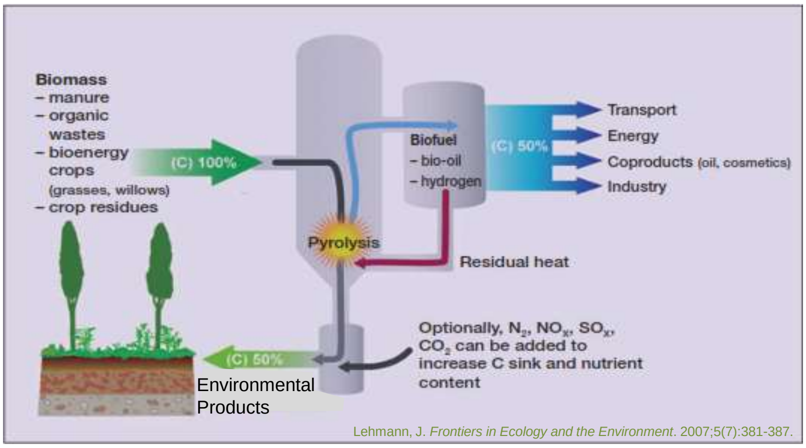
The Biochar Concept: 3 Goals

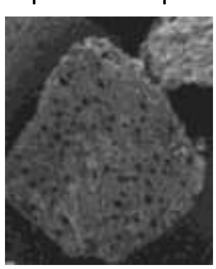


1. Production of renewable biomass energy
2. Carbon sequestration
3. Environmentally beneficial products

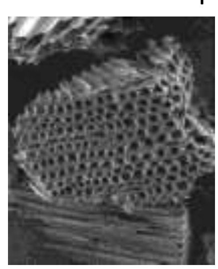
Biochar = Green Alternative

Biochar Material Properties

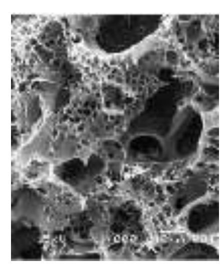
- Properties depend on feedstock and production conditions



Hazelnut Shell



Douglas-Fir



Cane Pith

- Relevant Sorption Properties: surface area, surface reactivity, ash content, pH, particle size

Biochar is not created equal → Material Screening is Critical

Cane pith image credit: Tseng & Tseng, *Journal of Hazardous Materials*. 2006

Biochar vs. Activated Carbon

	Granular Activated Carbon	Biochar
Feedstock	Primarily Coal, some biomass	Biomass
Pyrolysis Temperature	500-800 °C	350-800 °C
Activation Process	Steam, chemicals: O_3, KOH, 2,000 °C	Environmental/Biological Oxidation
Surface area	Up to 1600 m^2/g	Up to 500 m^2/g
Carbon balance	Positive	Negative
Cost	$1,500-$3,000/ton	~$500/ton

Biochar = Green alternative for lower cost applications

PoPT Biochar Screening

pprc

- Column Studies to screen biochars and secondary components for Zinc and Copper removal
  - Secondary Components : compost, oyster shells, perlite
- Two synthetic influent levels:
  - Low: ~0.3 mg/L; dissolved zinc and copper
  - High: ~3 mg/L; dissolved zinc and copper
- Ten total mixtures

PoPT Biochar Hydraulics

Particle Size	%, Mass Fraction	
	Biochar #1	Biochar #2
<0.4 mm	21.5	13.2
0.4 - 2.4 mm	41.1	63.9
2.4 - 4.8 mm	23.3	22.5
>4.8	14.2	0.4

Fine particles migrate through filters:

Plug filters → reduced flow rates

May be exported to environment

Biochars must be rinsed or sieved to remove fines

PoPT Column Results

Media	Media Conductivity	Dissolved Copper Removal Efficiency		Dissolved Zinc Removal Efficiency	
	inches/minute	In = 0.266 mg/L	In = 2.91 mg/L	In = 0.319 mg/L	In = 3.01 mg/L
Mixture #1	10.4	97.7	99.4	85.3	72.2
Mixture #2	10.2	98.6	93.8	63.6	20.3
Mixture #3	8.2	99.8	99.6	99.5	83.0
Mixture #4	8.5	97.7	99.7	95.6	90.3
Mixture #5	10.9	98.7	83.3	65.8	9.3
~~Mixture #6~~	~~4.4~~	~~98.6~~	~~99.9~~	~~98.7~~	~~98.7~~
Mixture #7	6.6	98.5	99.8	97.6	99.9
Mixture #8	9.5	98.5	99.8	97.6	98.9
Mixture #9	7.5	99.2	99.9	99.4	99.9
~~Mixture #10~~	~~3.3~~	~~99.5~~	~~99.9~~	~~98.9~~	~~99.9~~

- Copper removal rates excellent for all media mixtures
- Zinc removal more variable
- Media conductivity variable: >5 inches/minute required

Pilot System Design Specs

Downspout Tote System:

Dimensions: 3’ x 3’ x 7’ tall

Initial Peak Flow Rate = ~50 gpm

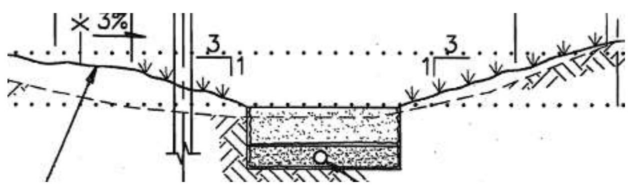
Design Flow Rate = 15 gpm

In-Ground Filter:

Dimensions: 4’ wide x 15’ long x 2’ deep

Initial Peak Flow Rate = ~150 gpm

Design Flow Rate = 40 gpm



OSU Optimization Project

Goal: Optimize biochar-based filtration media for multiple product configurations

- Downspout Totes
- In-Ground Filters
- Biofiltration mixes
- Vault systems

OSU Oregon State University

OREGON BEST

Optimize For: Multiple contaminant removal, lifetime, hydraulics, clogging

Well Monitored Pilot Installations

Commercialization Partners:

BioLogical Carbon, LLC

SunMark Environmental Services, LLC

Questions?

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