



HPBSM Performance for Removing 6PPD-Q and Preventing Coho Salmon Mortality

Curtis Hinman and Associates



King County



ECY 6PPD-Q SUBGROUP, DECEMBER 2023

Context

HPBSM:

- Evaluated for a wide range of contaminants (metals, nutrients, PAHs, motor oil, bacteria, sediment), but not 6PPD-Q .
- King County wanted to test HPBSM for 6PPD-Q treatment as part of their process to adopt HPBSM.



Purpose of Study

Evaluate HPBSM for:

- Reducing 6PPD-Q concentrations in stormwater.
- Protecting coho salmon from acute mortality.
- Learn more about 6PPD-Q behavior in the study environment.



Study Design

- Large column array at WWU Media Lab. Each media blend replicated 3x
- Dose media columns with stormwater from I-5 (Ship Canal).
- Evaluate influent and media effluent for 6PPD-Q, TSS, DOC, ORP, conductivity, pH.
- Expose coho salmon to untreated influent and treated effluent water and evaluate for acute mortality.



HPBSM and 60/40 Blends

Treatment Number	BSM Blend Abbreviations	Primary BSM Blend	Polishing Layer
1	60/40	60% ecology sand/40%compost	none
2	70ss/20cp/10ash	70% state sand/20% coco coir/10% high carbon wood ash	None
3	70ss/20cp/10ash/ aafep-layer	70% state sand/20% coco coir/10% high carbon wood ash	90% state sand/7% coarse activated alumina/3% iron aggregate
4	70ss/20cp/10ash/compmulch/ aafep-layer	70% state sand/20% coco coir/10% high carbon wood ash/2-inch compost mulch	90% state sand/7% coarse activated alumina/3% iron aggregate

State sand: Section 9-03.1(2)B (Class 1) of the Washington State Department of Transportation Standard Specifications

CURTIS HINMAN AND ASSOCIATES

STUDY DESIGN

ECY 6PPD-Q SUBGROUP, DECEMBER 2023

Dosing Findings: 6PPD-Q (dosing experiment 1)

Preliminary results. Do not cite or use for reproduction

Dosing Event	Volume (liters)	Flow Rate (liters/hr)	Influent	60/40	70vs/20cp/10ash/sand d-layer	70vs/20cp/10ash/aafep-layer	70vs/20cp/10ash/compmulch/aafep-layer
1	27	11	0.785 (ug/L)	0.0029 (ug/L)	<MDL (0.002 (ug/L)	<MDL (0.002 (ug/L)	<MDL (0.002 (ug/L)
Coho (%survival)			5%	100%	100%		100%
2	27	11	0.229 (ug/L)	0.0038	0.0027	<MDL (0.002 (ug/L)	<MDL (0.002 (ug/L)
Coho (%survival)			0%	100%	100%		100%

Dosing volume equivalent to a 10-year, 24-hour Seattle storm.

LC50: 0.095 ug/L

LC20: 0.020 ug/L

Specification Recommendations



Guidance on using new high performance bioretention soil mixes

By
Douglas Howie, PE and Brandi Lubliner, PE
For the
Water Quality Program
Washington State Department of Ecology
Olympia, Washington

May 2021
Publication 21-10-023



Activated Alumina

The Activated Alumina should meet the following requirements for quality and grading:

Test / Method	Testing Responsibility ^a	Criterion	Requirement
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 353.2	Proponent	NO ₃ +NO ₂	0.1 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and NEMI Method SM 4500-P E-99	Proponent	Total Phosphorus	0.1 mg/L (Max.)
		Ortho-phosphorus	0.1 mg/L (Max.)
Synthetic Precipitation Leaching Protocol (EPA Method 1312) and EPA Method 200.8 UCT-KED	Proponent	Copper	1 µg/L (Max.)
Producer Analysis	Manufacturer	Alumina (Al ₂ O ₃) content	90% (Min.)
	Manufacturer	Bulk density	760 Kg/m ³ (Min.)
	Manufacturer	Surface area	300 m ² /g (Min.)
Gradation (ASTM D422)	Manufacturer	#14 US Standard Sieve	100% Passing
	Manufacturer	#28 US Standard Sieve	0% Passing

^a Though the manufacturer will provide many of the tests indicated in this table, project proponents are encouraged to test the exact material which will be provided for their projects. Manufacturer tests are only run periodically on the source material not on the exact material supplied for the project.