

PEAT SORPTION MEDIA PASSIVE TREATMENT OF TRACE METALS WITHOUT A STINK

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Road Map

- ▣ Passive treatment of trace metals
- ▣ Peat sorption media
- ▣ Site
- ▣ Pilot testing
 - Design
 - Results
- ▣ Summary



Passive Treatment of Mine Drainage

▣ Biochemical Reactors (BCR)

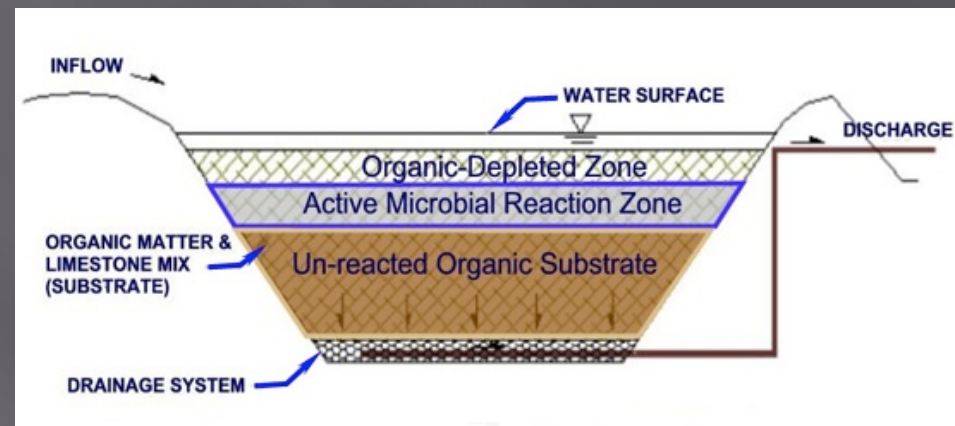


▣ Constructed Treatment Wetlands



BCR Design

- Organic substrate
 - Generally mixture
 - Hay, wood chips, limestone, manure
- Vertical flow
- Anaerobic processes
- Microbial driven
 - Sulfate reducing bacteria



Constructed Treatment Wetlands

- ▣ Horizontal flow across surface
- ▣ Water depths generally 6-12"
- ▣ Aerobic Processes
- ▣ Primary removal -interaction with substrate



Limitations

- ▣ BCRs
 - Non uniform media
 - Preferential flow paths
 - Start up
 - 1-2 weeks incubation
 - Initial release of organic rich water
 - BOD
 - Nutrients
 - Color lasts ~ 3-6 months
 - Odors
 - Hydrogen sulfide

Residence time ~ 1-2 days



Limitations

- ▣ Wetlands
 - Large footprint
 - Start up
 - ▣ 2 weeks for plant transplants to set roots
 - ▣ 1-3 years for vegetation to fully establish
 - Flow Distribution
 - ▣ Potential for channelization
 - Winter performance

Residence time ~ minimum 1-2 days

What is Peat sorption media?

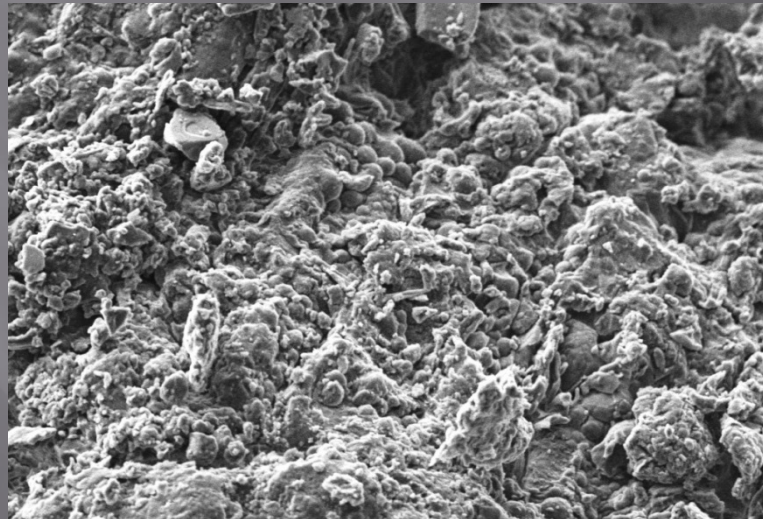
- ▣ APTsorb™
 - Patented peat based sorption media
 - Hardened granule



APTTMsorb Granule

Properties

- Size -10, +30 mesh (0.6 to 2 mm)
- Large surface area
- High hydraulic conductivity (~ 0.5 cm/sec)
- High metal affinity (1-15% max dry wgt)

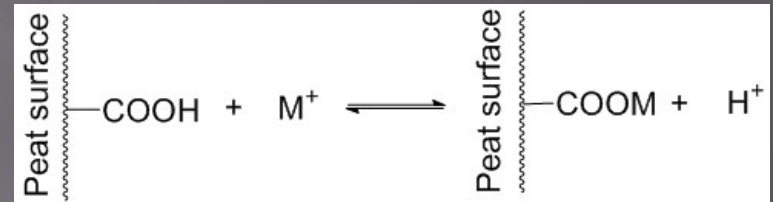


Granule 2000x

Mechanisms

▣ Dissolved Metal Removal

- Ion exchange
- Adsorption
- Chemisorption
- Complexation
- Adsorption-complexation



▣ Particulate Metal Removal

- Filtration
- Interaction with surface
- Successful removal of 3 - 5 micron particles

The Site

- ▣ Base metal mine



Characterization

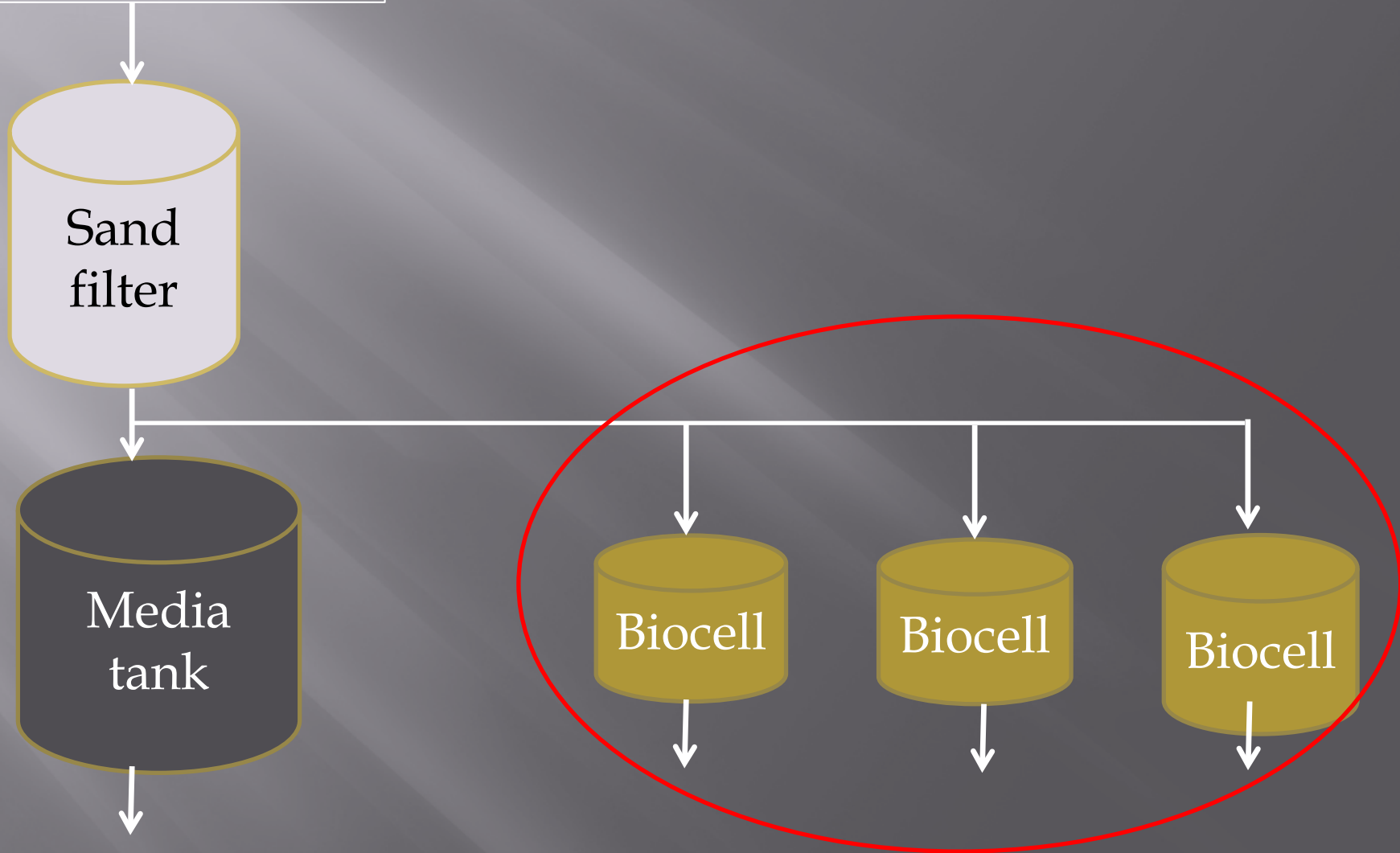
- Direct discharge from active underground mine
 - Water quality
 - Elevated and variable suspended solids
 - pH ~ 8
 - Pb controlling metal

	Concentration ug/L		
Metal	Total	Dissolved	Permit
Pb	2100	150	11.5
Zn	115	70	137.3
Cd	0.8	0.2	0.5

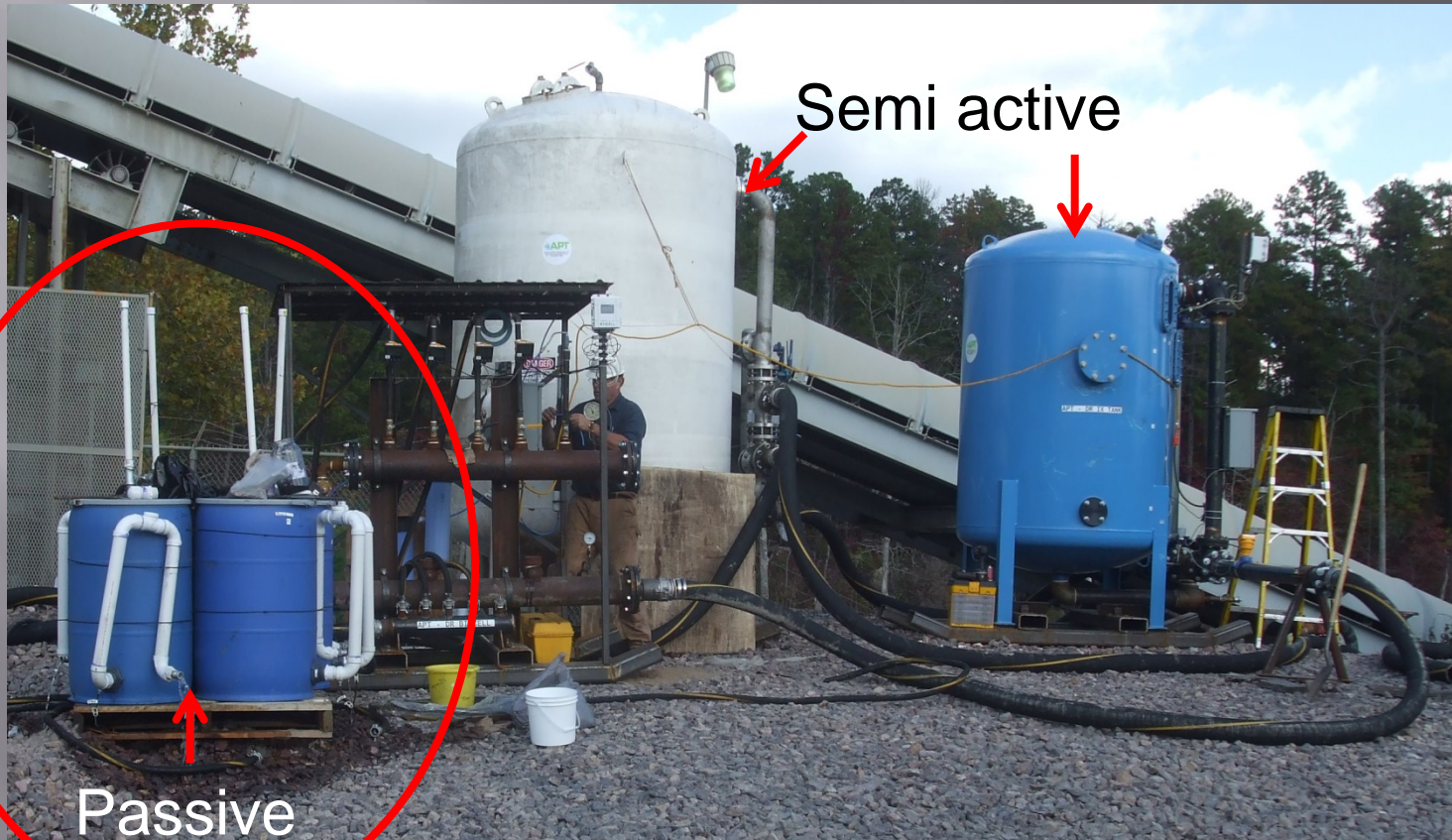
- Flow up to 8,000 gallons/min

ACTIVE MINE
DISCHARGE

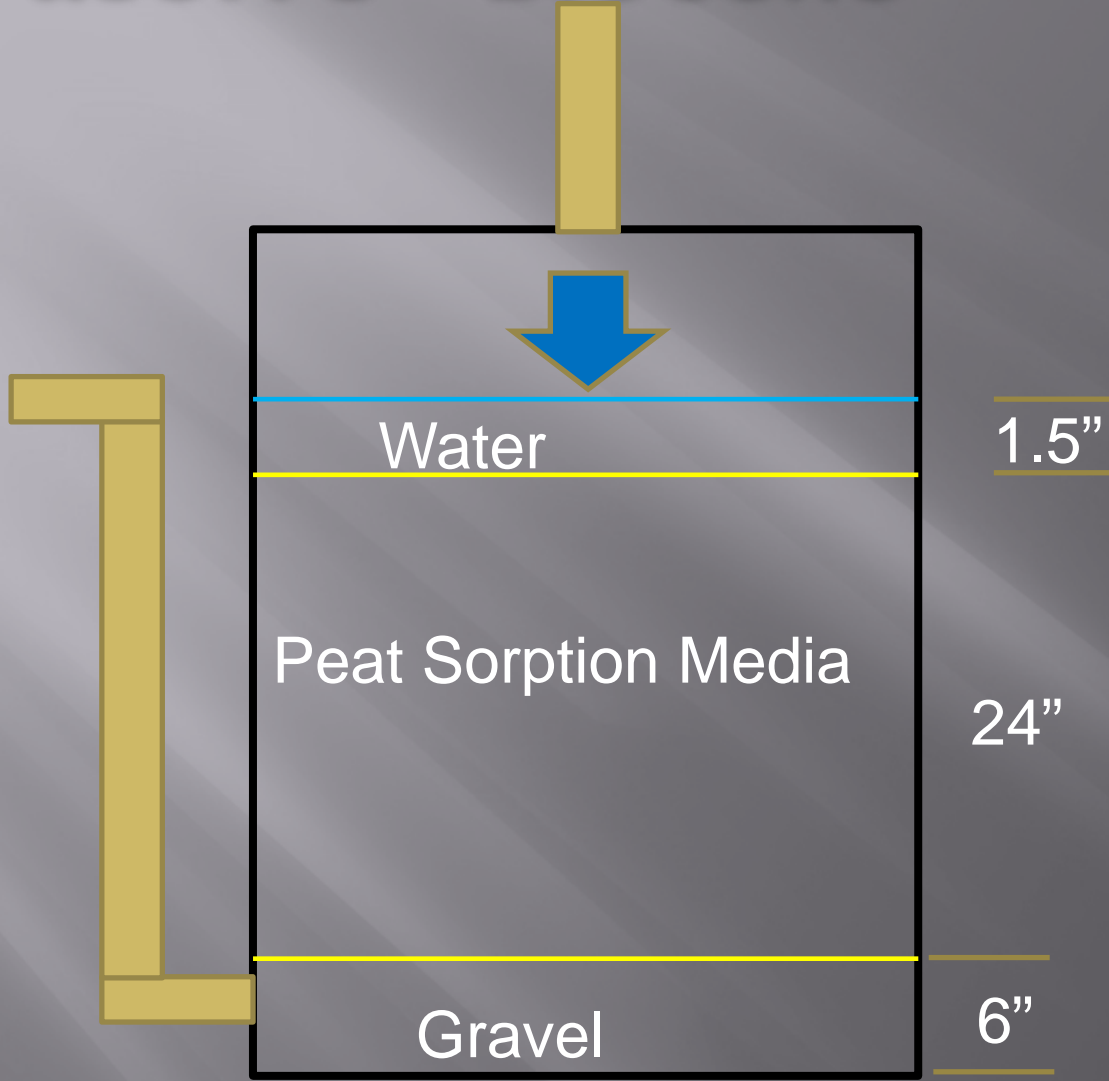
Pilot Design



Pilot Test



Passive - Biocells



Biocells

- Input water filtered through sand filter
- Media, -10, +30 mesh
- Design

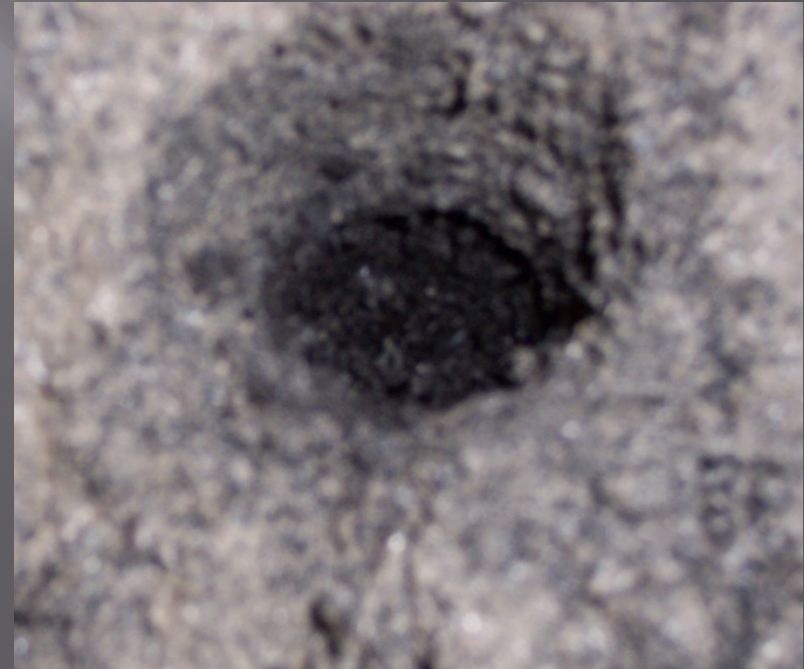
Biocell	Flow rate gpm	Hydraulic loading gpm/ft ²	Residence time min
1	0.6	0.25	60
2	2.4	1	15
3	1.2	0.5	30

10 month pilot test
Temperature -10 to 100

RESULTS

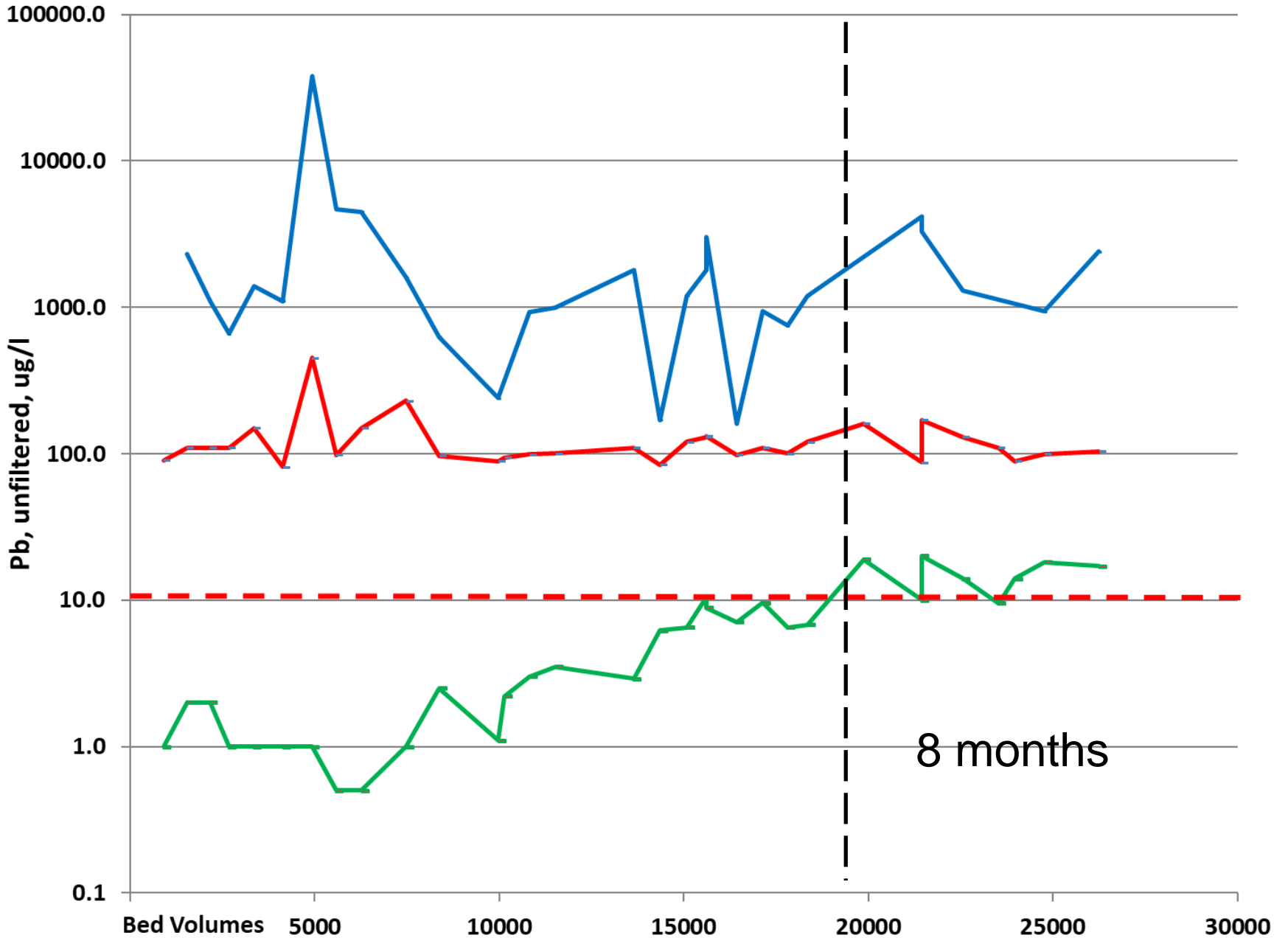
Biocells Solids Removal

- ▣ Sand filter did not remove all suspended solids
- ▣ Solids confined to top inches

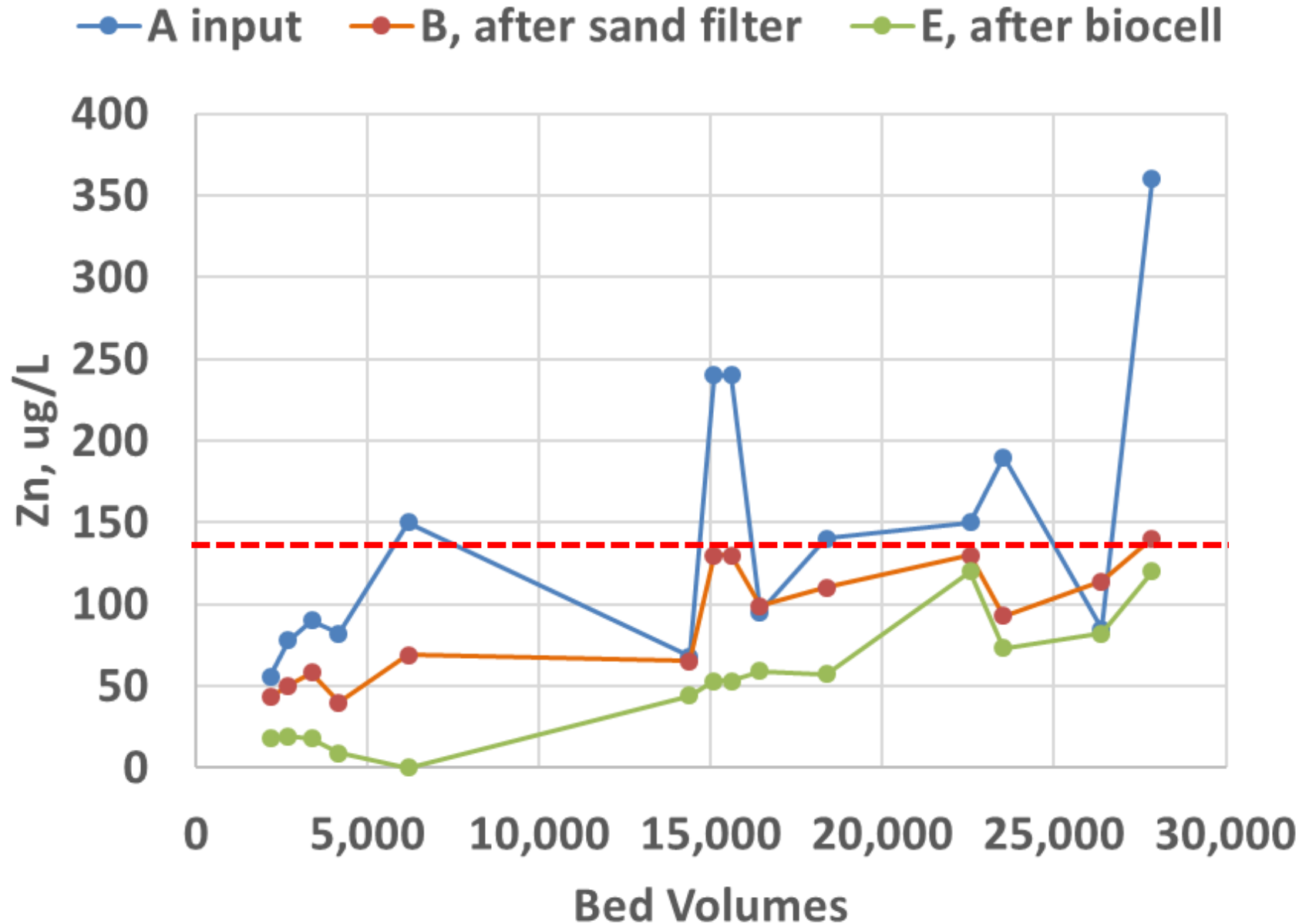


Pb removal biocell 2

— A, input — B, after sand filter — after APTsorb

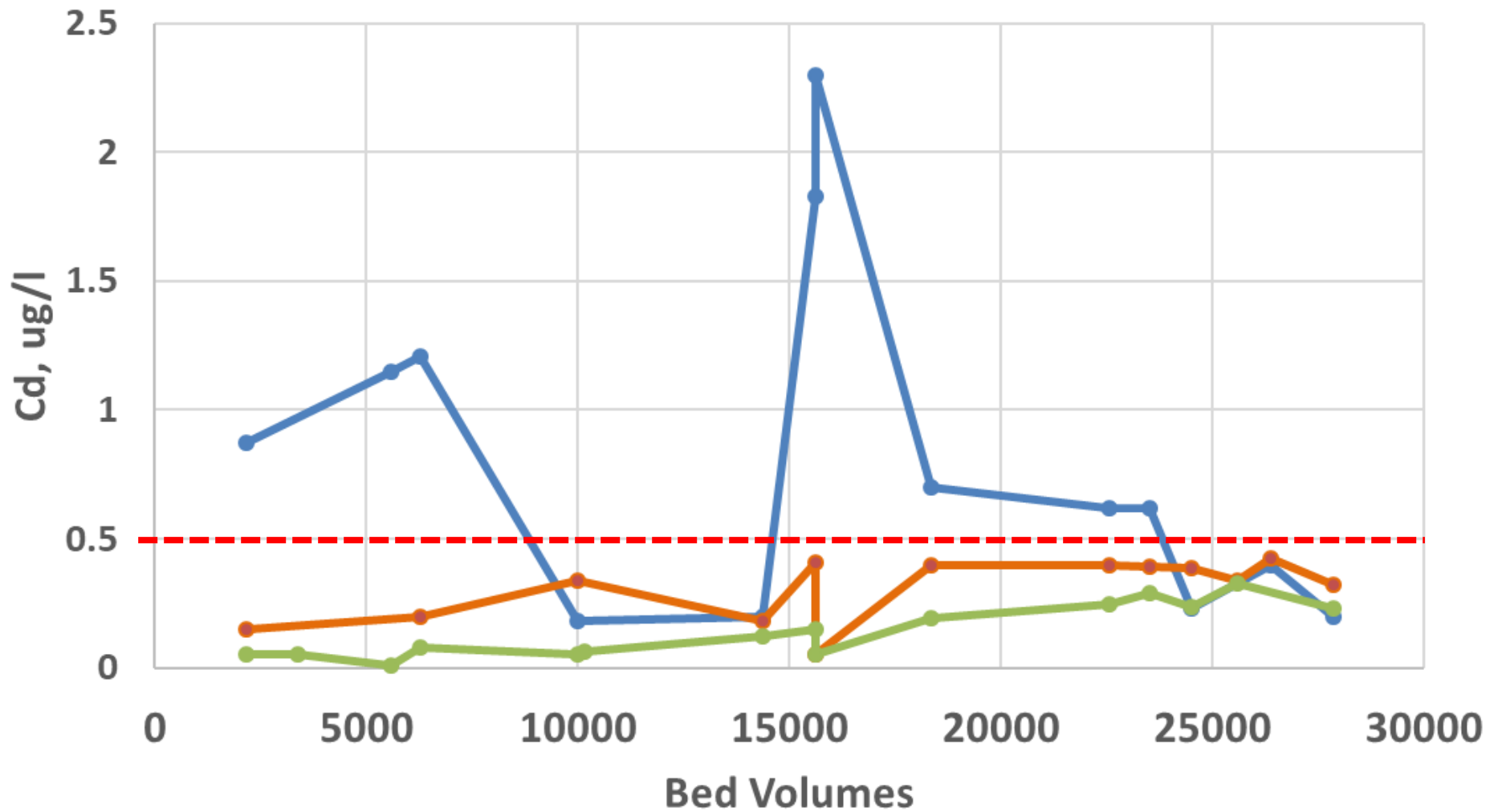


Zn removal, Biocell 2; Zn vs Bed Volume

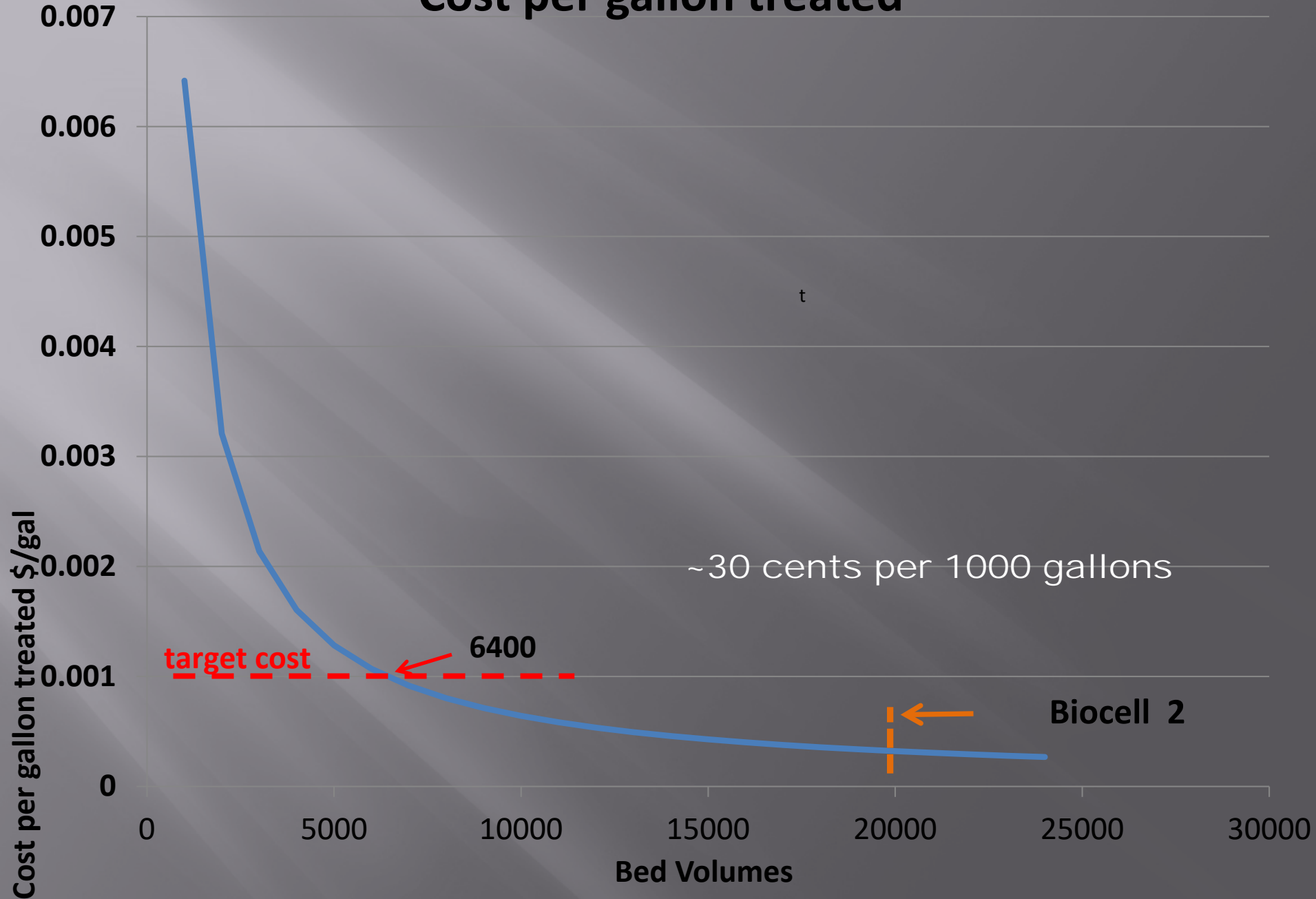


Cd removal, Biocell 2, Cd vs Bed Volume

input after sand filter after APTsorb

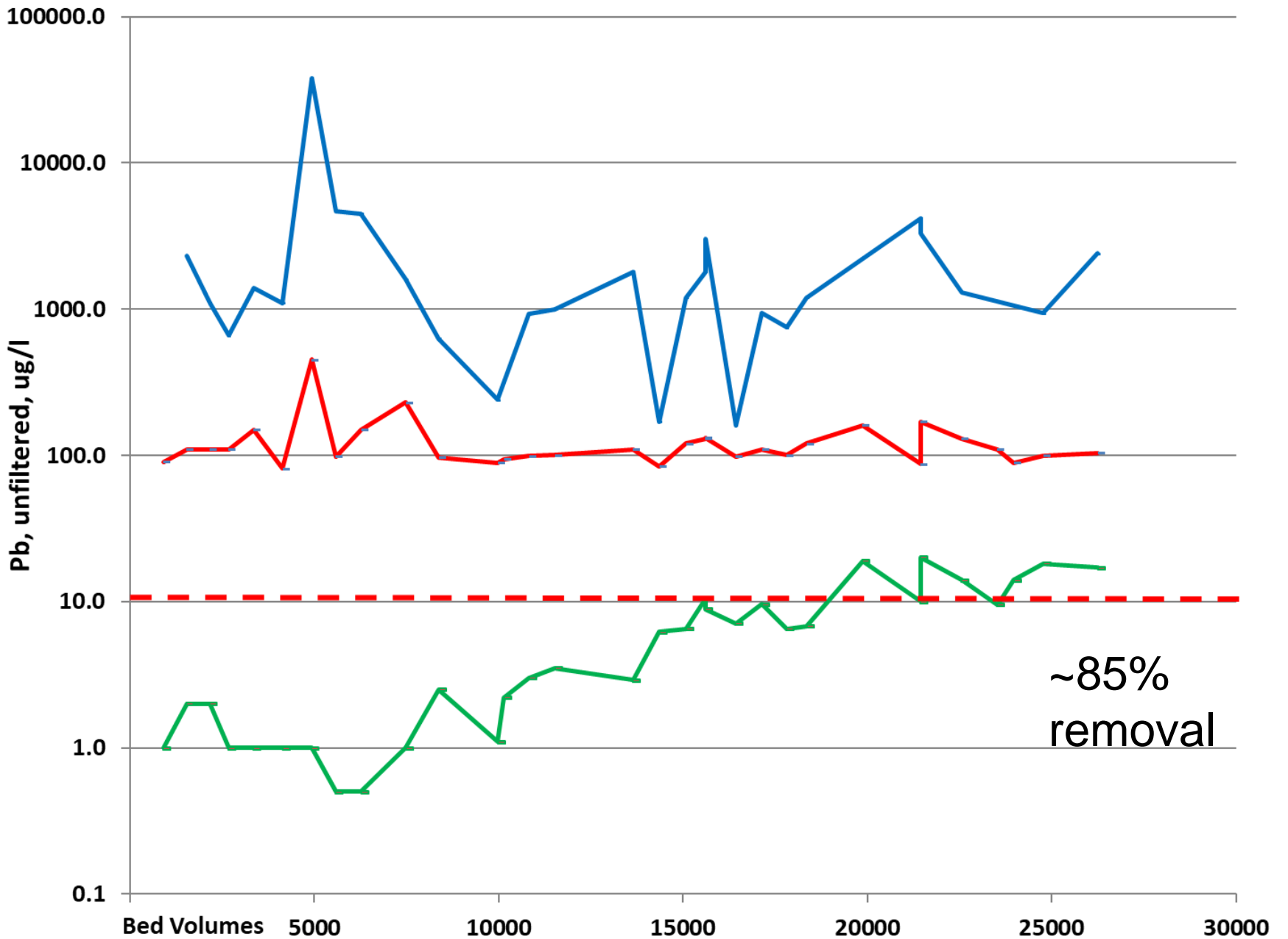


Cost per gallon treated

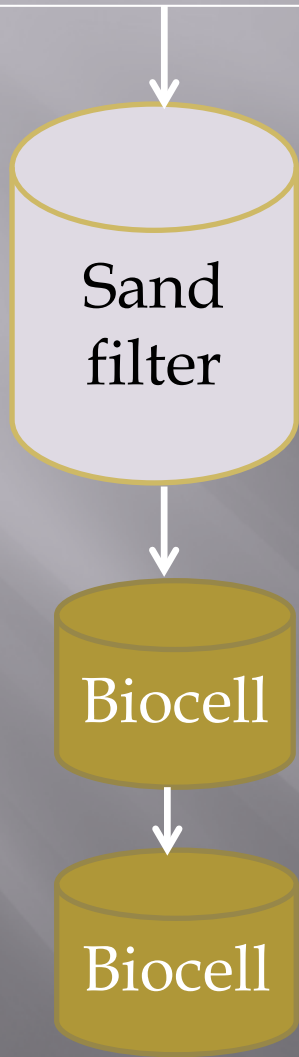


Pb removal biocell 2

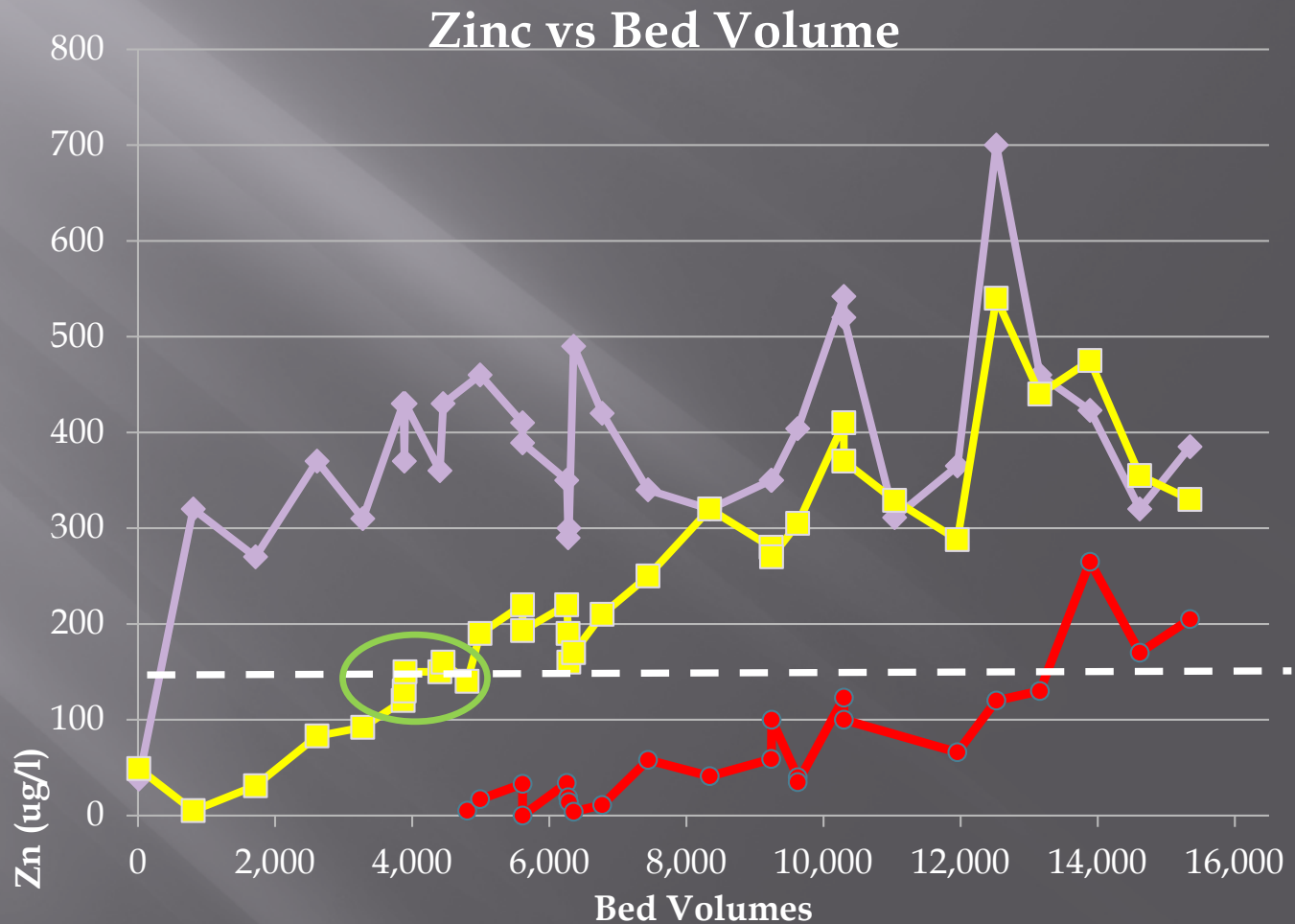
— A, input — B, after sand filter — after APTsorb



ACTIVE MINE DISCHARGE



Pilot Design





BV	0.2	1.9	3.6	5.2	7.5	9.7	13.0	18.3
Min	2	15	30	45	65	85	115	160

**Good News:
water meets discharge limits,
but.....**



What do we do with the exchange media?

Removing Media

- Light weight
- Easily moved by pumping or suction



Disposal Options

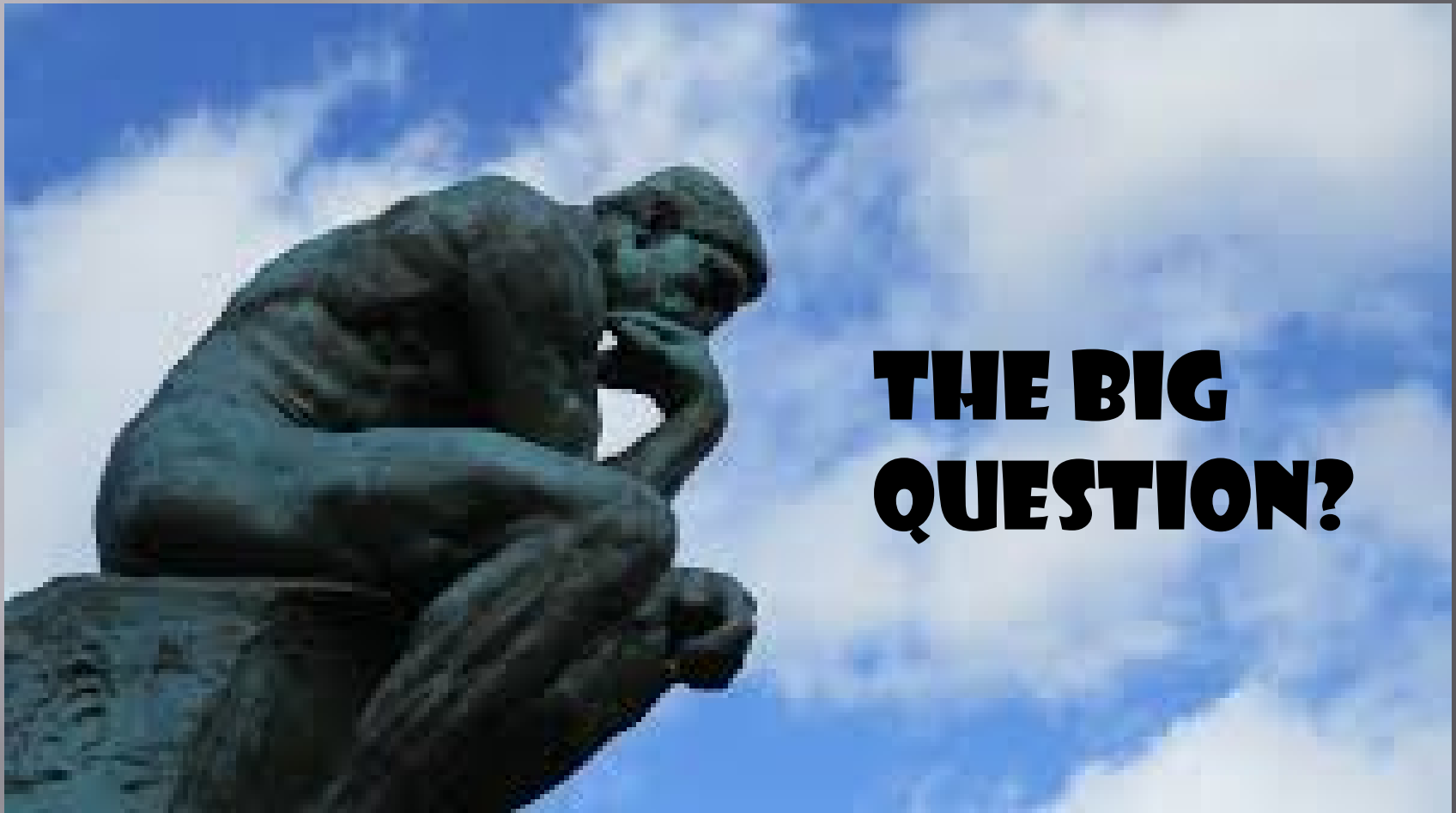
- ▣ Potential metal recovery
 - Pb ~1%
 - Ore 3%
- ▣ Disposal in tailings basin
 - Potential amendment to improve vegetation
- ▣ Off site disposal
 - TCLP
 - Metals strongly bound to media

TCLP- Stormwater

Metal Plating Facility; 3 years

Parameter	Influent ug/L	Solid (mg/kg)
Chromium	526	1346
Cadmium	219	566
Zinc	565	1338

Contaminant	Regulated Level (mg/L)	TCLP results (mg/L)	% metal released
Cadmium	1	0.1	0.4
Chromium	5	ND	< 0.01
Zinc	NR	2.8	4.6



THE BIG QUESTION?

How long will the media last?

Longevity- Single Cell Systems

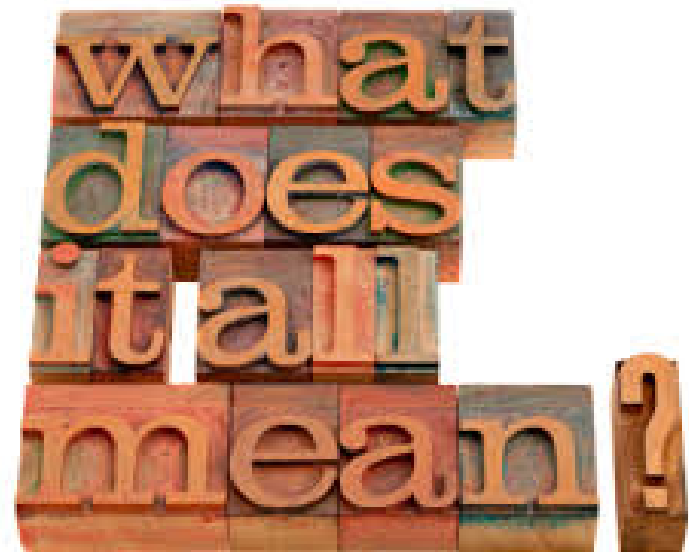
Application	Duration	Metals of concern	Time between media change	Bed volumes treated
Mine water	1 year	Cu	> 1 year	32,000
Mine water	9 months	Pb,	> 9 month	28,000
Mine water	5 months	Zn, Pb, cd	4 months	12,500
Stormwater	9 years	Cr, Cd, Zn	1.5 to 3 years	500-1000
Roof runoff	3 years	Zn	>3 years?	Unknown
Stormwater	7 years	Cu	> 3months	Unknown

Comparison- Trace Metal Removal

Treatment	pH	Residence time	Nuisance parameters	Winter Operation
Wetland	6-8	1-2 days	Initial Fe, color	Problematic
BCR	3-8	1-2 days	Color, BOD, nutrients, odor	Needs Insulation Rates slow
Peat Sorption Media	6-8	15 min	Minimal color	Needs insulation

Summary

- ▣ Met permit limits
- ▣ Cost 70% below target
- ▣ Uniform media with high permeability
- ▣ 15 minute contact time
- ▣ No nuisance parameters
- ▣ Easy to replace
- ▣ Potential metal recovery



Got Questions?



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