BEYOND BCRS: THE USE OF PEAT SORPTION MEDIA TO TREAT MINE DRAINAGE

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Road Map

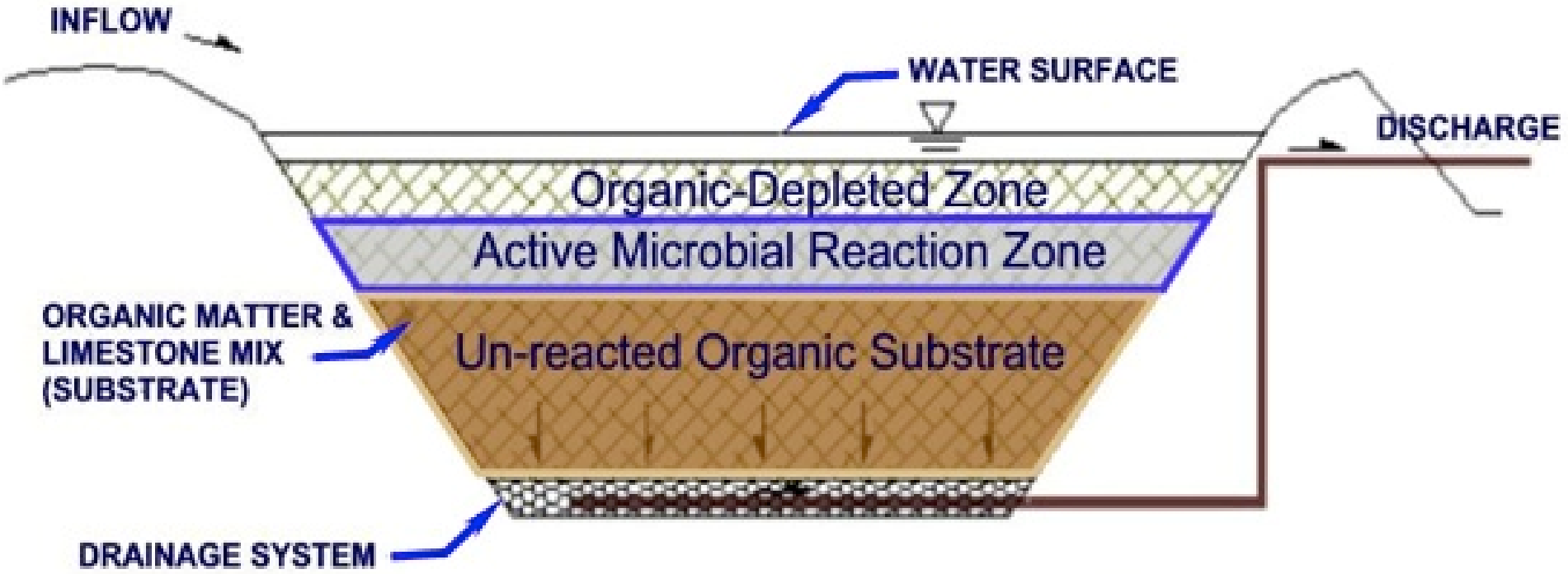
- Passive treatment of trace metals
- Peat sorption media
- Site
- Pilot testing
  - Design
  - Results
- Summary

Passive Treatment of Mine Drainage

- Biochemical Reactors (BCR)

- Constructed Treatment Wetlands

Biochemical Reactors



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

- Wetlands
  - Large footprint
  - Winter performance
    - Flow distribution
- BCRs
  - Initial release of organic rich water
    - BOD
    - Nutrients
  - Color lasts ~ 3-6 months
  - Odors
    - Hydrogen sulfide

Residence time ~ 1-2 days

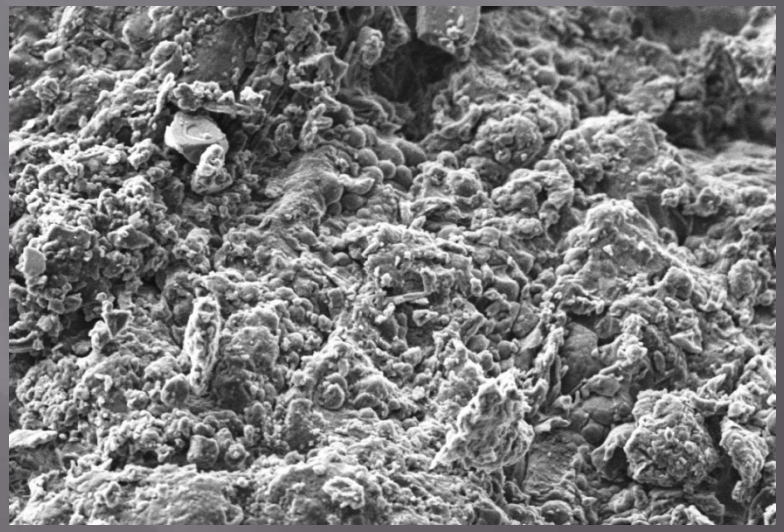
What is Peat sorption media?

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

APTsorb ™ Granule

Properties

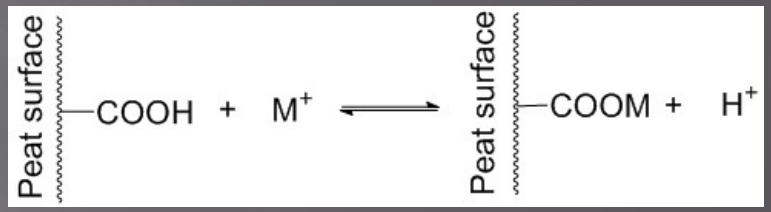
- Size -10, +30 mesh (0.6 to 2 mm)
- Large surface area
- High hydraulic conductivity (~0.5 cm/sec)
- High metal affinity (1-15% max dry wgt)



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

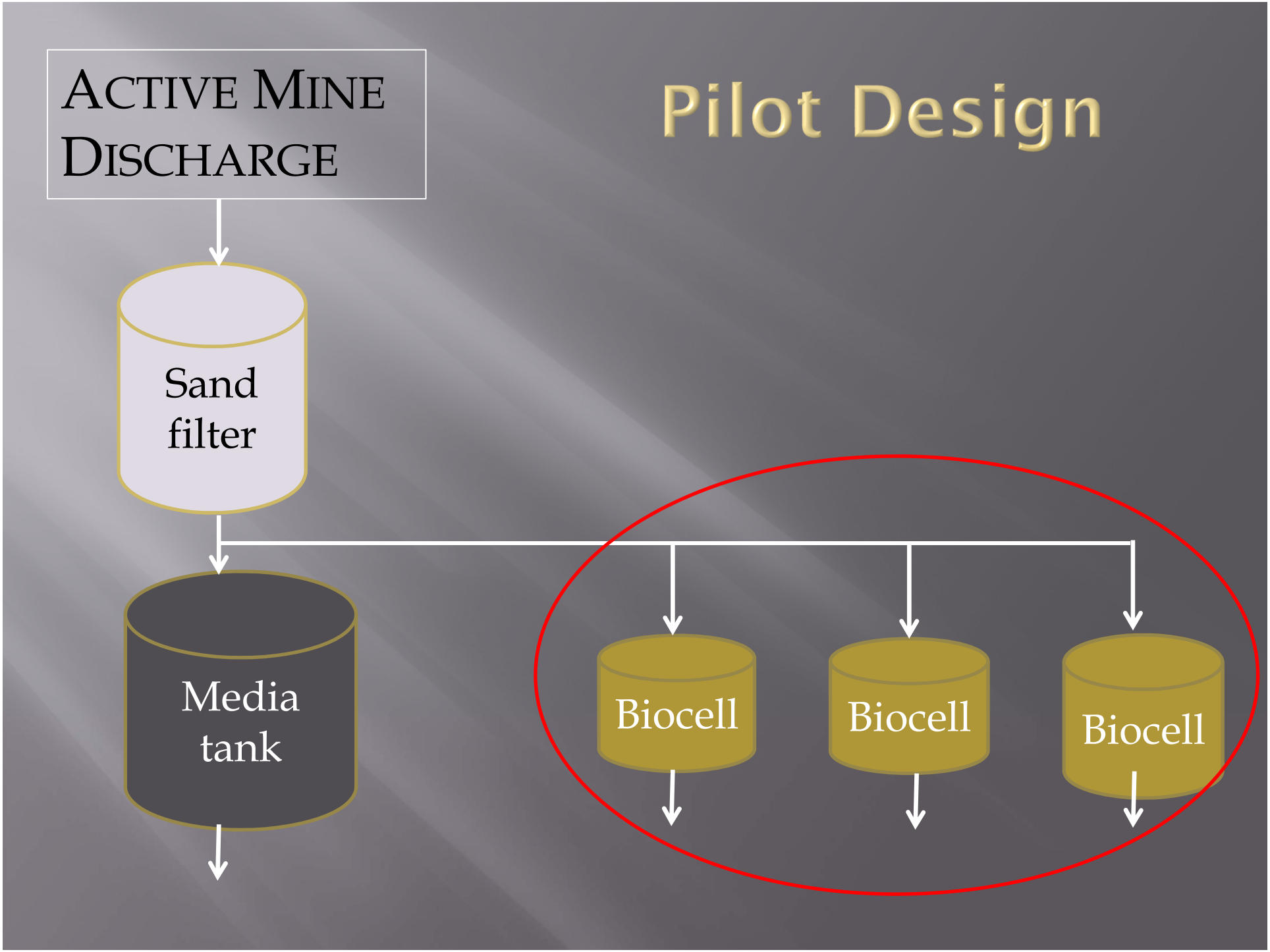
Characterization

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

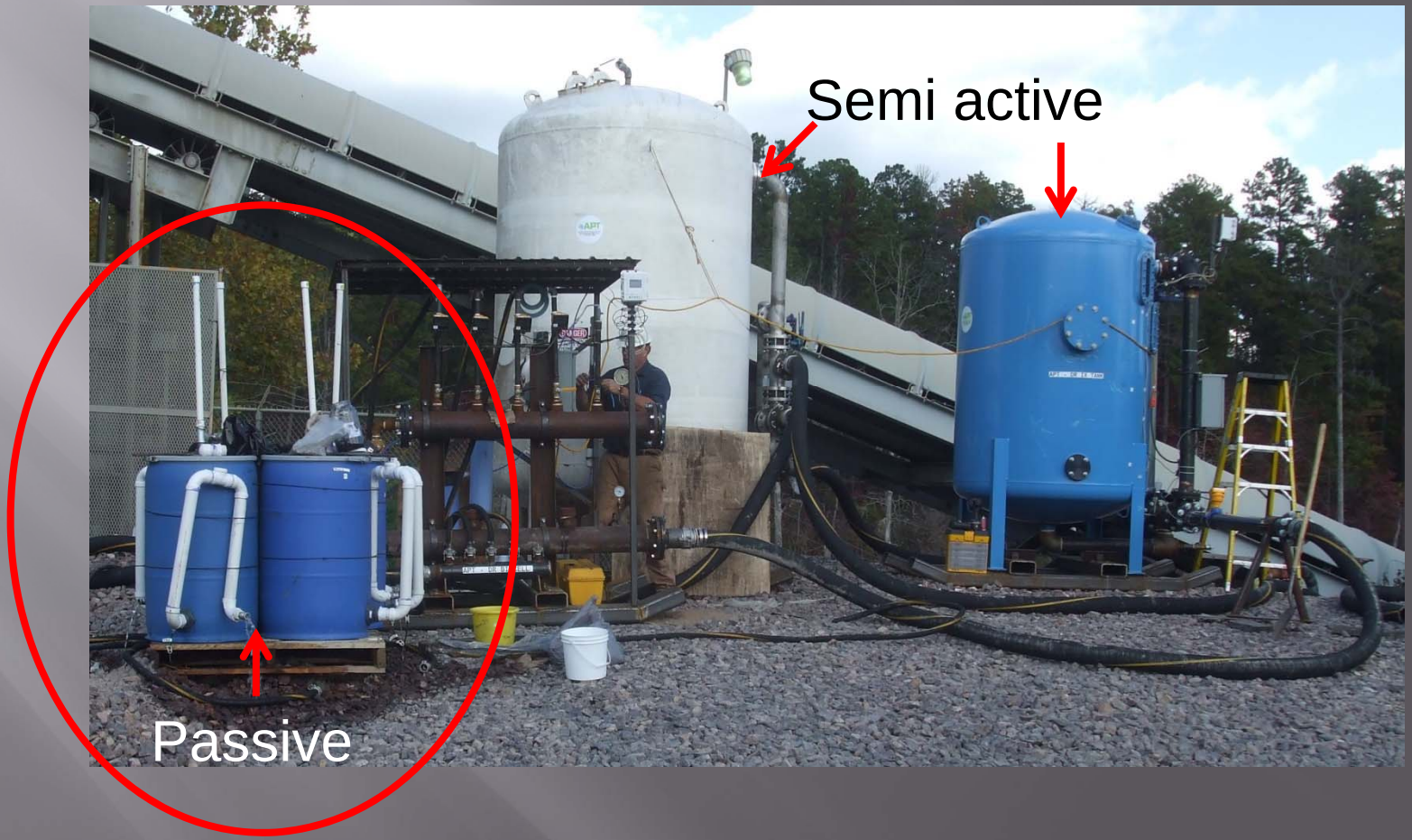
	Concentration ug/L		
Metal	Total	Dissolved	Permit
Pb	2100	150	11.5
Zn	115	70	137.3
Cd	0.8	0.2	0.5

- Flow up to 8,000 gallons/min

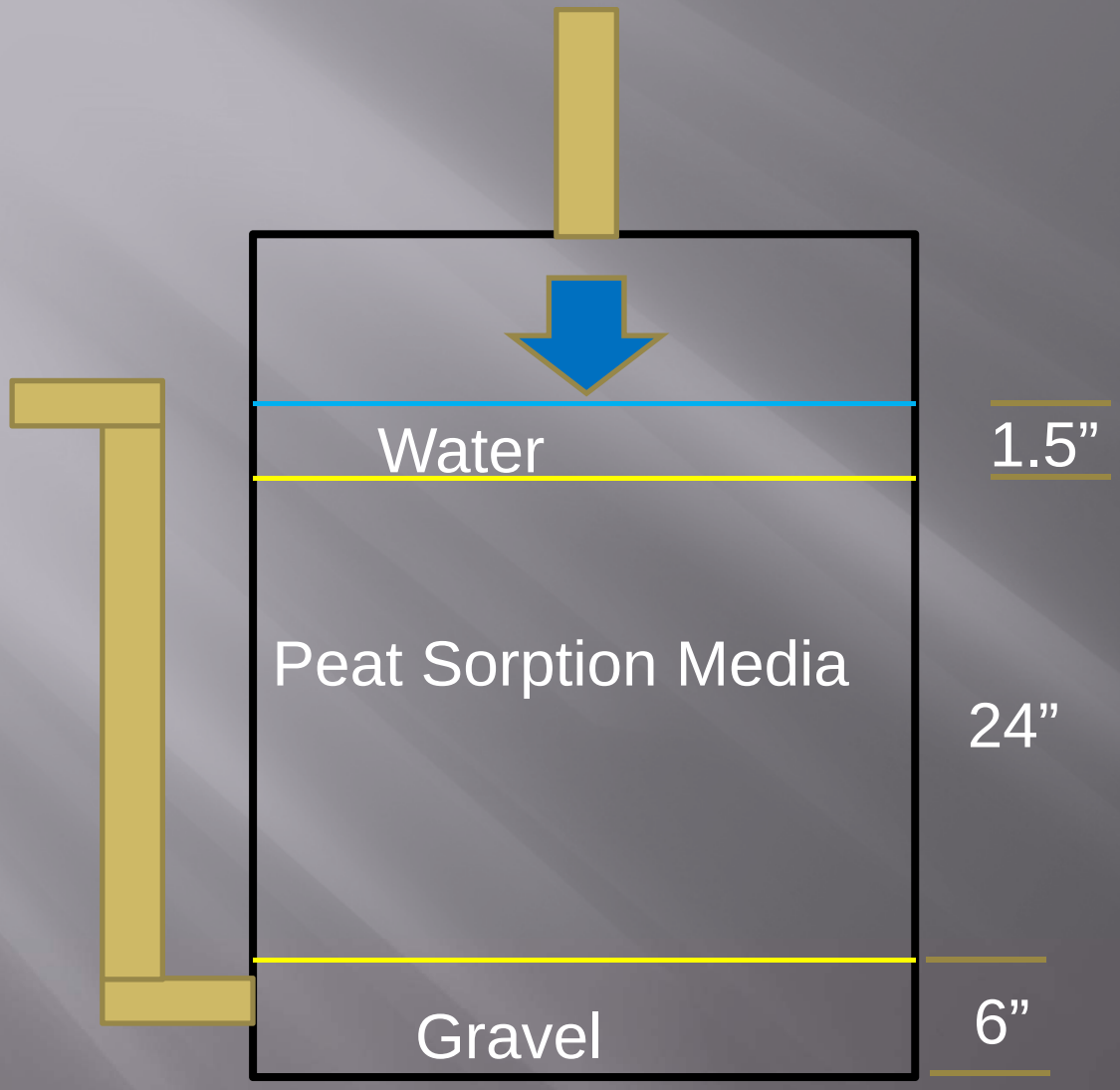
Pilot Design



Pilot Test



Passive – Biocells



Biocells

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

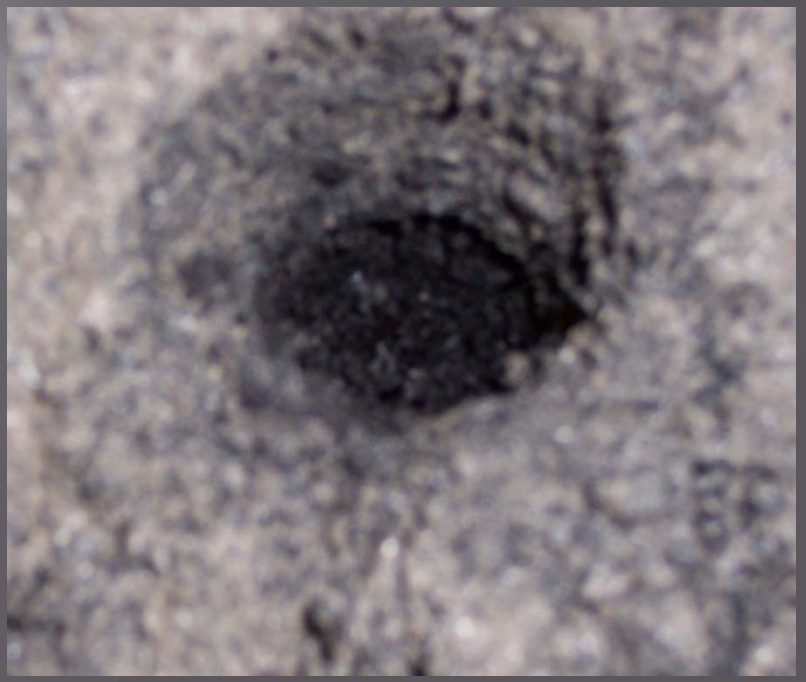
Biocell	Flow rate gpm	Hydraulic loading gpm/ft^2	Residence time min
1	0.6	0.25	60
2	2.4	1	15
3	1.2	0.5	30

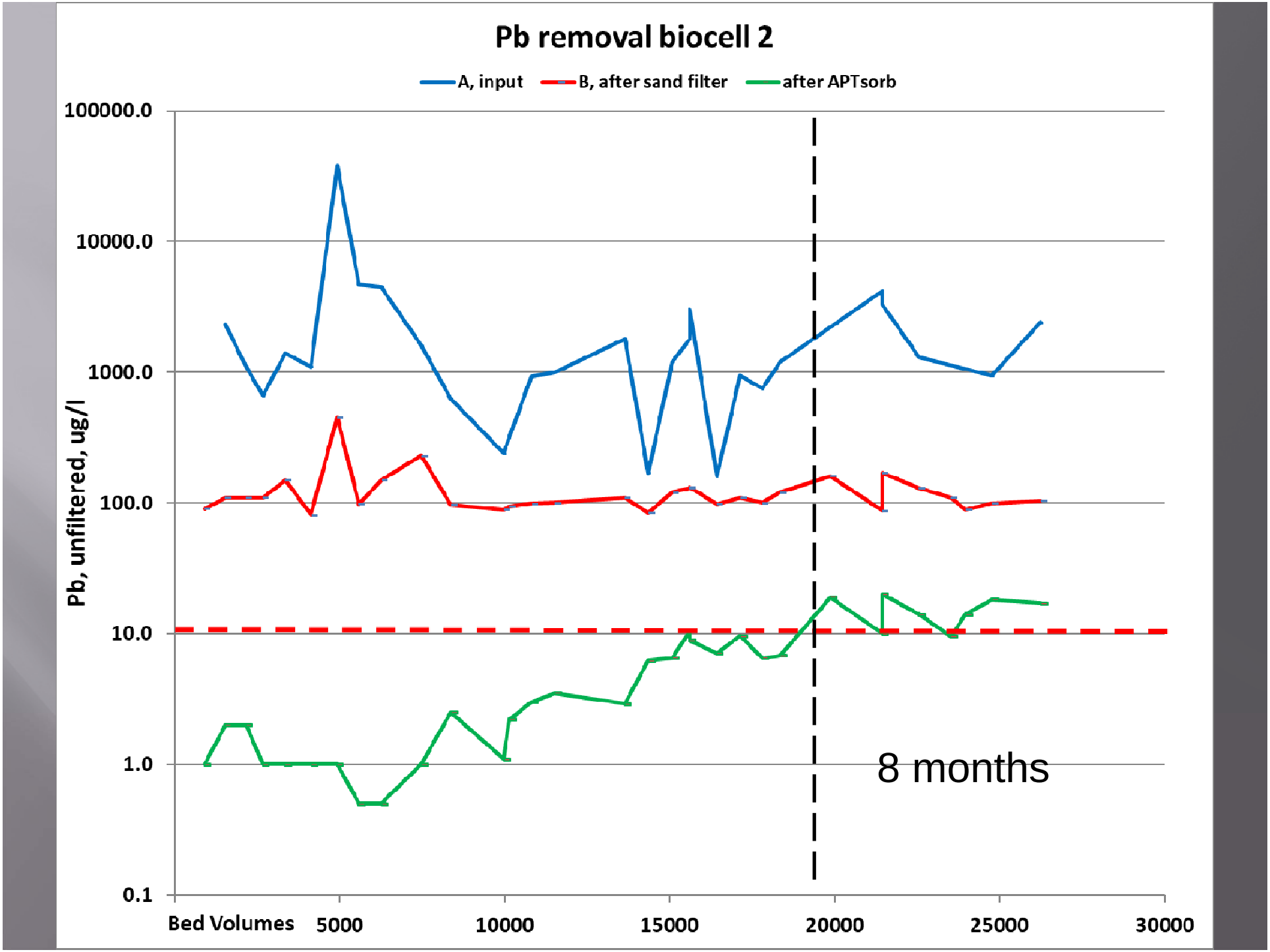
10 month pilot test
Temperature -10 to 100

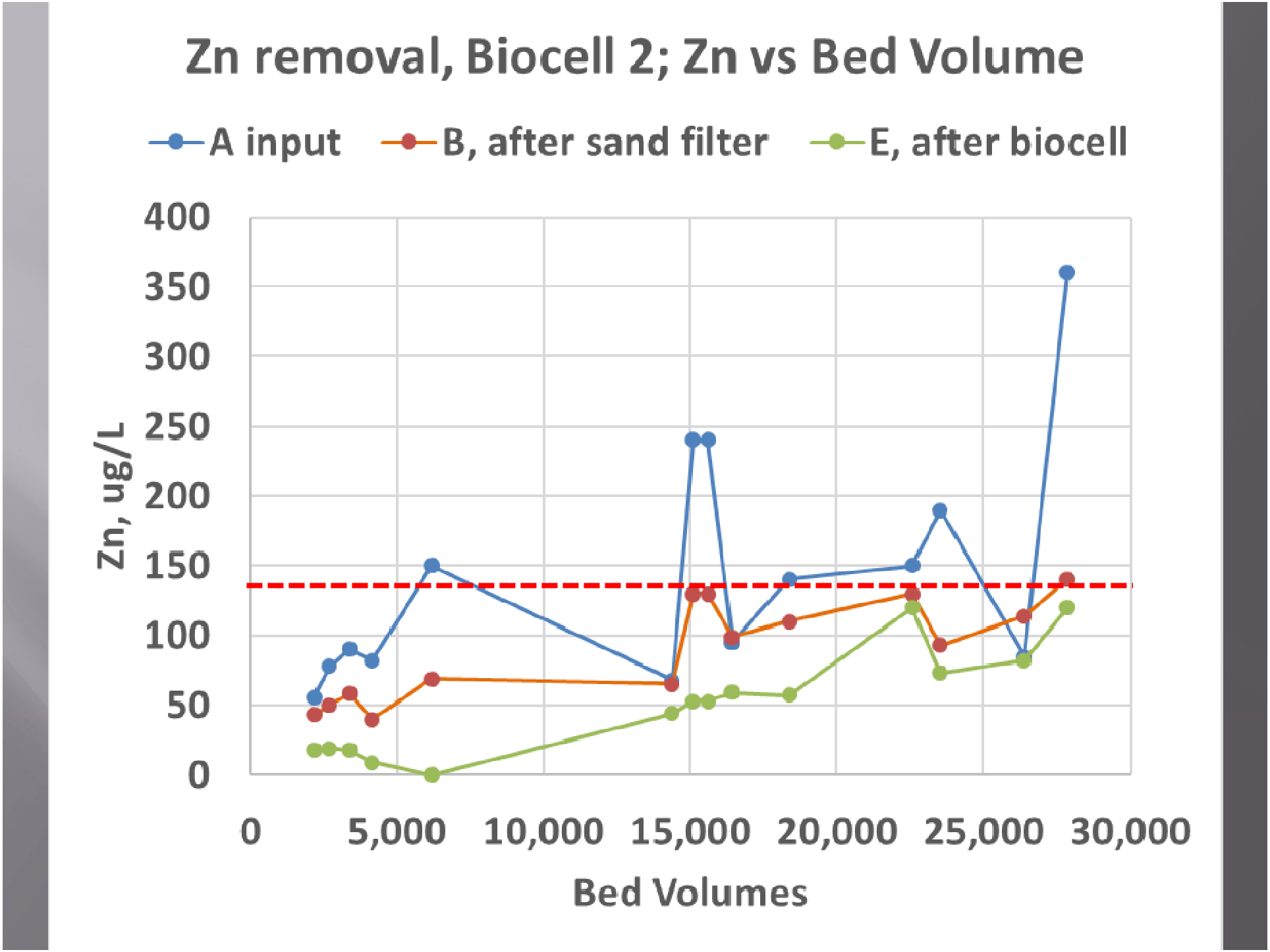
RESULTS

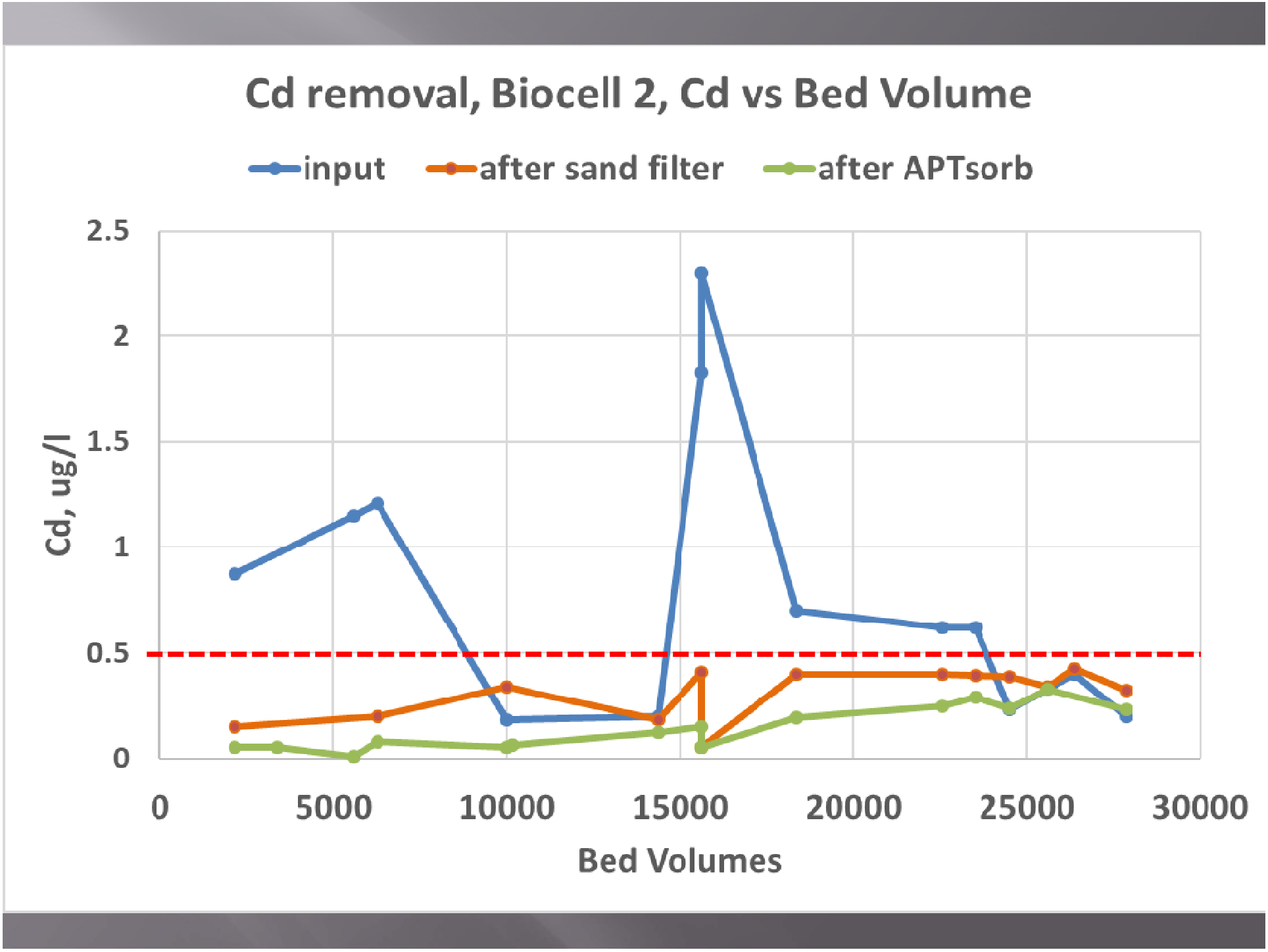
Biocells Solids Removal

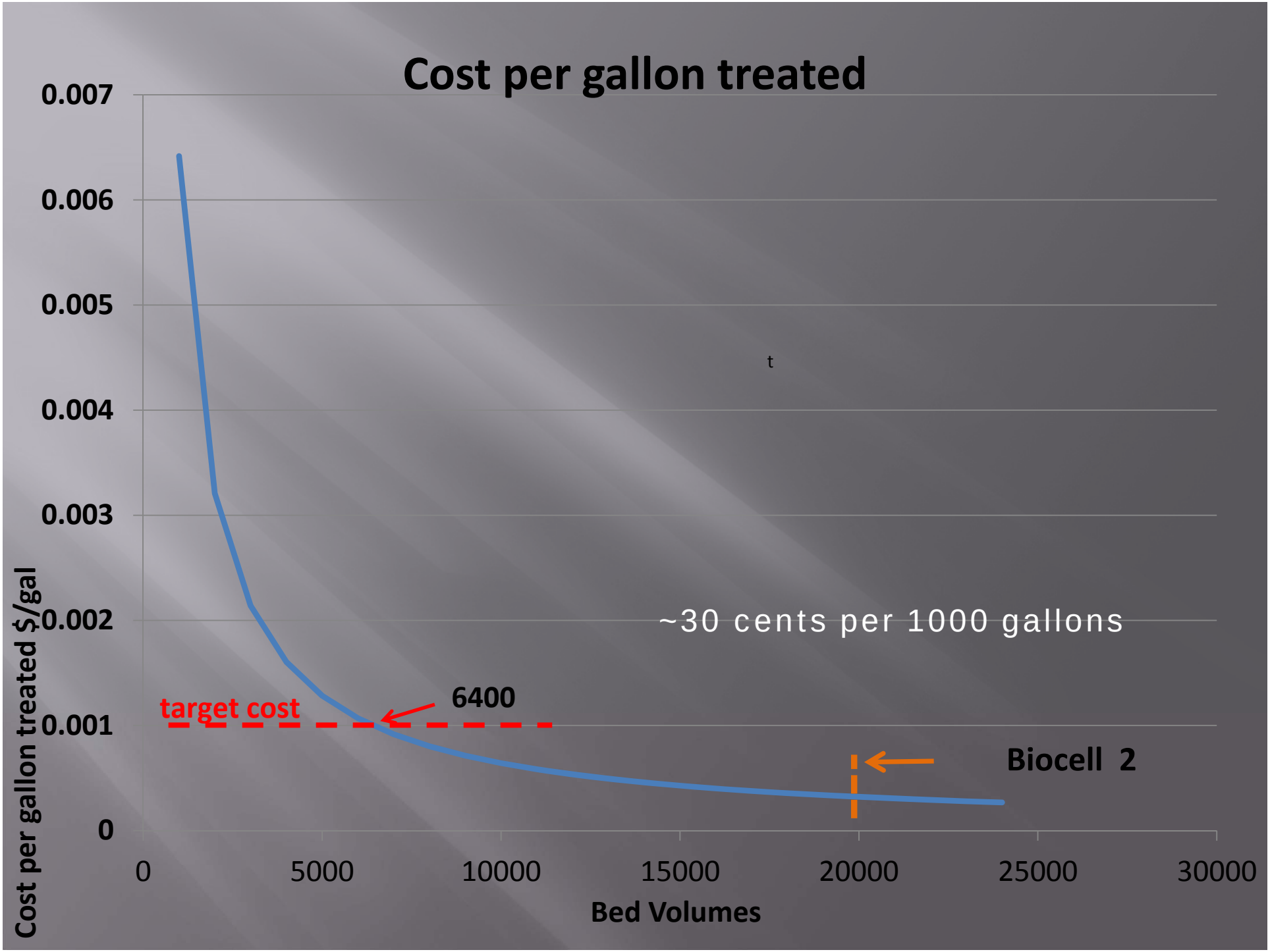
- Sand filter did not remove all suspended solids
- Solids confined to top inches

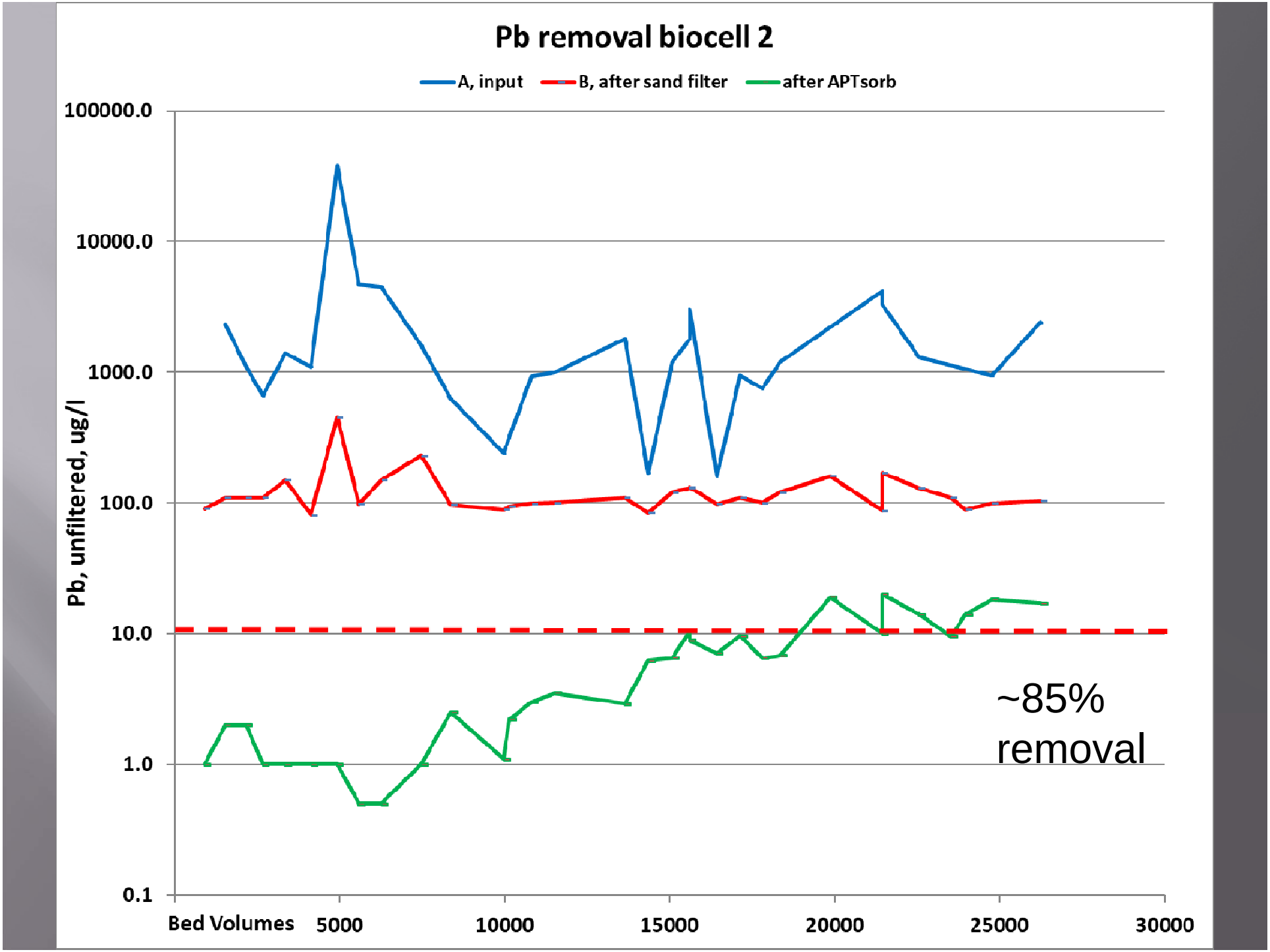



Pb removal biocell 2
A, input
B, after sand filter
after APTsorb
100000.0
10000.0
1000.0
100.0
10.0
1.0
0.1
Pb, unfiltered, ug/l
Bed Volumes
5000
10000
15000
20000
25000
30000
8 months


Zn removal, Biocell 2; Zn vs Bed Volume
A input
B, after sand filter
E, after biocell
Zn, ug/L
400
350
300
250
200
150
100
50
0
0
5,000
10,000
15,000
20,000
25,000
30,000
Bed Volumes

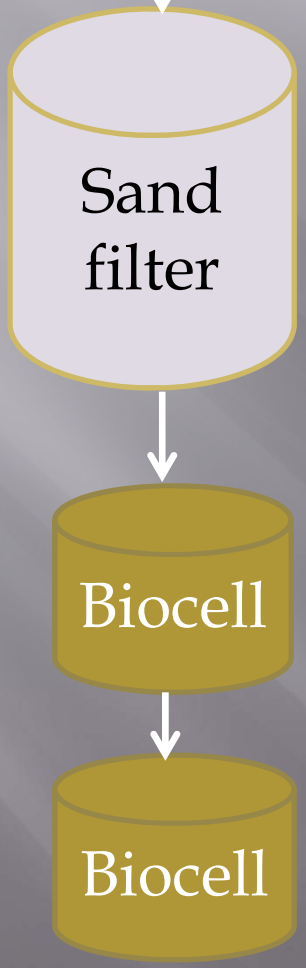

Cd removal, Biocell 2, Cd vs Bed Volume
input
after sand filter
after APTsorb
Cd, ug/l
2.5
2
1.5
1
0.5
0
0
5000
10000
15000
20000
25000
30000
Bed Volumes

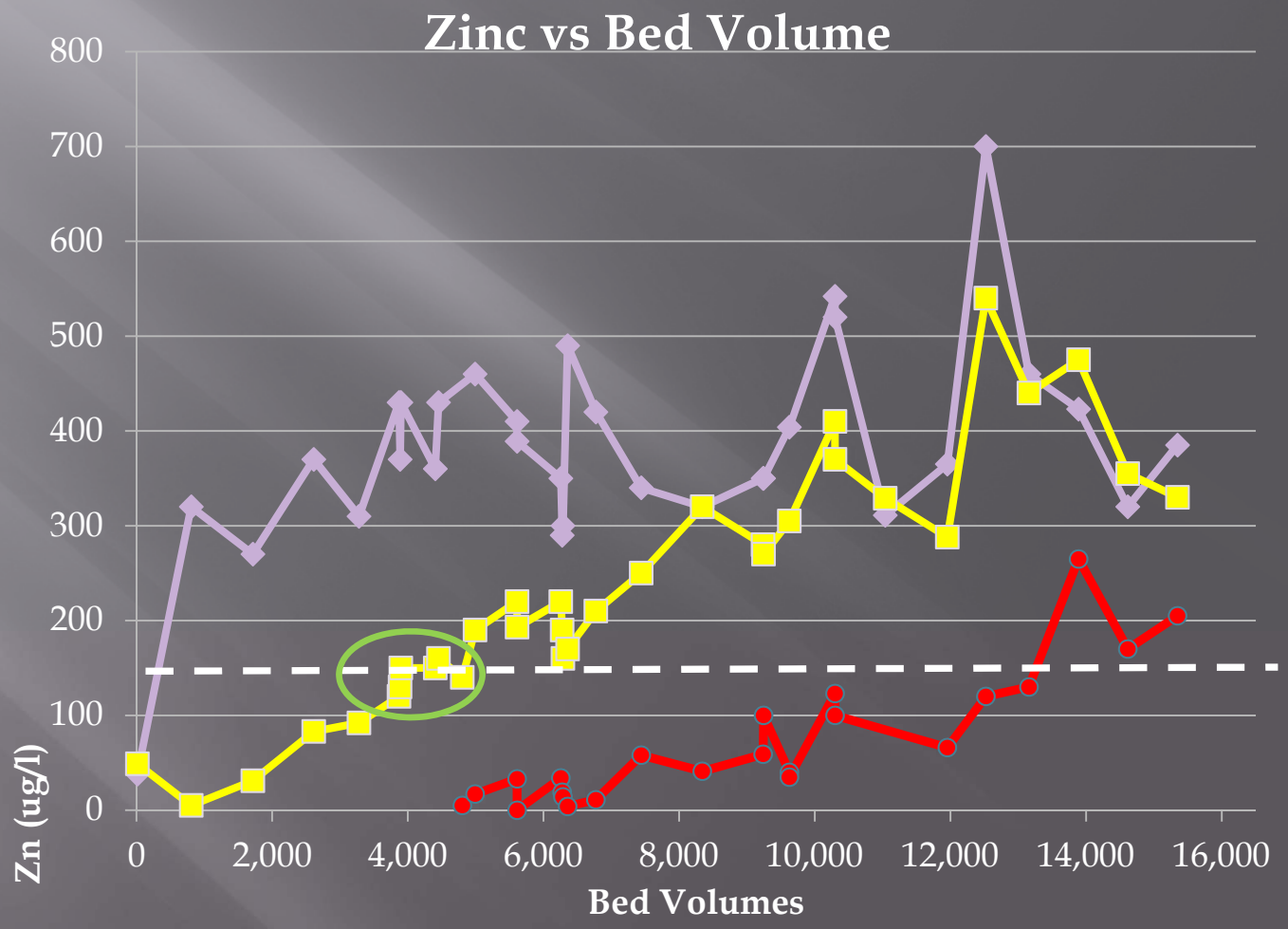

Cost per gallon treated
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Cost per gallon treated $/gal
0
5000
10000
15000
20000
25000
30000
Bed Volumes
~30 cents per 1000 gallons
target cost
6400
Biocell 2


Pb removal biocell 2
A, input
B, after sand filter
after APTsorb
100000.0
10000.0
1000.0
100.0
10.0
1.0
0.1
Pb, unfiltered, ug/l
Bed Volumes
5000
10000
15000
20000
25000
30000
~85%
removal

Pilot Design

ACTIVE MINE DISCHARGE





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

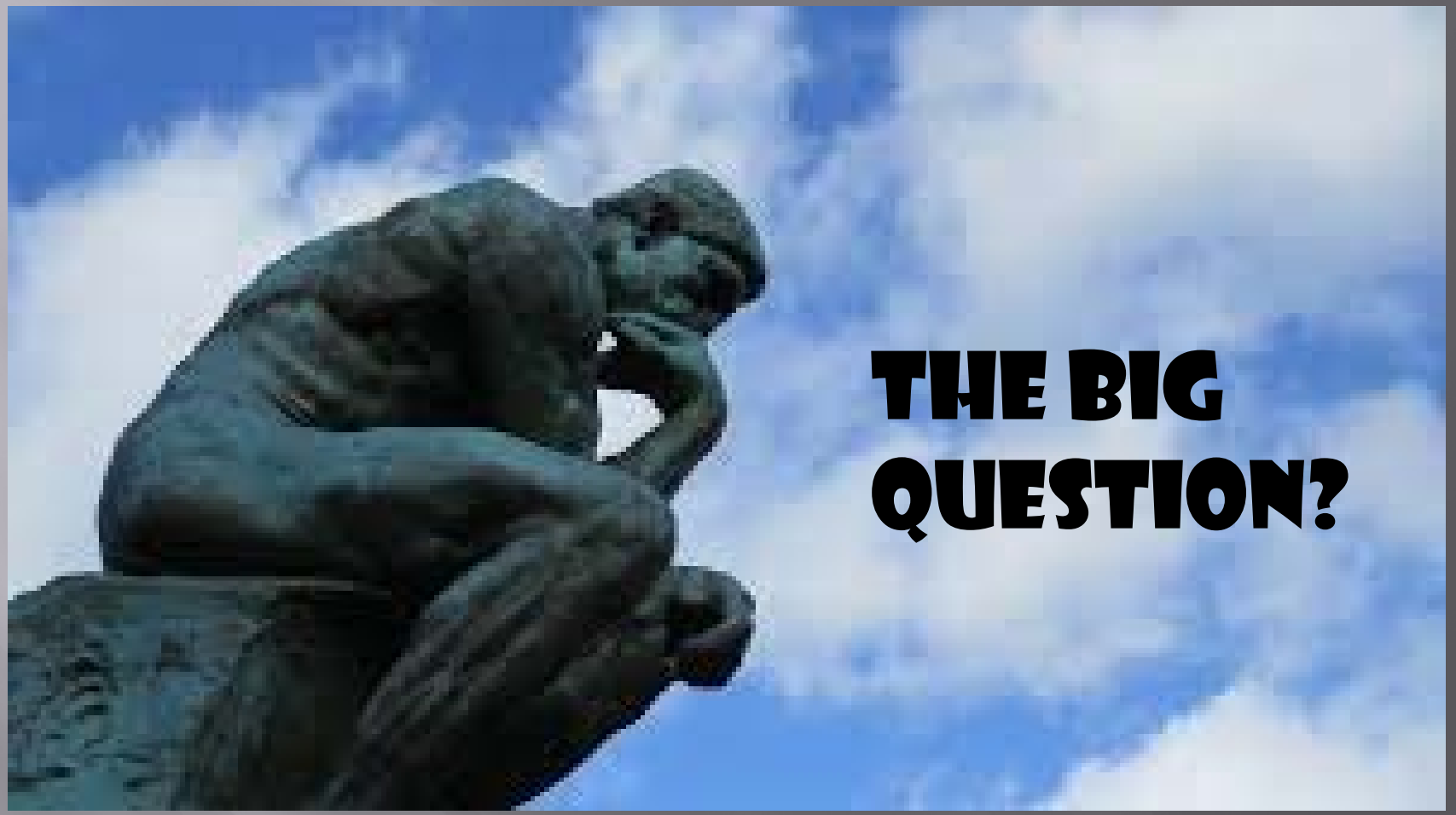
- Potential metal recovery
  - Pb ~1%
  - Ore 3%
- Disposal in tailings basin
  - Potential amendment to improve vegetation
- Off site disposal
  - TCLP
  - Metals strongly bound to media

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



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
Peat Sorption Media	6-8	15 min	Minimal color	Needs insulation

Summary

- Met permit limits
- Cost effective
  - 30 cents/1000 gallons
  - Reduce costs with lead/lag approach
- Transmits water like coarse sand
- Short contact time
  - 15 minutes
- No nuisance parameters
- Easy to replace
- Potential metal recovery

Got Questions?

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