Ecologically Effective Contaminant Removal

Sorbster® Media

Wastewater, leachates, ground water, process water, and ponds

Sorbster® History

- Sorbster media “invented” in 2007
- Very specific activated alumina substrate created tp maximize macroporosity and surface area
- Proprietary chemistry applied to entire available surface
- Technology developed in 2008 with the USEPA to enhance **M**ercury and **A**rsenic **R**emoval for Great Lakes remediation. MAR Systems was incorporated.

- MAR Systems liquidated in 2017
- Sorbster Inc purchased the IP suite , manufacturing technology and inventory in 2017

Sorbster® Media Properties

- Removal of soluble heavy metals from water by chemisorption
- High adsorbent capacity: Up to 75% by weight, typically 30 wt.%
- Ability to reach ultra low levels (ppb and ppt)
- Effective across broad pH range: pH 3 to 10
- Does not support bacterial growth
- Multi-metal removal in single water pass
- No ancillary waste stream
- Low fouling potential
- Low energy requirement
- Passes TCLP/CA WET for non-hazardous disposal options

Sorbster® Adsorbent Media Types

Sorbster (Sorbster MM, Sorbster Hg, Sorbster Se)

- Multi-metals removal
- Selenium Optimized
- Mercury Optimized

Sorbster F, Sorbster Cu

- Fluoride
- Copper

Sorbster Si

- Silica

- **Water flow is the primary control parameter**
- **Establish water-to-media contact time**
- **Reacted chemistry provides adsorption sites for both soluble cations and anions**

- **Long media life**
  - **High removal efficiency**
    - **Flexible implementation options**
      - **Low total cost**
        - **Robust media – wide range**
          - **No hidden costs**

Avoid surface active chemistries that can coat surface sites and sustained levels of free oxidants

Sorbster® Selective Adsorption Capability

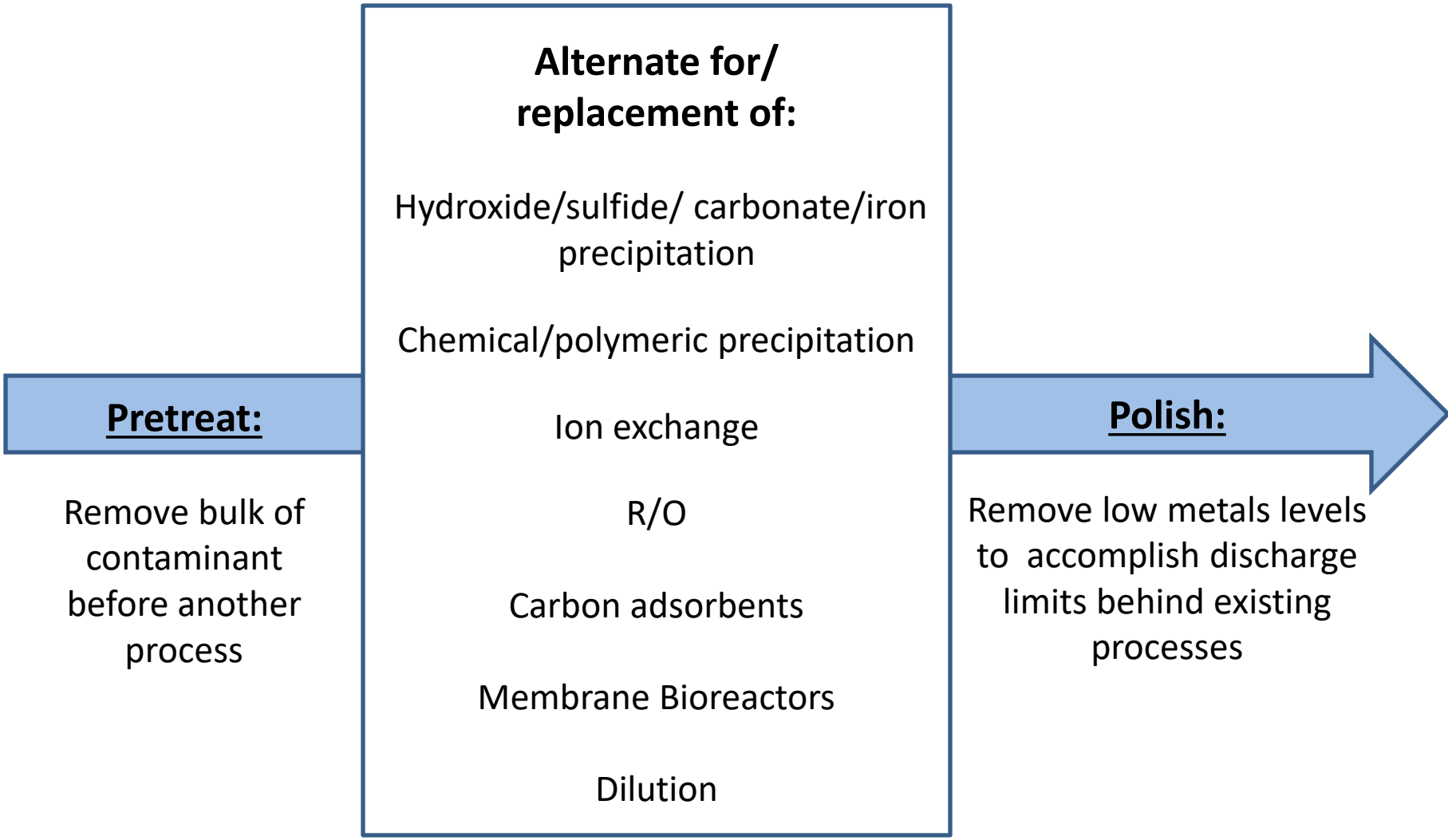
Contaminants Removed		
Mercury	Arsenic	Selenite
Copper	Fluoride	Selenate
Cadmium	Thallium	Vanadium
Tin	Barium	Hexavalent Chromium
Antimony	Cobalt	Silica
Lead	Zinc	*Up to 99% removal to achieve Mercury <1.3ppt Selenium < 1.0 ppb*
Boron	Molybdenum	
Nickel	Cyanide	

Most Typical Water Ions Do Not Interact & Pass Through Sorbster™ Media

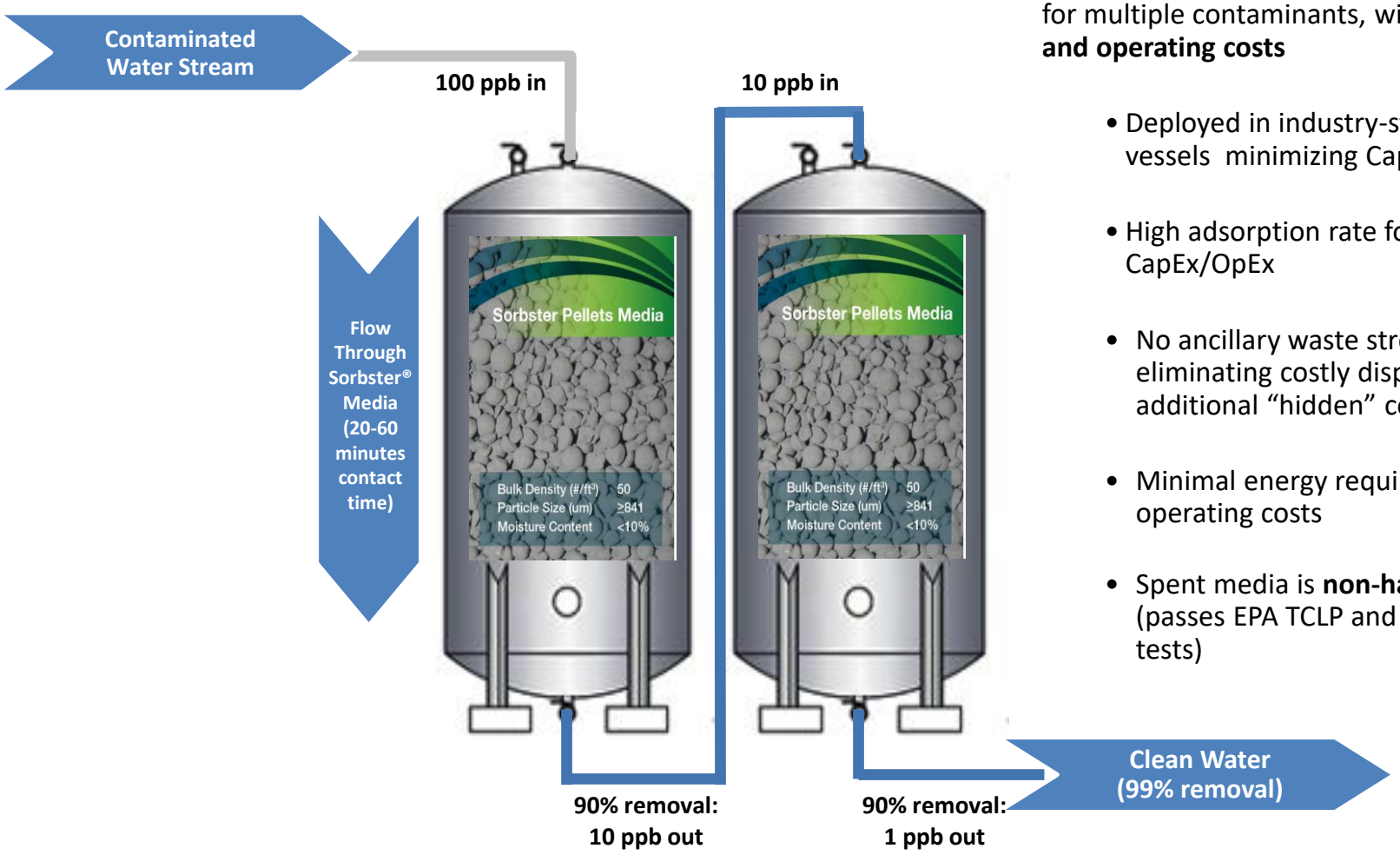
Inlet to Sorbster®(ppm)	Outlet of Sorbster® (ppm)
Chloride up to 20,000 ppm	Chloride up to 20,000 ppm
Calcium up to 3500 ppm	Calcium up to 3500 ppm
Magnesium up to 6000 ppm	Magnesium up to 6000 ppm
Sulfate* up to 89,000 ppm	Sulfate* up to 89,000 ppm
Iron and Aluminum up to 10 ppm	Iron and Aluminum up to 10 ppm

This table shows client water results, these are not maximum levels for the media
**Occasional sulfate removal to 30% maximum*

Opportunities for Sorbster® Use



Proprietary Sorbster® Media



- Able to reach **ultra-low** contaminant levels for multiple contaminants, with **low capital and operating costs**
  - Deployed in industry-standard vessels minimizing CapEx
  - High adsorption rate for lower CapEx/OpEx
  - No ancillary waste streams to treat eliminating costly disposal and additional "hidden" costs
  - Minimal energy requirements and operating costs
  - Spent media is **non-hazardous** (passes EPA TCLP and CA WET tests)

Sorbster® Competitive Advantages

Technology	Ability to reach <1ppt Hg	Low-level Se <5ppb	Selective multi-metal removal (Se, As, Hg, F, etc.)	Low Fouling Potential	No ancillary waste stream	pH Range
Sorbster®	●	●	●	●	●	**3-12**
Ion Exchange	Limited	●	Limited	●	✖	0-14
Carbon	●	✖	✖	●	●	4-7
RO	●	●	●	✖	✖	2-10
Precipitation / Coagulation	✖	✖	●	✖	✖	5-10
Bioreactors	✖	●	Limited	✖	✖	6-9
Membrane Bioreactors	●	●	●	✖	✖	6-9

Sorbster® Medias for Silica Removal from Water Systems

Sorbster®

Ecologically Effective Contaminant Removal

Sorbster® Media Technology

- Reduction by chemisorption of soluble silica
- Physical properties
  - Particle size: 1/8” (nominal) diameter spheres
  - Bulk Density: 40 – 48 lbs./ft³
  - High macroporosity
- Typical Application:
  - Continuous flow-through vessels or batch tanks
  - pH 6 to 9.5
  - Temperature: 32°F to 150°F
  - Empty Bed Contact Time (EBCT): 10 – 60 minutes
  - Service Flux Rate: 1 to 6 gpm/ft² of vessel surface area

Product Line

- Sorbster® Si-1
  - Suitable for all water qualities and applications
    - Process waters, cooling water, boiler water, groundwater, wastewater
    - Pretreatment for selenium removal
  - Economical silica removal

- Sorbster® F-1
  - Simultaneous removal of silica and fluoride

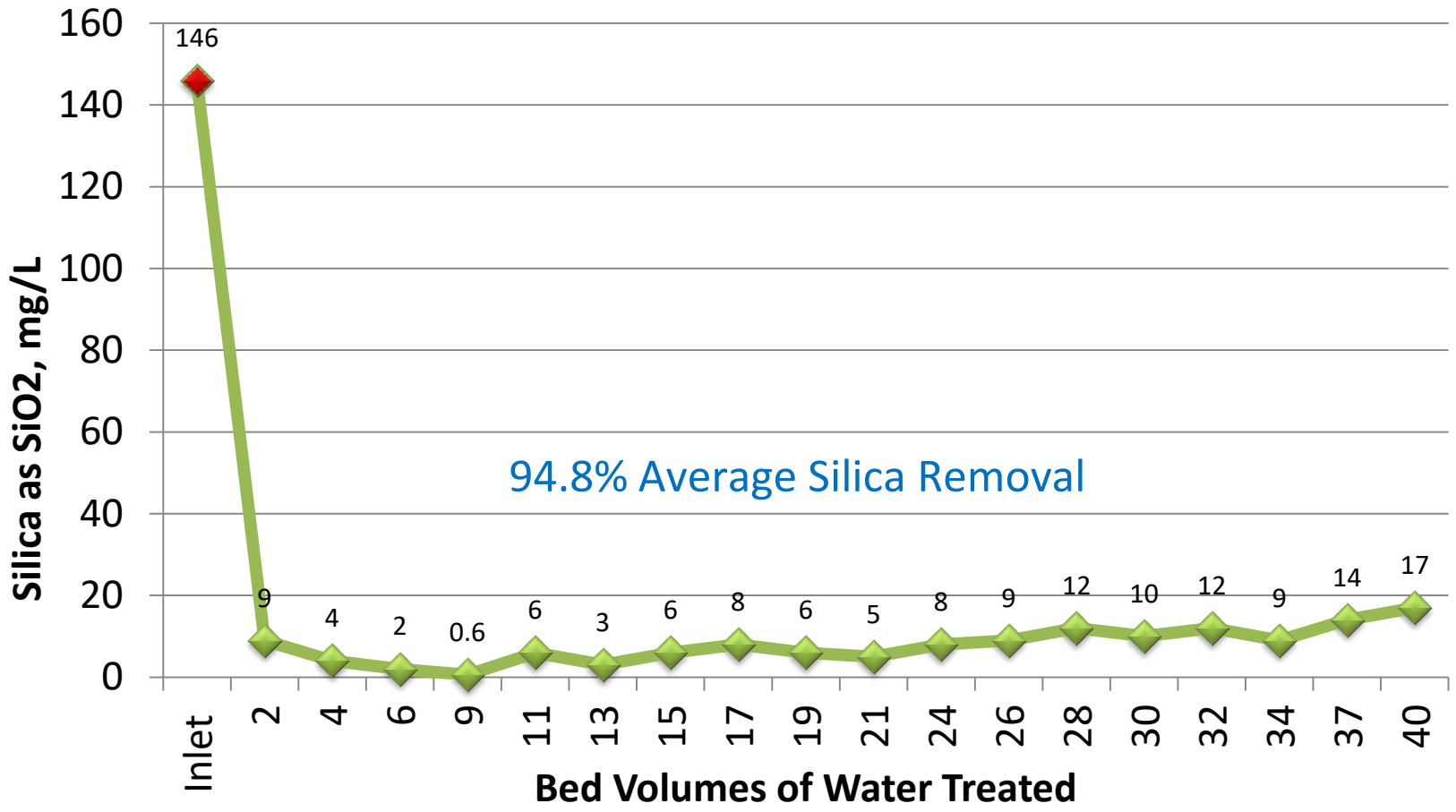
Uses

- *Silica removal from industrial waters*
  - Medias are designed for soluble silica, also known as reactive silica. Not suitable for colloidal silica, polymerized silica (glass) or magnesium silicate forms of silica
  - Expected removal rate >90% @ 15-20 wt.% capacity
  - Most effective contact time is 30 minutes - silica removal benefits from a longer contact time
  - Primary removal mechanism is formation/chemisorption as aluminum silicate complex and media has unlimited sites for this
  - Good performance measured up to 140°F making it cooling tower, process water & boiler water pretreatment suitable
  - Performance can be diminished in the presence of polar organics, very high chlorine levels and surface active compounds (surfactants)

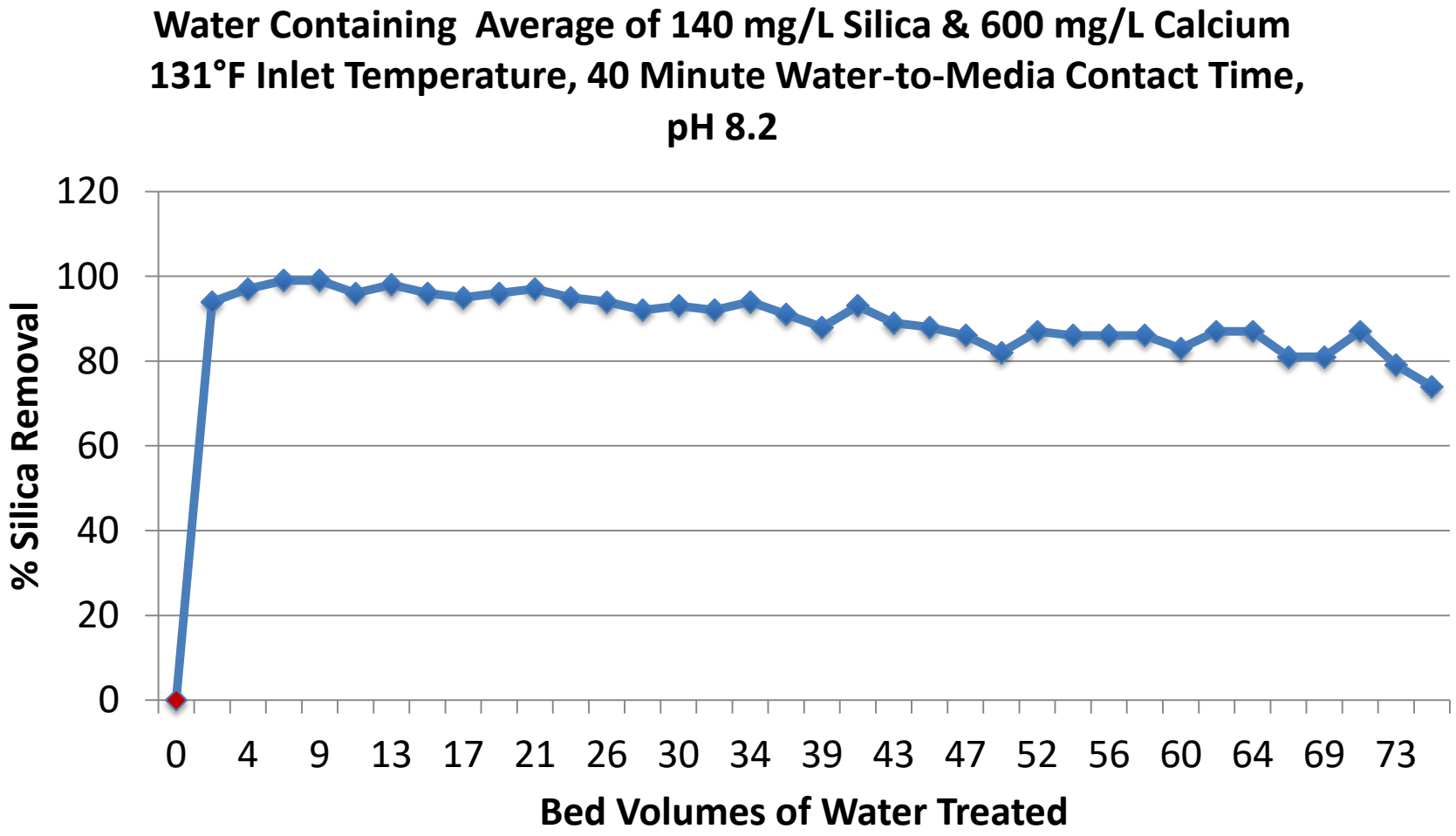
Performance of Sorbster® Si Media at Cooling Tower Conditions

- High Silica Concentration: 145 mg/L
- Elevated Temperature: 104° F
- High Calcium Concentration: 600 mg/L
- Water-to-Media Contact Time: 40 Minutes EBCT
- 75 Bed Volumes Treated

Silica Removal by Sorbster® Si Media @ 40 Min EBCT, 104°F, 146 mg/L Silica, pH 7.8



% Silica Removal – Sorbster® Si Media



Sorbster®

Ecologically Effective Contaminants Removal

Sorbster® Media Performance for Copper, Nickel, Lead and Zinc

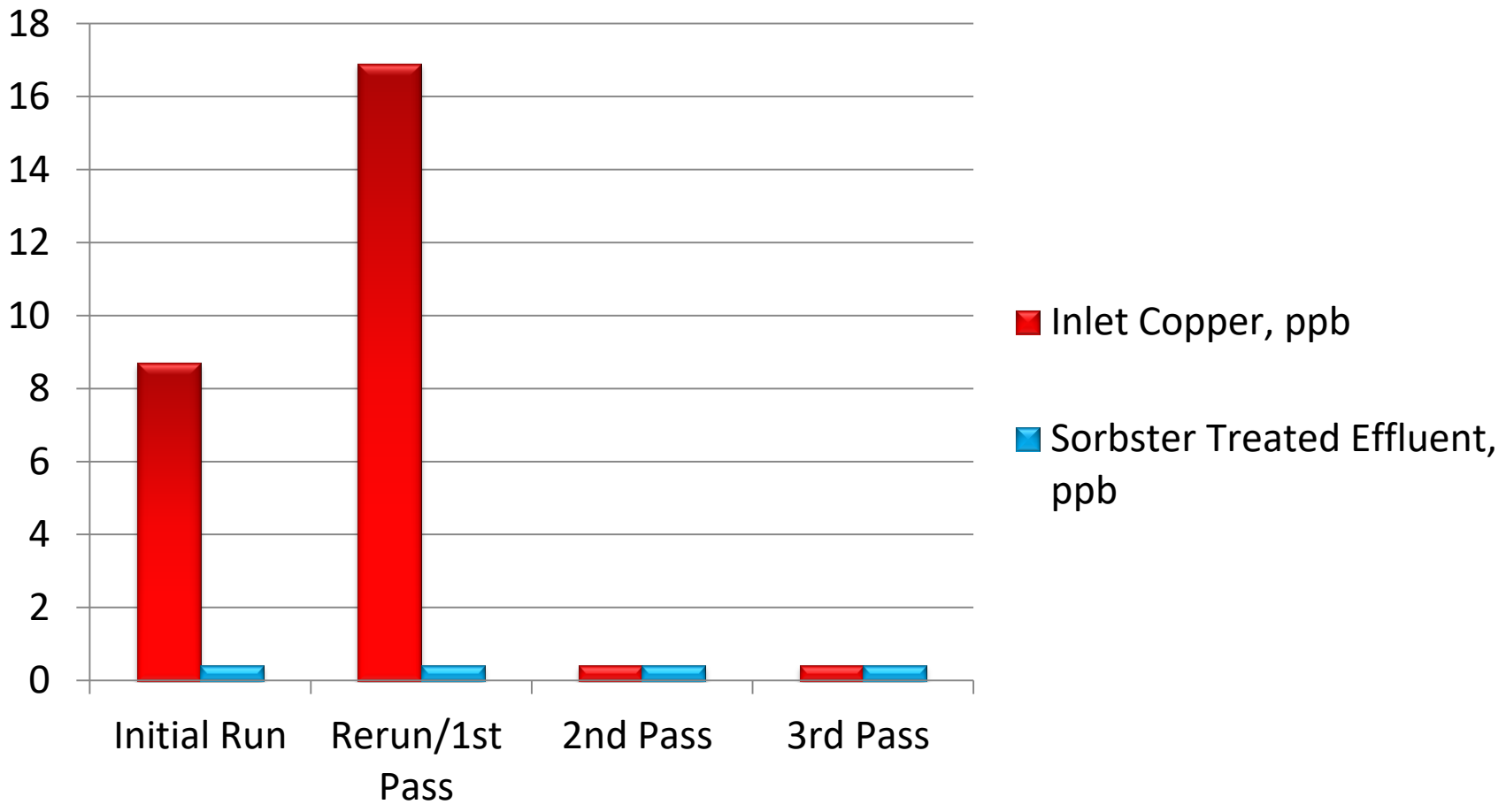
Summary of Various Field Water Treatments

www.sorbster.com

Sorbster® Removes Copper, Nickel, Zinc and Lead from Wastewater

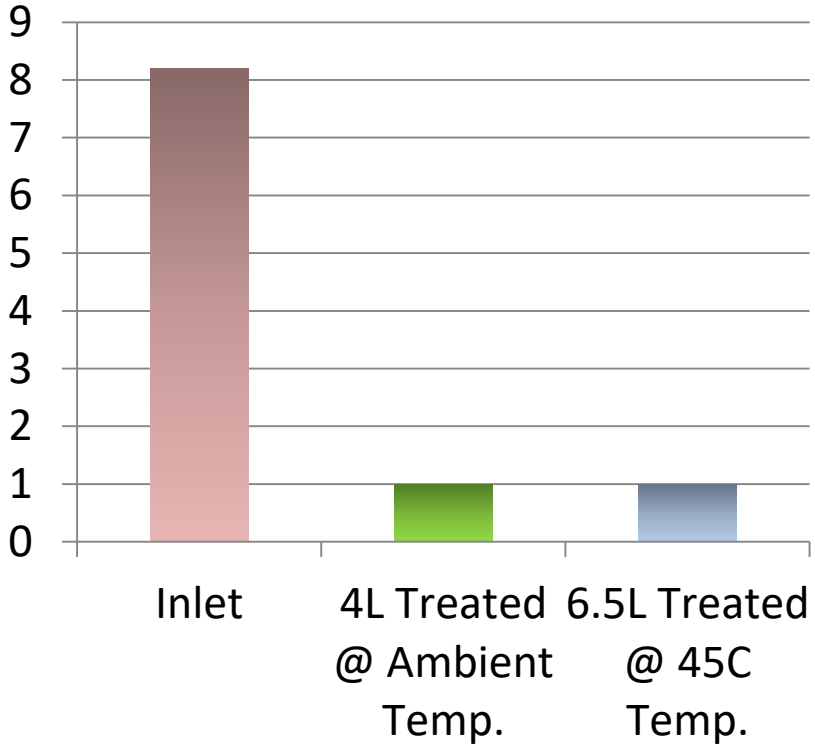
- Performance is a function of:
  - Water quality
  - Contact time (typically 20 minutes or less)
  - Competing contaminant cations and anions
  - Water flow (1 to 6 gpm/ft_2)

Sorbster® Copper Removal – Filtered FGD Water

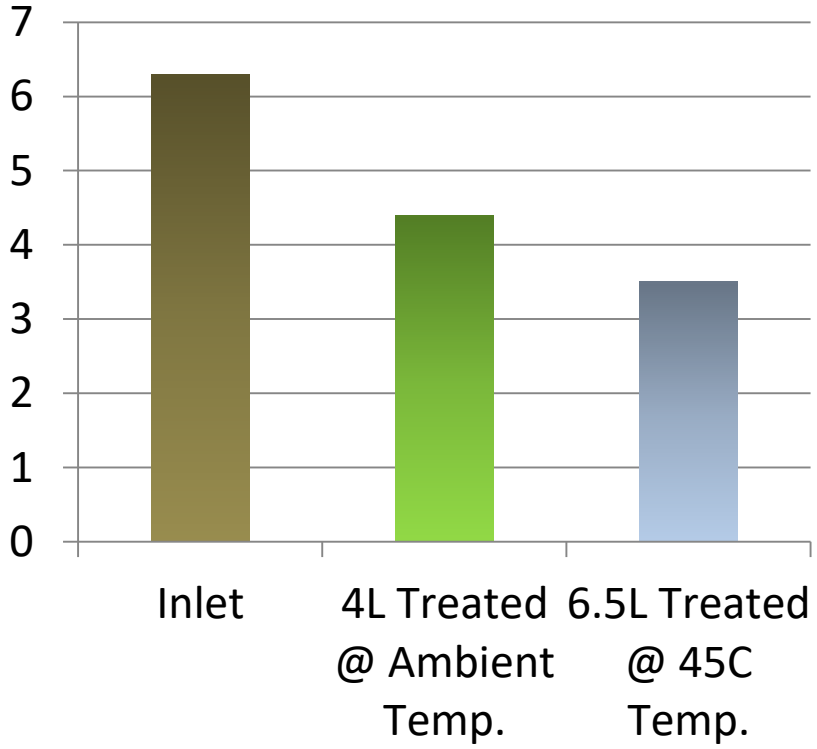


Sorbster® Removal of Contaminants from Northeastern USA FGD Scrubber Water

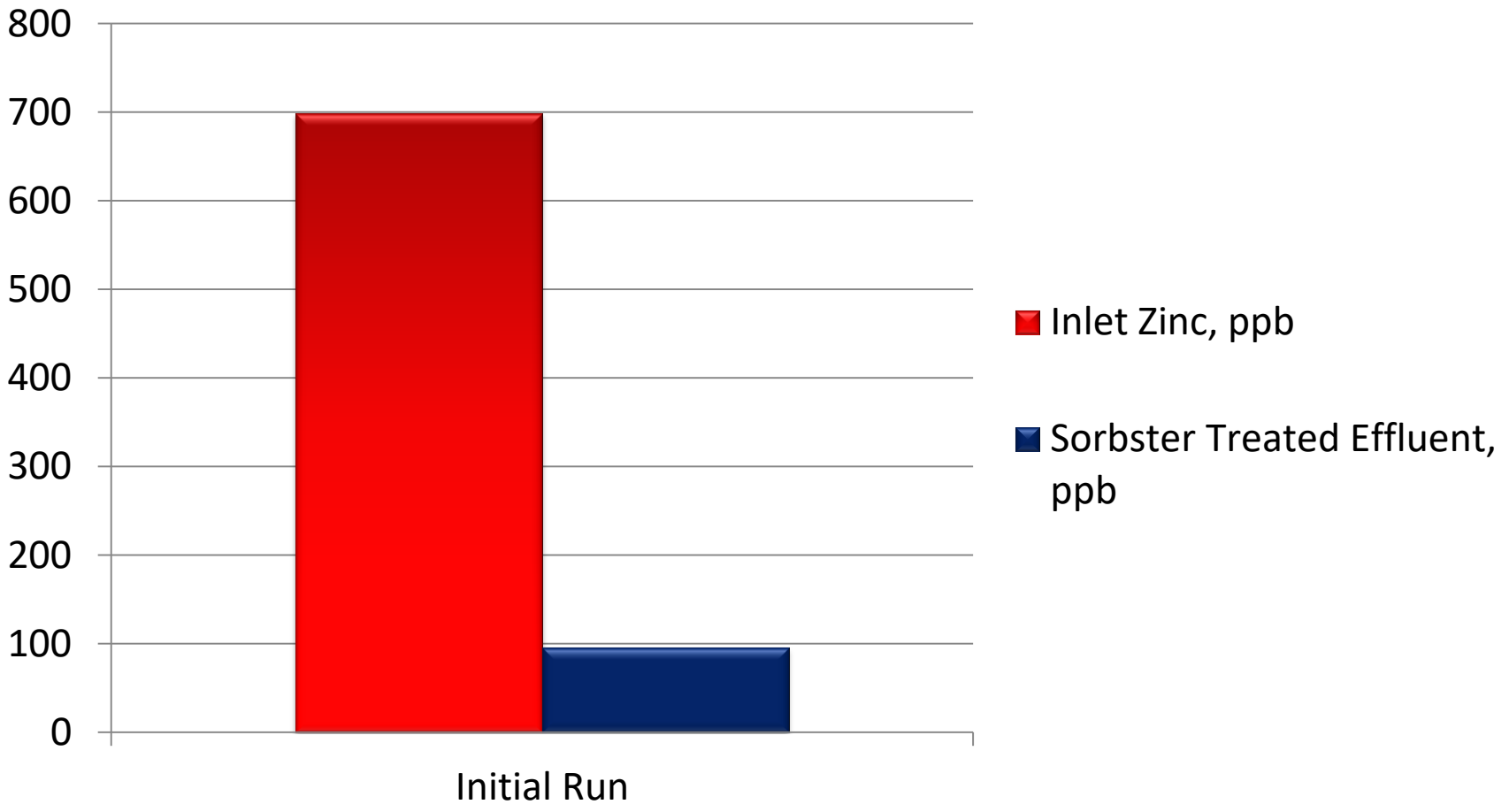
Copper, ppb, not Detected in Treated Effluent



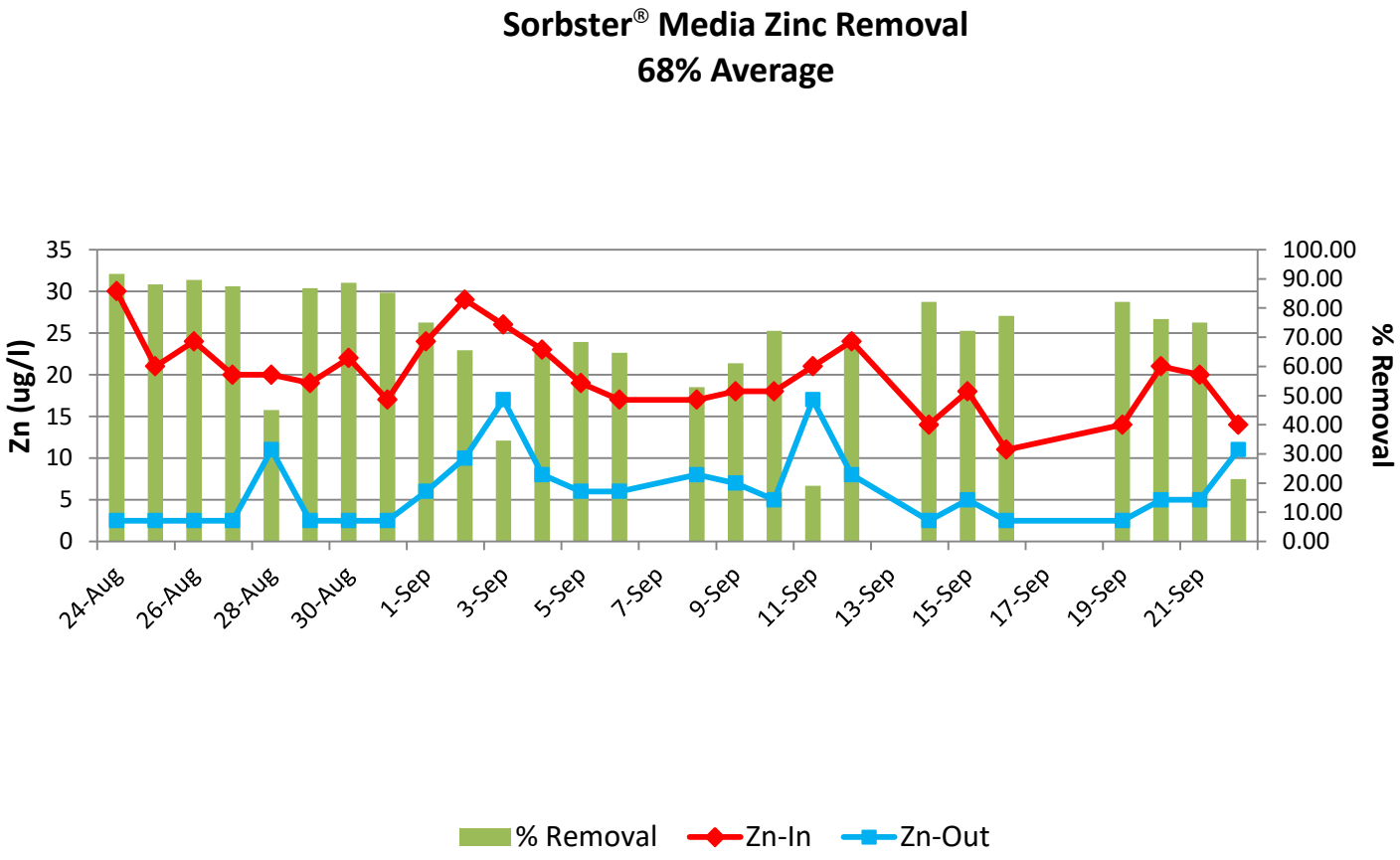
Nickel, ppb, Increasing Removal over Time



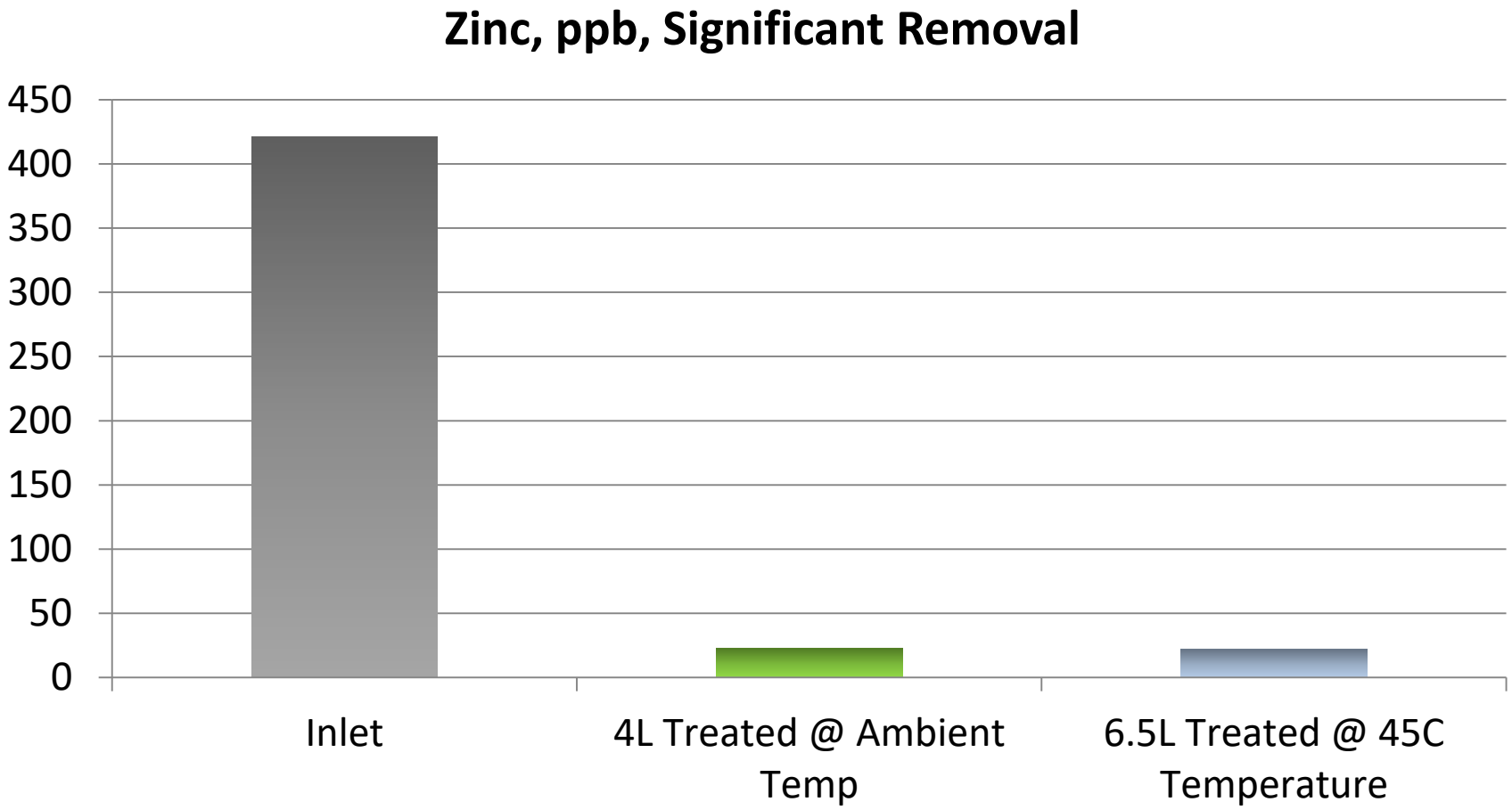
Sorbster® Zinc Removal – Filtered FGD Water



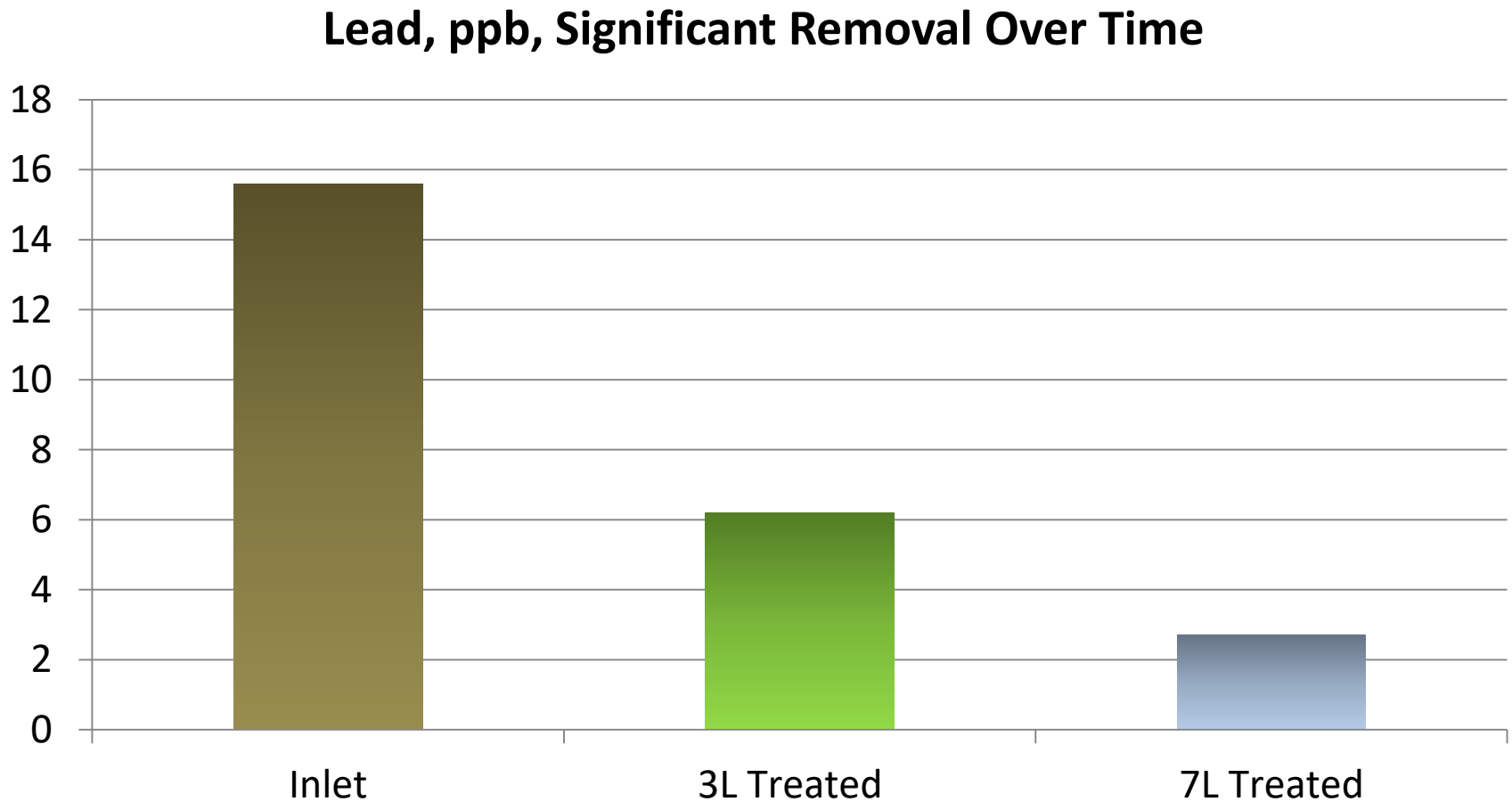
Sorbster® Zinc Removal- Refinery Wastewater Field Trial – 35,000 gallons treated



Sorbster® Zinc Removal from Northeastern USA FGD Scrubber Water



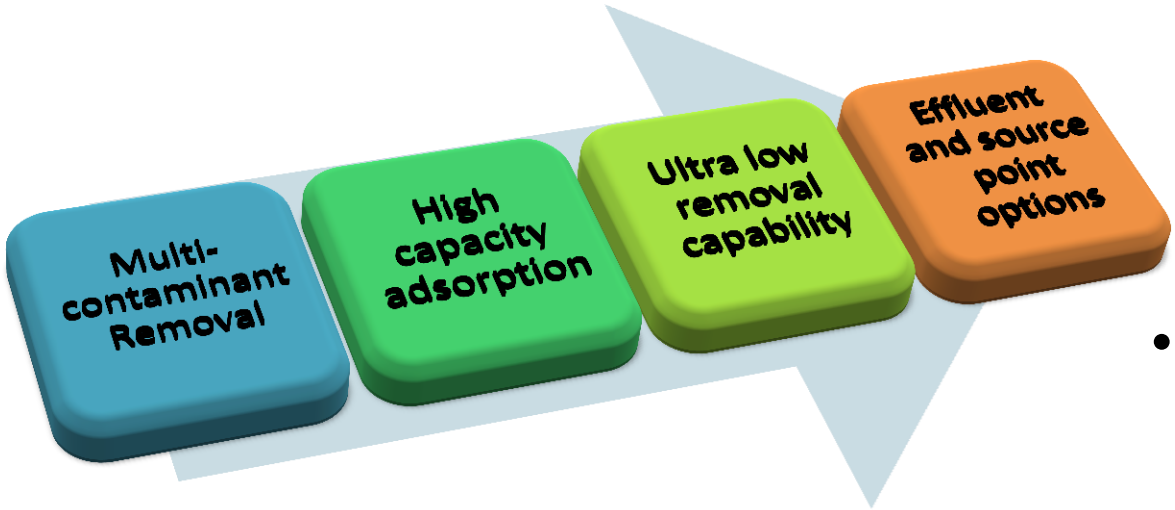
Sorbster® Lead Removal from Filtered FGD Water



Sorbster® Treatment Options

- Flow through vessels in lead-lag configuration – pump and treat
- Temporary applications for seasonal treatment
- Sox where utilities are not available
- Sorbster® fines for remediation cap & treat
- Wetlands barriers and containment
- Intermittent Flows

One Media – Multiple Solutions



- Lower Cap-ex and Op-ex than all other effective treatment options (>=90%)
- Easy to deploy, change out and non-hazardous disposal (significantly reduced "hidden cost")

Have a system in place and a client in environmental ***compliance*** *in 6-8 weeks*

Need More Information?

- To learn more about how our adsorption technology can help you improve your process water, meet your discharge permit limits and clean up spills, contact Sorbster® Representative.
- By listening to those within industrial water treatment, we are able to understand customer issues and provide solutions
    - Sorbster® Representative Contacts -

Pete Avila

Michael Lamb

Of SEMICONDUCTOR SMART SOLUTIONS