

American Society of Reclamation Sciences

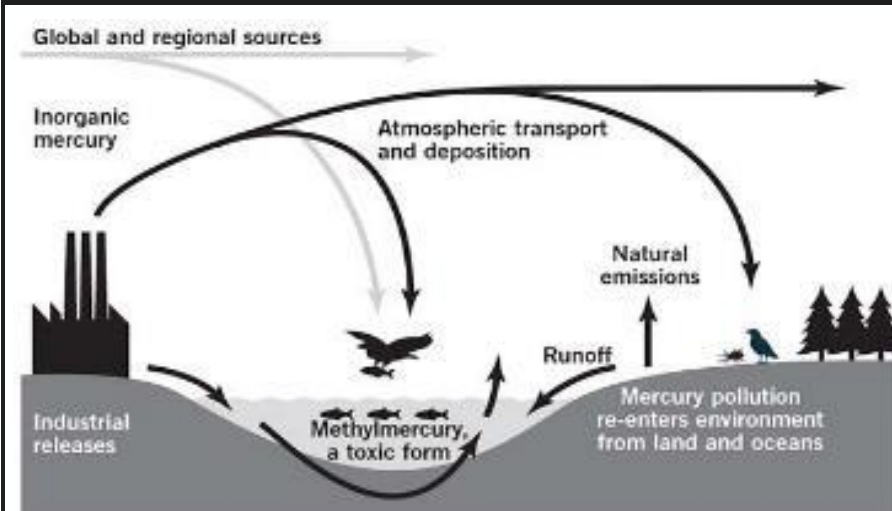
Use of MercLok™ P-640 to Reduce Elemental Mercury Beads *and* *Remediate Highly Contaminated Materials*

Caleb Fontenot – R&T Advisor (Albemarle Corporation)

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Environmental Problem and MercLok Solution

TODAY'S PROBLEM



Mercury, Gold & Silver Mining



Industrial, Chemical & Munitions

ALBEMARLE'S SOLUTION



Target **sites** contaminated with **mercury**

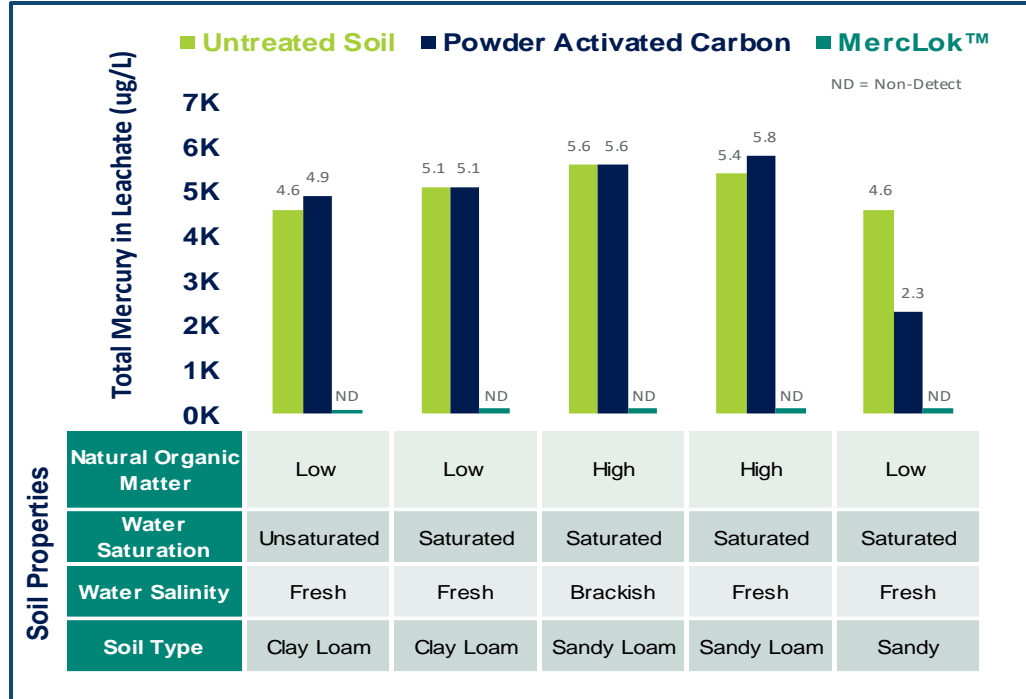


Apply **MercLok™** to soil, sediments or mixed wastes

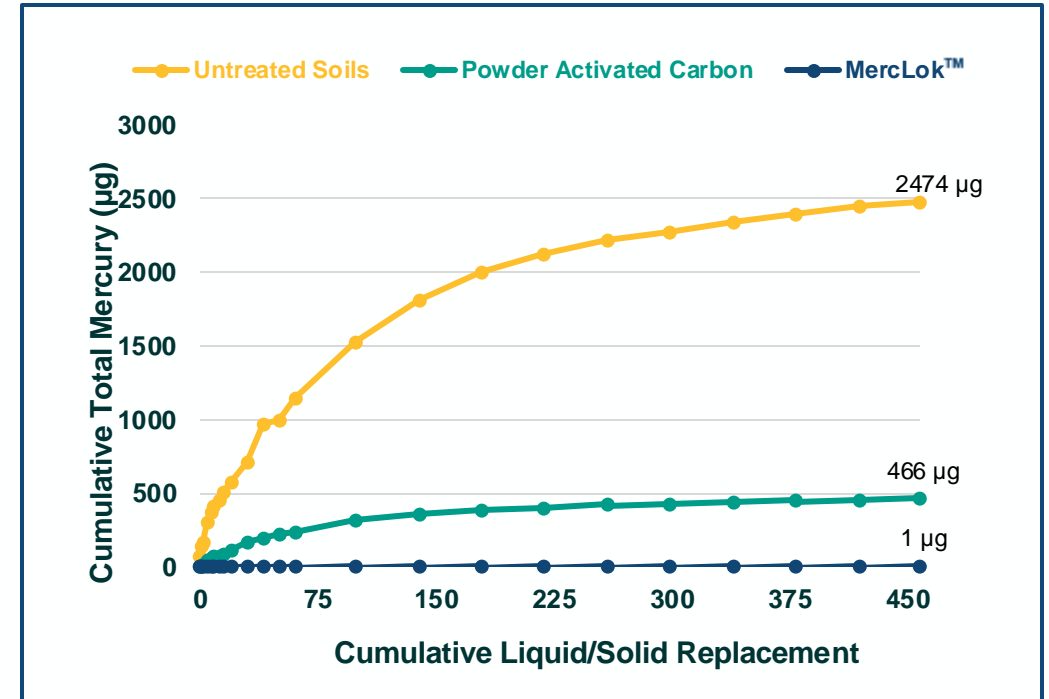


Use **In-situ** and **ex-situ remediation** techniques to contact, **capture** and **immobilize mercury**

Source Control Via Leachate Reduction



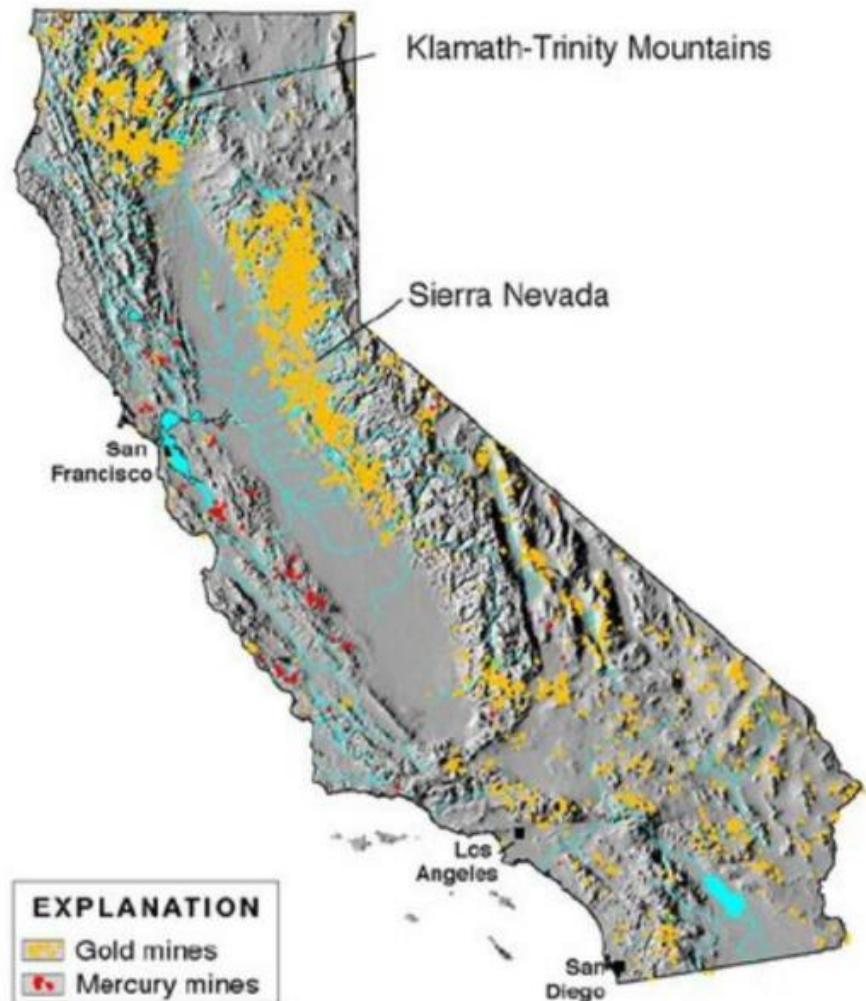
- The soils treated with **Merclok P-640** showed reductions in the amount of leachable mercury by over 99%
- Leachability of treated soils is not subject to interference by presence of natural organic mater, soil type, salinity, or saturation.
 - Data indicates similar performance across a wide range of pH.



- The column treated with **Merclok P-640** showed 99.9% reduction in cumulative mercury leached from the soil.
- The stability of mercury on **Merclok P-640** treated material was maintained even when extending the cumulative liquid/ solid (L/S) replacement in the EPA Method 1314 to 45 times more than the prescribed value of 10 L/S.

Sources can be stabilized in place

California Mercury Mine Study Site



1,000s Abandoned Mines in CA



Mercury Mine - Abandoned in 1970s

Objective: Efficiently address environmental threats from legacy mercury mine site calcines management

Material *Characterization* - Conduct leachability tests (**STLC**, TCLP) of untreated and treated calcines

Material *Classification* - Conduct **DI WET** Leachability tests, collect **leachate** under site conditions, determine site characteristics and background concentrations.

Field Study Design

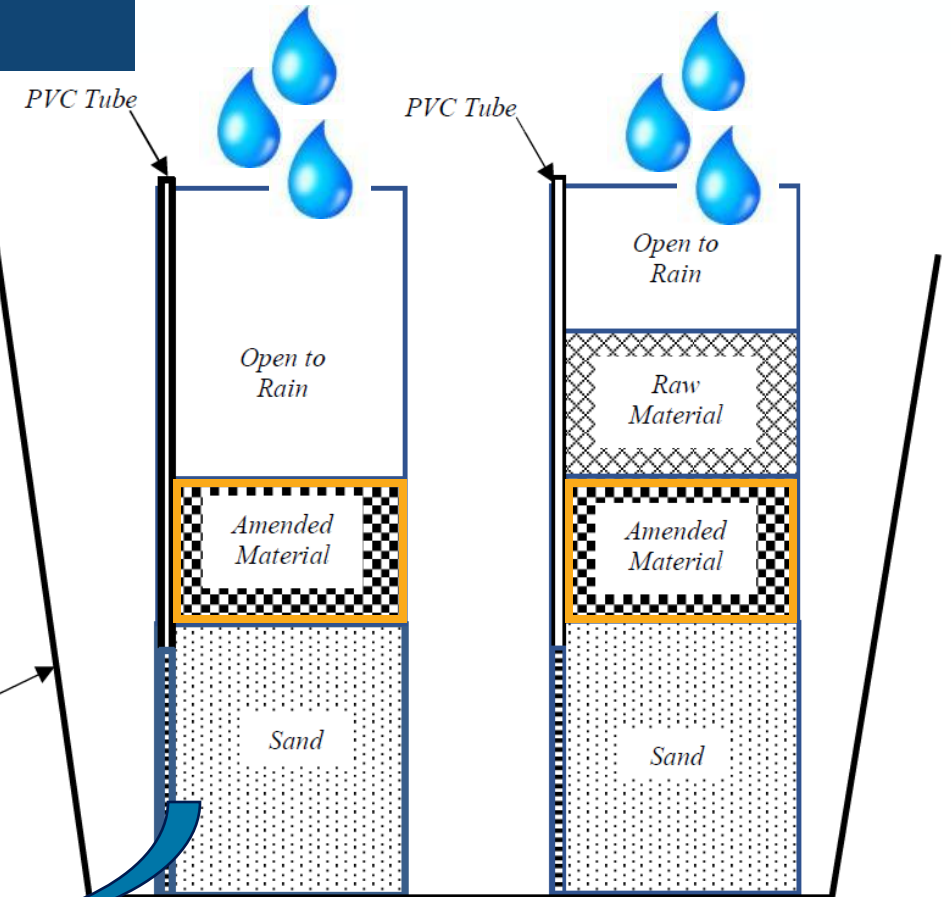


Pilot Study in 16 Barrels

- Two Contaminated Materials
- Two Techniques
- Exposed to Weather for 5 Months



Stock Tank



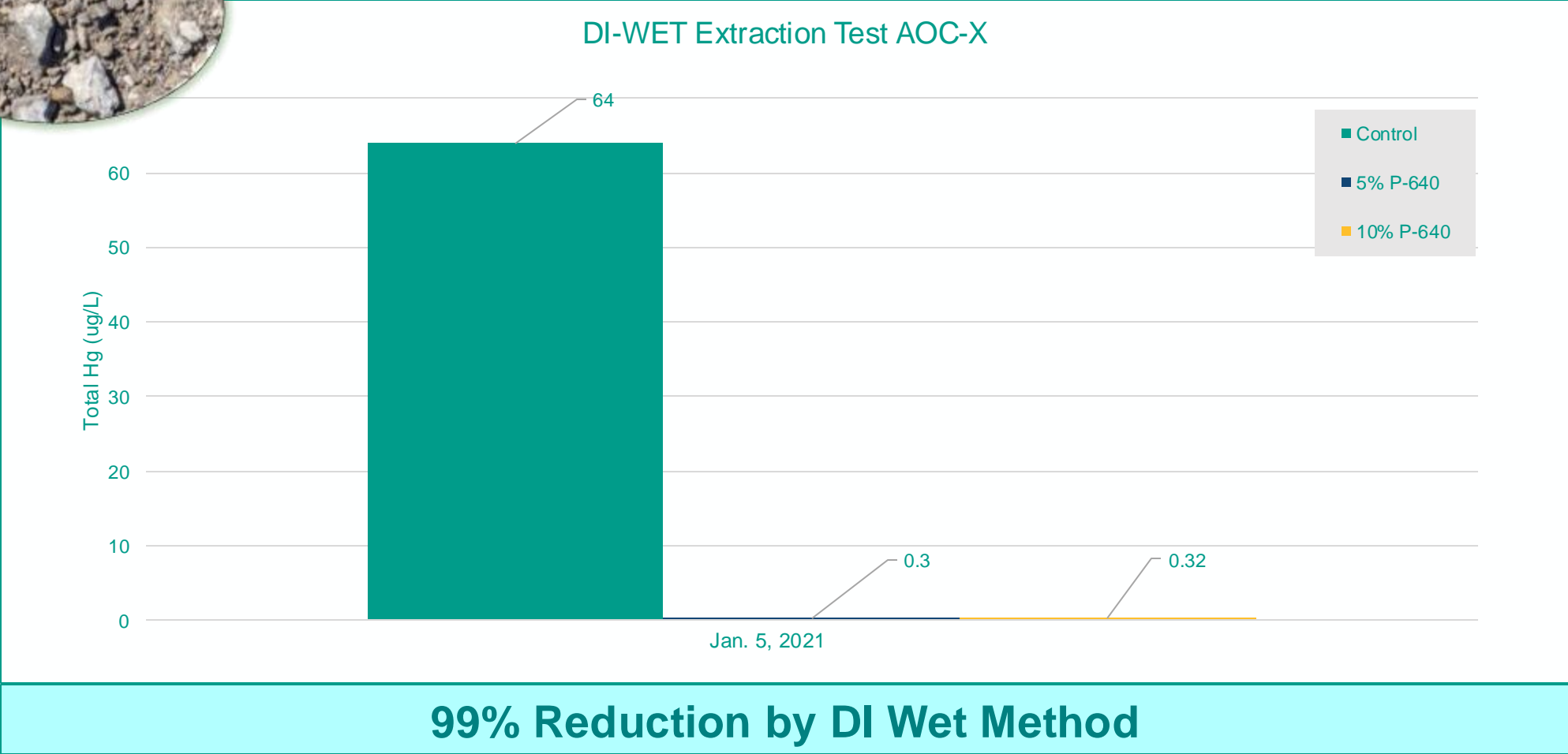
Site Classification/Characterization

Material	Location	Total Hg (mg/kg)	Cal WET (mg/L)	DI-WET (µg/l)
Calcines	AOC-6	360	0.025	0.3
	AOC-4	750	0.39	5.6
	AOC-X	2,700	1.1	51
Background Soil	B-1	11	0.0024	0.26
Regulatory Limit	---	<20	<0.2	<0.05

AOC-X Results – Leachability of Solids



Solids Sampled Immediately after Amending

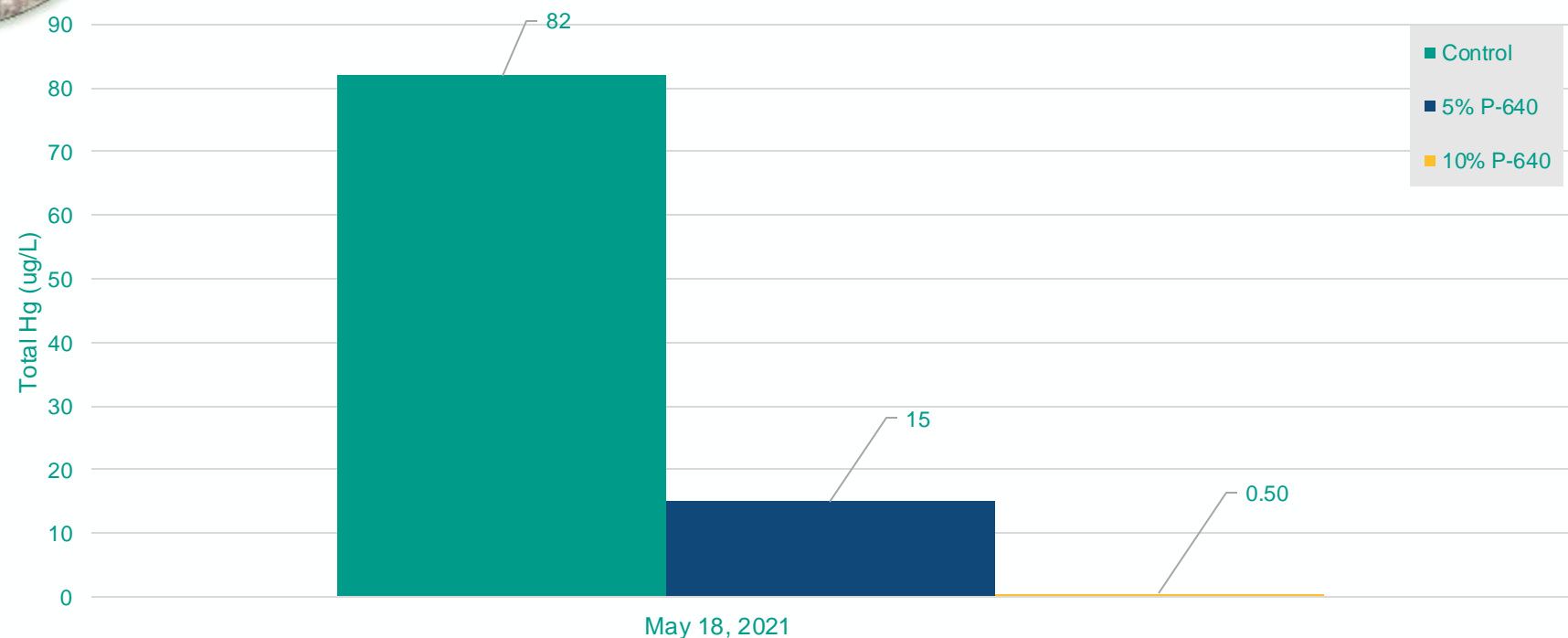


AOC-X Results – Leachability of Solids



Solids Sampled after 5 Months

DI-WET Extraction Test of AOC-X



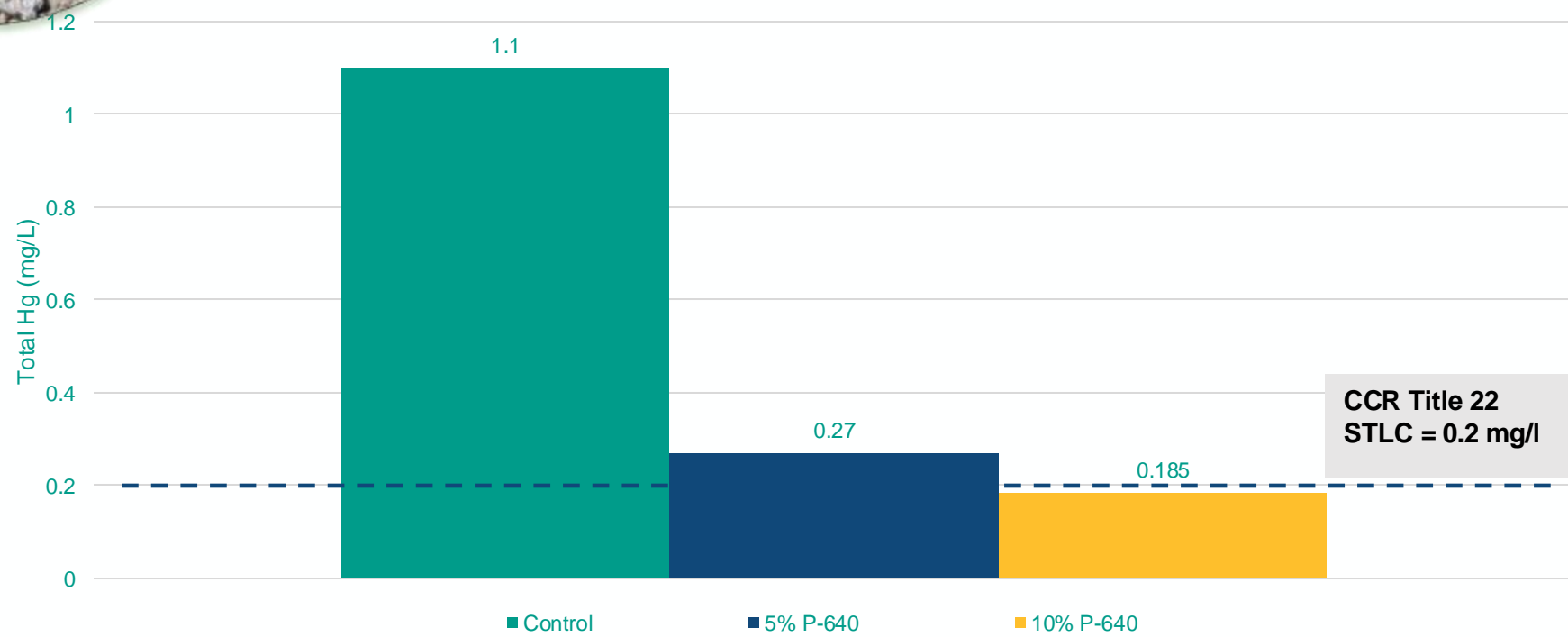
Up to 99% Reduction by DI Wet Method

STLC Waste Extraction Testing of Solids



AOC-X Results Immediately after Amending

WET Extract Comparison with STLC, AOC-X - Jan. 5, 2021



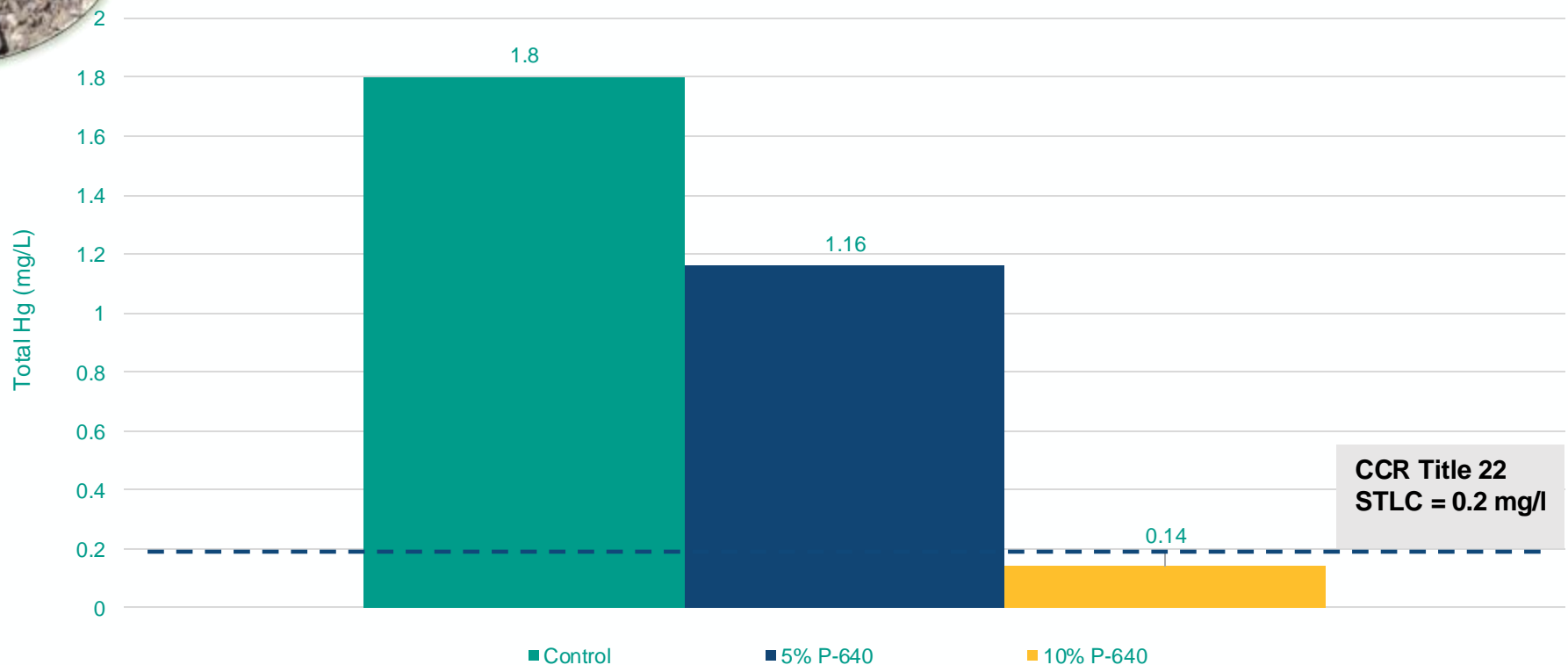
STLC Reduced to <0.2 Limit

STLC Waste Extraction Testing of Solids



AOC-X Results of Solids Sampled after 5 Months

WET Extract Comparison with STLC, AOC-X - May 18, 2022

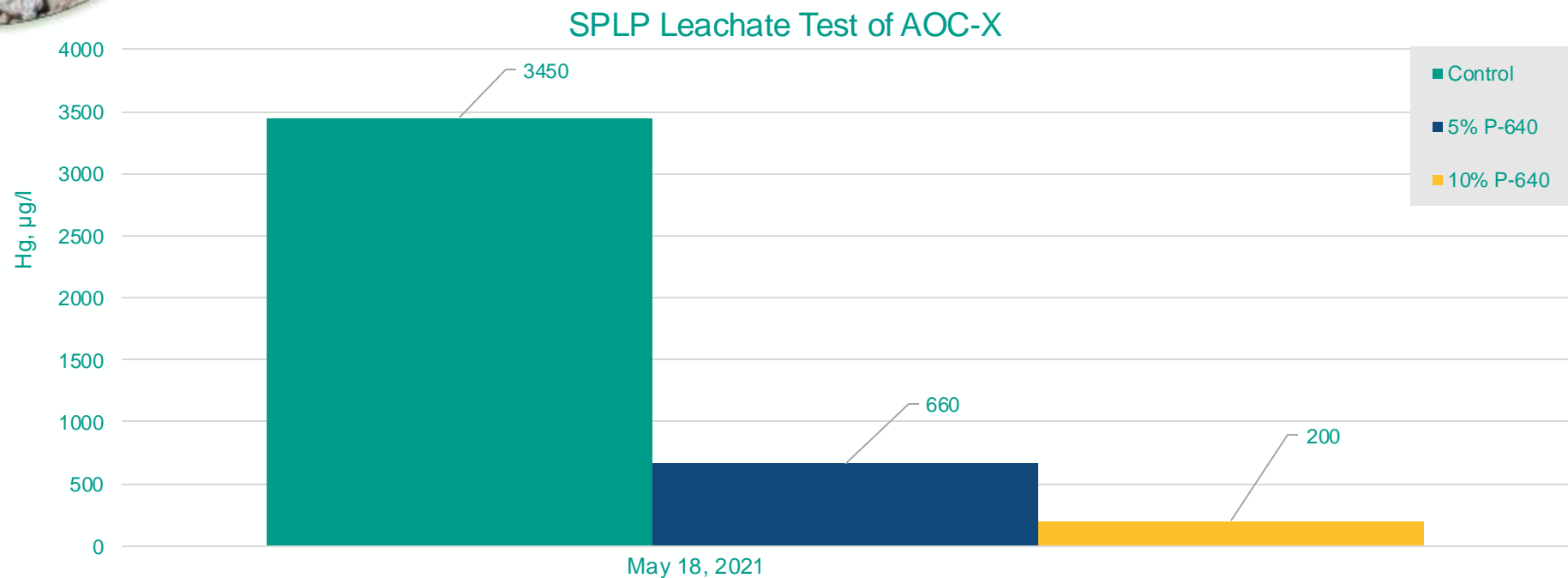


STLC Reduced to <0.2 Limit

AOC-X Results – Leachability of Solids



Hg Leaching Tests of Solids Removed from the Barrels after 5 Months



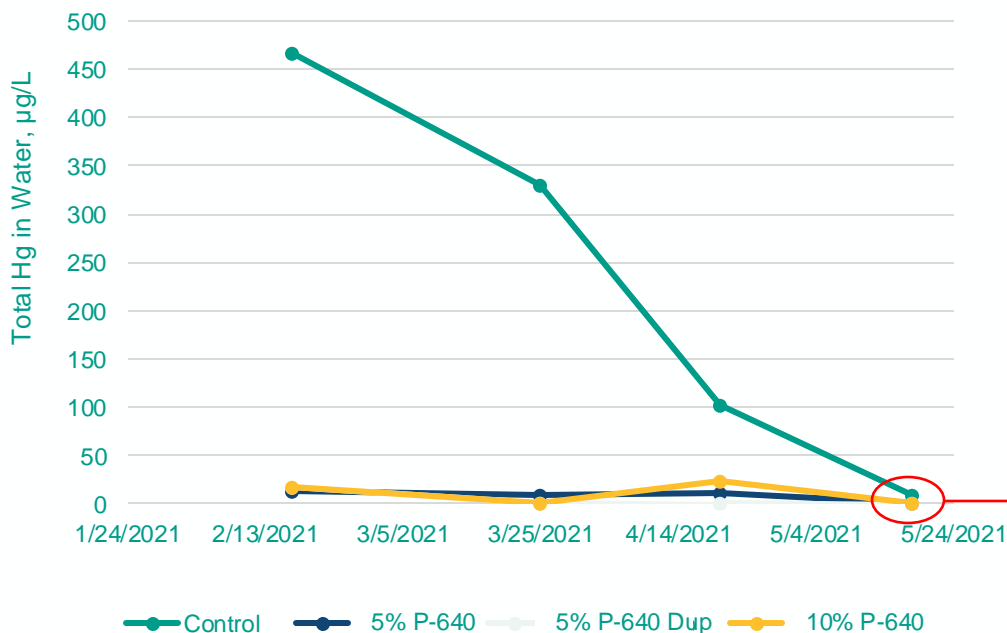
Up to 96% Reduction by SPLP Method

AOC-X Results – Rainwater Leachate



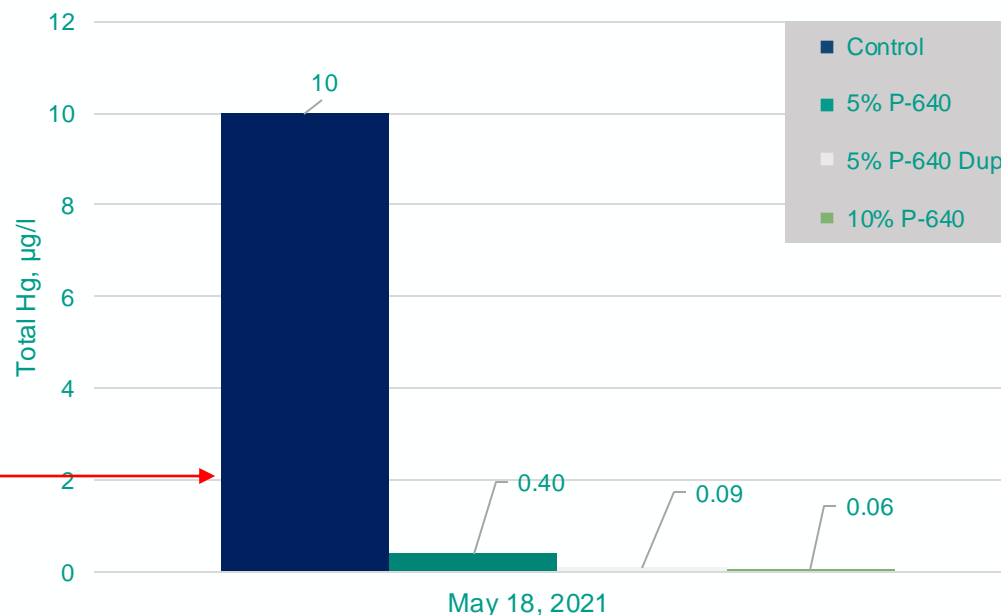
Hg Leaching of Calcines in Barrels by Rainwater – Total Hg

Total Hg in Leachate from AOC-X



96%-97% Reduction After 1 Month

Total Hg in Leachate from AOC-X, May 2021



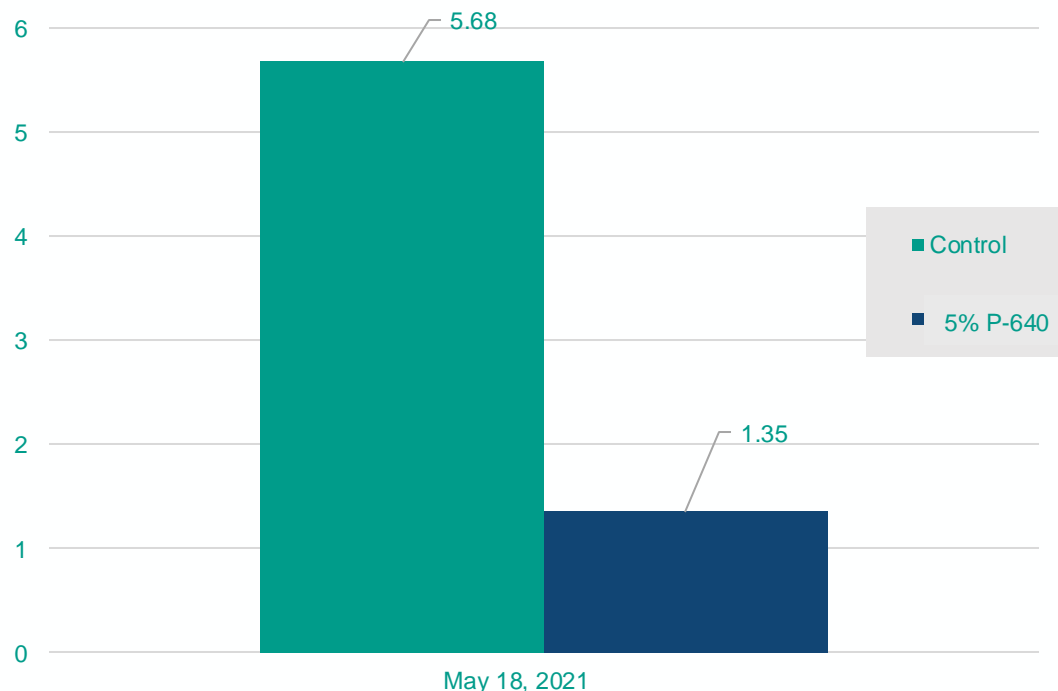
96%-99% Reduction After 5 Months

Results – Methyl Mercury



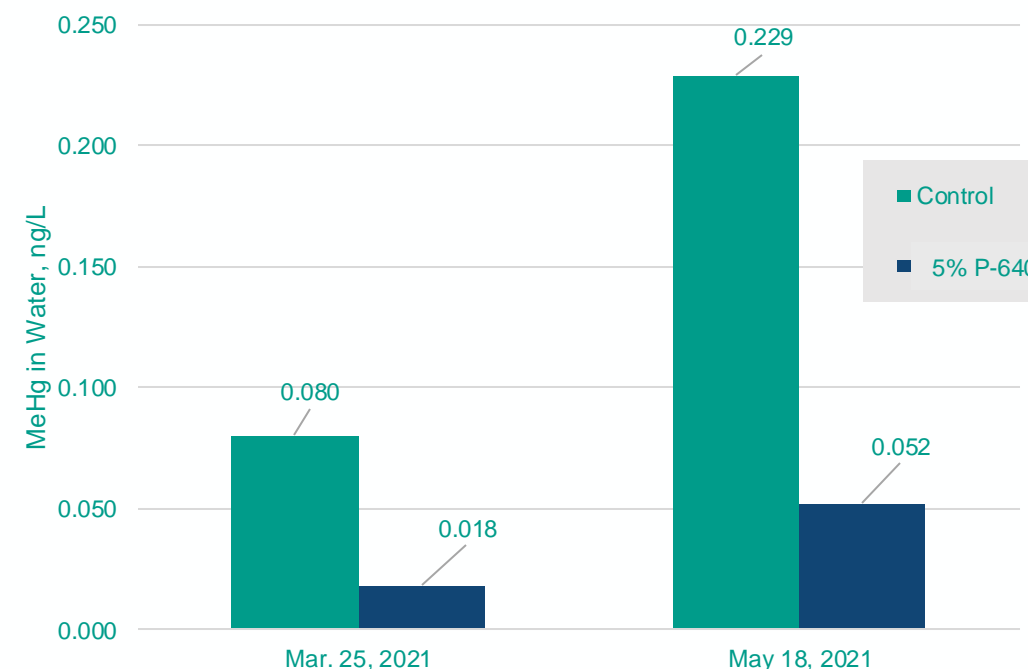
Methyl Mercury Control in Mining Waste when Open to the Environment

MeHg in Leachate from AOC-X



76% Reduction

MeHg in Leachate from AOC-6



77% & 78% Reduction

Treatment of Elemental Hg?

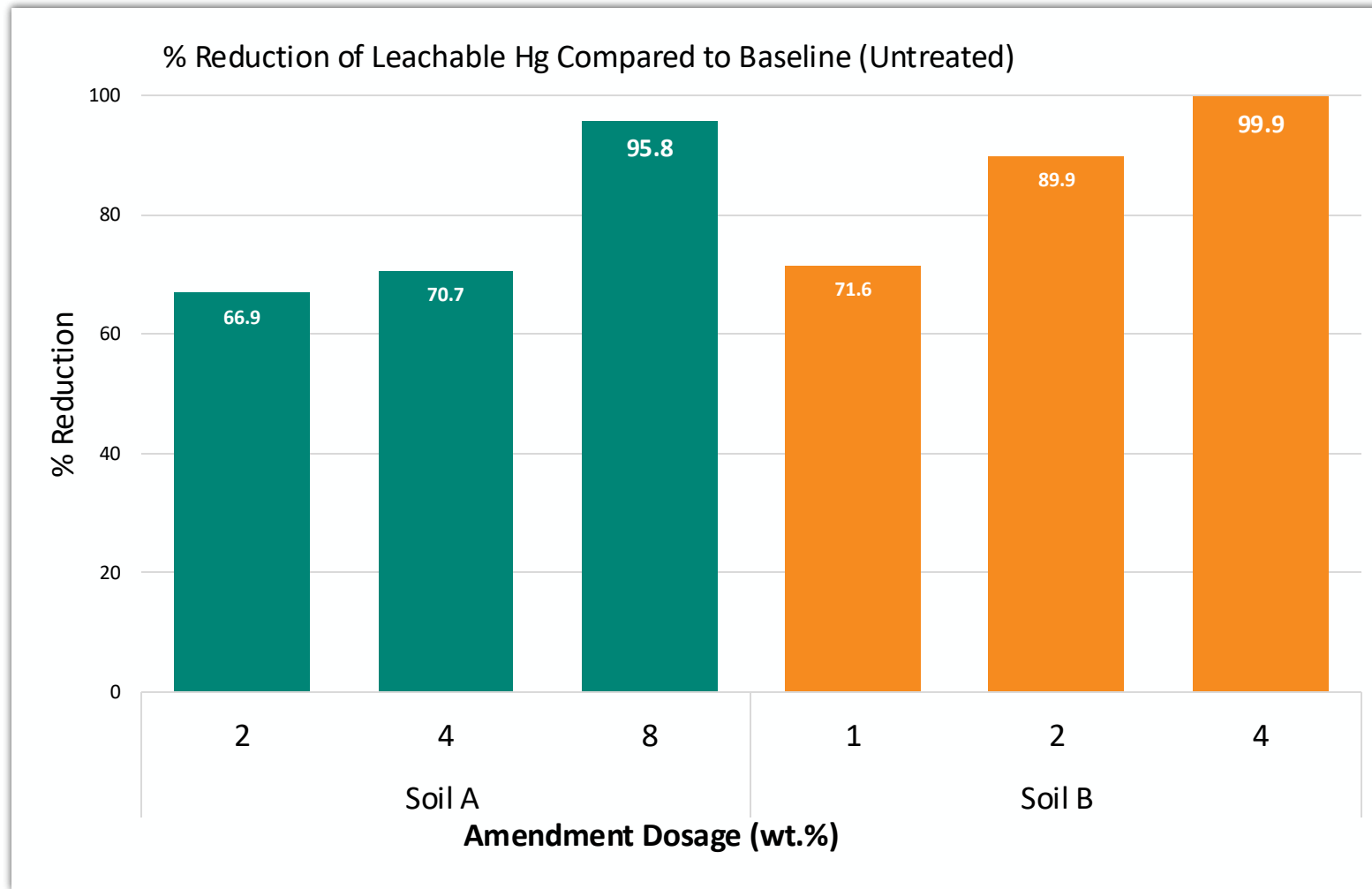
Sample	Soil Type	Total Mercury	Methylmercury
Soil A	Sandy Loam	2,005 mg/kg	125 µg/kg
Soil B	Clay Loam	236 mg/kg	1 µg/kg
Groundwater at Pilot Site	Gravel	211 µg/l	3 µg/l

Samples were analyzed before the treatment step to characterize the mercury and other contaminants.

- Soil A was in the hot spot, which was below a concrete slab that was previously the floor of a production building.



Reduction in Leachability of Elemental Hg



Two soils sampled, treated with P-640, and analyzed for leachability showed dosage response with reductions in leachability >95%.

Test method was EPA M1312, SPLP, which uses sulfuric and nitric acids.

Elemental Hg Waste Stabilization



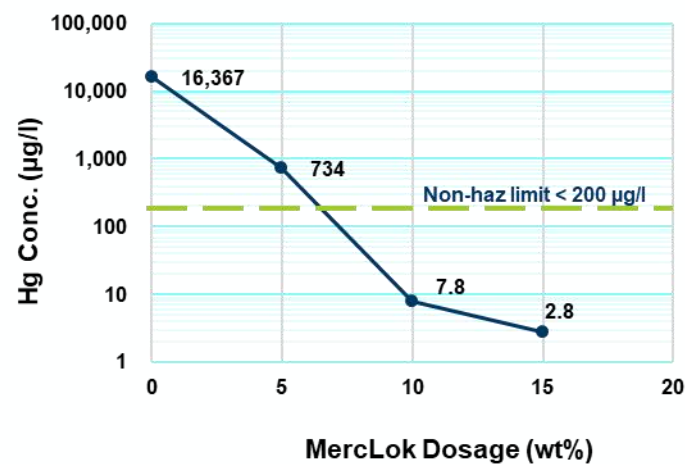
MERCLOK™

Manufacturing Brownfield Site Remediation

SITE: Legacy manufacturing site in high-population USA city with visible elemental mercury and PCBs

APPLICATION: Ex-situ mixing of MercLok into contaminated media for off-site disposal

Hg from TCLP Test

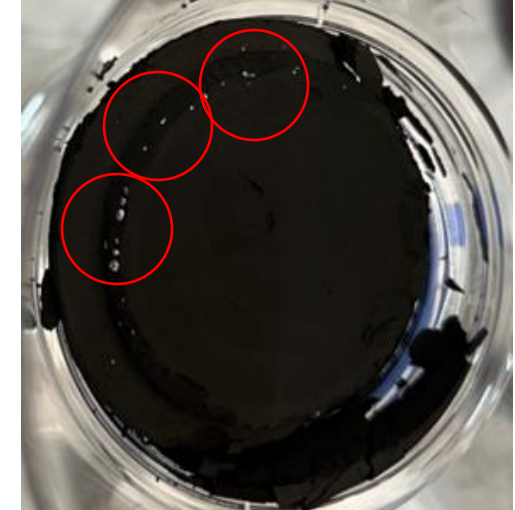
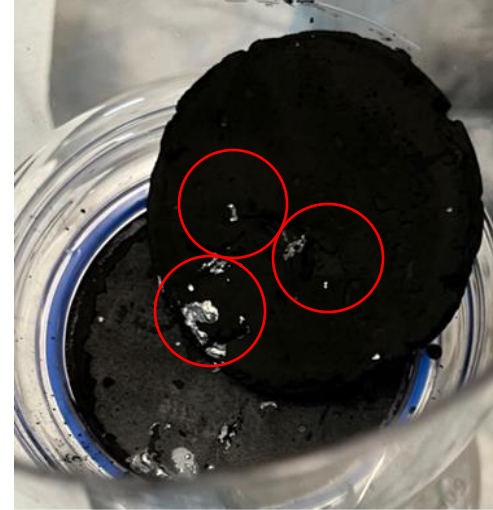


**SITE TREATABILITY
TEST CONFIRMED:**

**Over 99% reduction
in leachable
mercury** from
materials per TCLP
(Toxic Characteristic
Leaching Procedure)
testing

Allowed for off-site
disposal

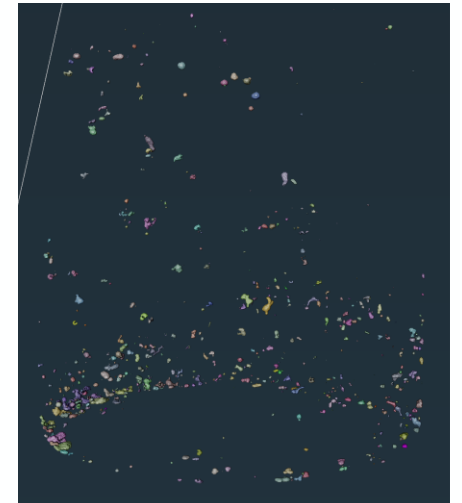
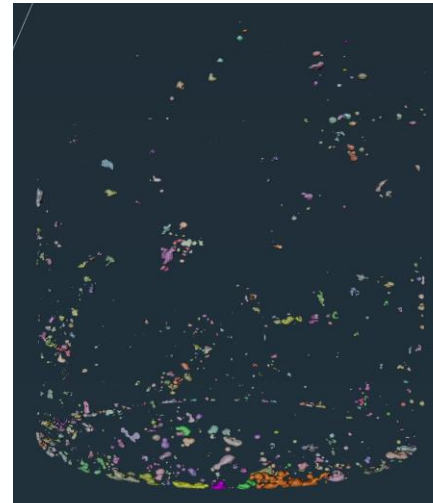
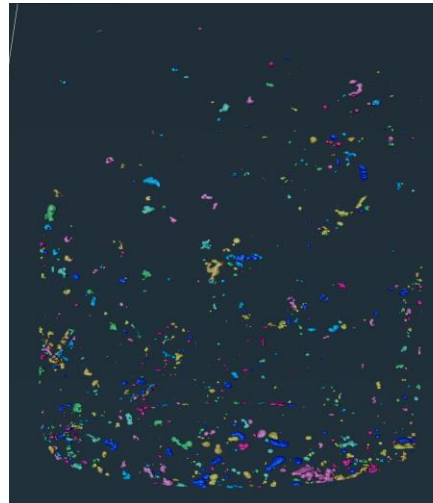
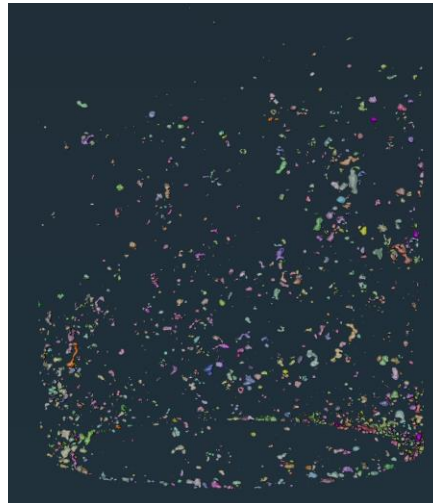
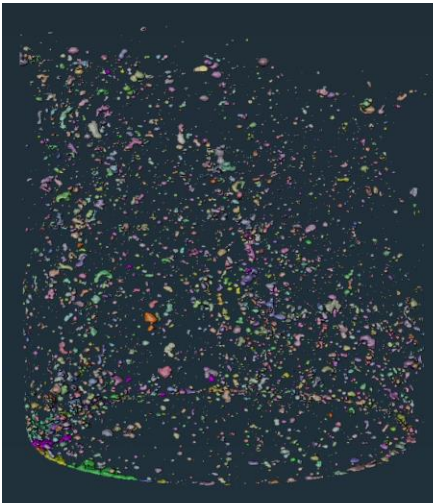
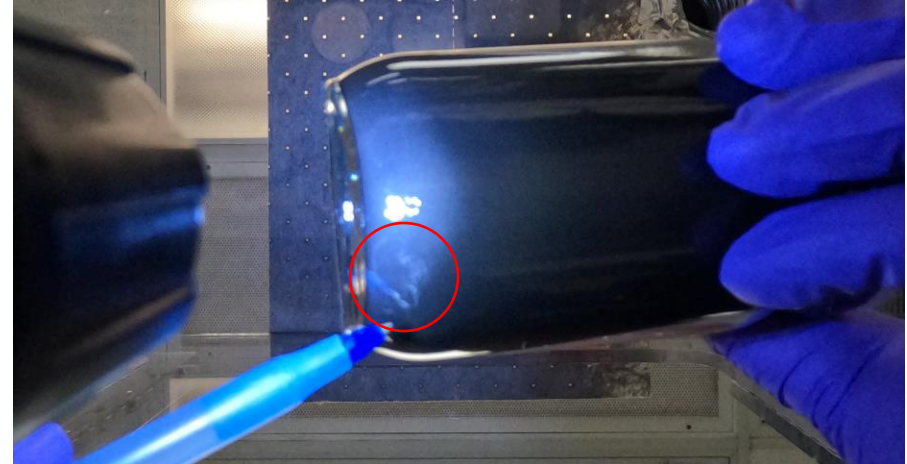
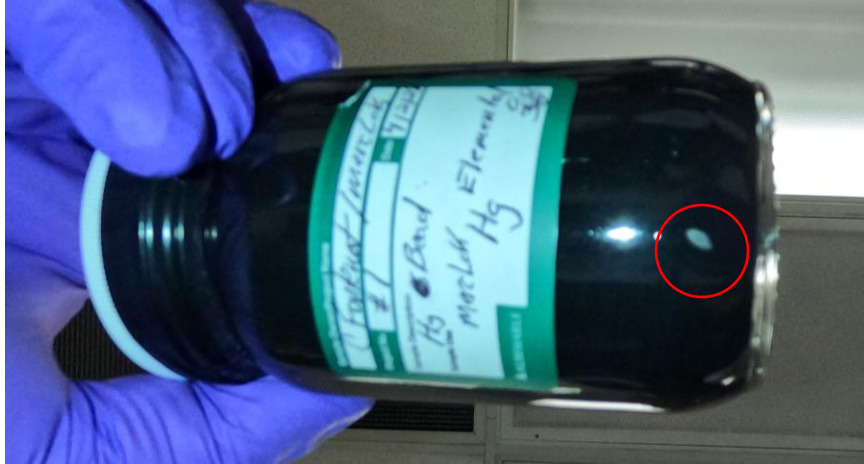
Elemental Hg Bench Study



For this test, a bead of fresh, unweathered, elemental mercury weighing 1 gram was added to a reactor containing 20 grams of P-640 and 160 grams of water.

Reactor	Leachate Total Conc. Hg (ng/L)
20X	470

Elemental Hg - Two observations



Summary

- MercLok™ stabilized mercury in calcines at the mercury mine pilot site.
 - Results verified using leachability testing of the solids as well as collection of leachate from the sump section of the test apparatus.
 - Pilot results showed significant reduction in methyl-mercury in the leachate.
- Wastes containing visible elemental mercury have been effectively treated to below hazardous waste numerical criteria.
- This technology could offer environmentally protective options for on-site remediation of calcines and other highly impacted mercury-containing wastes at legacy mercury mines.

Open Q&A



The Albemarle-funded pilot was supported by the collaborative efforts of:



BURLESON CONSULTING INC.
A Terracon COMPANY



For More Information Contact
Caleb Fontenot
caleb.fontenot@albemarle.com