Molecular Bonding System (MBS)

Overview & Case Studies

East Morgan Holdings, Inc
OTC Symbol: EMHI

East Morgan Holdings, Inc.
Waste Treatment Formulations for:

Mercury (Hg CS102)

Heavy Metals (HMCS 101)

Radioisotopes (RCS 102)

PCB

RCRA Metals Treatment Agent
Molecular Bonding System® (MBS)
A patented (US 5,877,393 & US 5,898,093)
RCRA Heavy Metal

What is Molecular Bonding System?

The MBS technology uses a proprietary blend of sulfides, phosphates and carbonate compounds that aggressively bind with RCRA Heavy Metals to render them into highly insoluble forms that allow waste steams to pass TCLP

MBS can be applied to a wide variety of contaminated substrates including: clay, sand, gravel or loam based soils, sludges, in-process wastes, slag, paint chips and bag house dust and/or gases

MBS was evaluated and accredited by the US Environmental Protection Agency (EPA)as part of the Superfund Innovative Technology Program Evaluation (SITE) Demonstration to prove innovative remediation technologies, (Ref 1)

What is the MBS Soil Treatment Process?

Soil is excavated and screened to remove debris larger than 2” in diameter

TCLP analysis is performed on untreated soil to determine leachable levels of RCRA Heavy Metals

MBS is added to a pug mill where it is blended with the soil for ex situ treatment

Depending on chemical feed & water requirements, the volume expansion of the treated soil ranges from 3% to 16%

TCLP analysis is again performed on the treated soil to determine leachable levels for RCRA Heavy Metals and the suitability of the waste for back fill and/or landfill disposal

In situ MBS treatment is also feasible

What is the MBS Gas Treatment Process?

- Metals analysis is performed on the untreated flue gas to determine total levels of RCRA Heavy Metals
- MBS is added to the system where it can be blended with the gas phase
- MBS can be added to off-gas systems with either wet or dry removal systems
- Metals analysis is again performed on the treated gas to determine total levels for RCRA Heavy Metals

EPA SITE Demonstration - Midvale, Utah - Slag Superfund Site

Waste streams contaminated with cadmium (Cd) and lead (Pb) were treated. Approximately 1500 tons of waste soil (500 tons of each waste type) was treated from three waste types labeled as Soil Fill (SF), Slag Pile B (SB) and Smelter Waste without Bricks (SW)

SAIC performed sampling and provided oversight & analytical support

Mean TCLP Leachable Pb Concentrations (mg/L):

Waste Soil	Untreated	Treated
SF	28	0.18
SB	17	0.70
SW	15	0.33

In addition, mean TCLP leachable Cd concentrations were below the regulatory limit of < 1 mg/L. (TCLP limit of 5 mg/L for Pb)

EPA SITE Demonstration - Midvale, Utah - Slag Superfund Site

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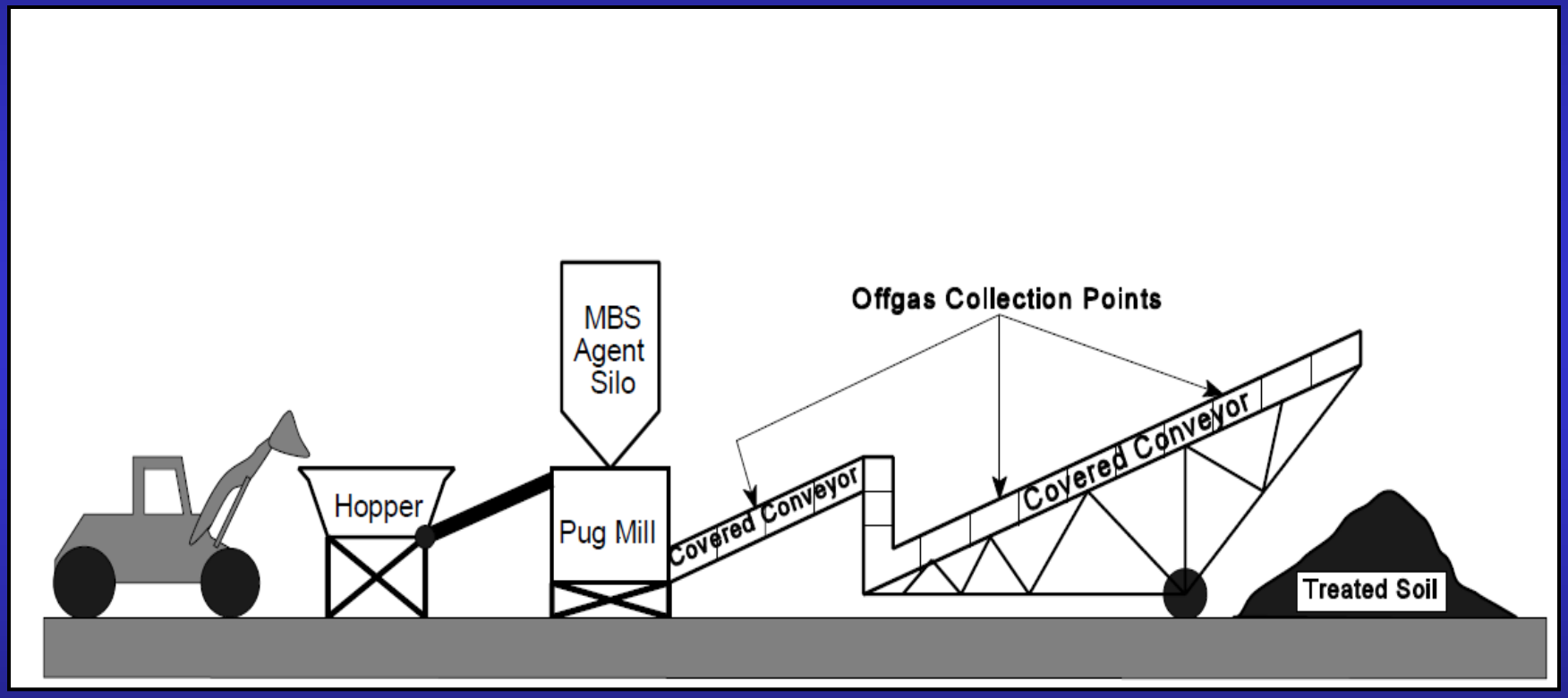


Schematic of MBS Process

Brookhaven National Laboratory Treatability Study

MBS treatment of a spiked mixed waste soil

A surrogate mixed waste was prepared with BNL radiologically contaminated soil spiked with salts of lead and cadmium. Three 250 gram batches of soil were treated with three different ratios of MBS and evaluated by TCLP results.

Contaminant of Concern	BNL Soil ppm	Spiked BNL Soil ppm	MBS 'A' ppm	MBS 'B' ppm	MBS 'C' ppm	TCLP Limit ppm
Lead	0.019	36.12	0.689	0.496	0.273	5
Cadmium	<0.0015	5.25	0.1099	0.0979	0.0619	1

All samples tested were below TCLP and proposed UTS limits. MBS had no effect on radioactive Cesium mobilization. Sample A had the highest metals concentration and Sample C had the lowest metals concentration

Ravenna, Italy MBS Project

Ravenna is located south of Venice on the southeast coast of Italy

The site was used for manufacturing, natural gas processing and an oil refining

The Contaminants of Concern were Chromium, Cadmium and Mercury

Several technologies were tried before MBS was implemented

250,000 metric tons of soil were treated using MBS at a weight percent of 5.7

The soil was left in place after treatment and the site was redeveloped

Ravenna, Italy MBS Project

continued

MBS Process Equipment

Ravenna, Italy MBS Project

continued

MBS Process Equipment

Ravenna, Italy MBS Project

continued

MBS Treatment Results

Contaminant	Pretreatment Metal Concentrations ug/L	* Post Treatment Metal Concentrations ug/L	ICP Detection Limits ug/L	European Concentration Limits ug/L
Cadmium	73	< 0.1	0.1	5
Chromium	213	< 1	1	50
Mercury	5.4	< 0.1	0.1	1

* EPA SW 846 Method 3050B and Method 6010C

pH values ranged from 7.95 to 8.12 after MBS Treatment

(using Method APAT IRSA 29/03 2060)

East Point Providence, Rhode Island
MBS Project

Ocean State Steel had a steel mill along the Seekonk River in the city of East Providence for many decades

One of the largest environmental cleanups in Rhode Island history

Remediated 27 acres of land along the river

Primary contaminant of concern was lead with initial (TCLP) leachable lead concentrations of 15 mg/L

MBS Treatment reduced the leachable lead concentrations to < 0.25 mg/L using 5.7 weight % MBS

East Point Providence was awarded the Brownfield's Project of the year.

East Point Providence, Rhode Island MBS Project continued

Before Remediation with MBS

East Point Providence, Rhode Island MBS Project continued

Before Remediation with MBS

East Point Providence, Rhode Island MBS Project continued

During Remediation with MBS Before Redevelopment

East Point Providence, Rhode Island MBS Project continued

After Remediation with MBS

Additional MBS Treatment Projects

MBS Treatment Results

Project Location	Metal	Source	Pretreatment TCLP mg/L	Average Post Treatment TCLP mg/L	EPA TCLP Limit mg/L
Virginia	Lead	Burnt Copper Wire	62	0.92	5
British Columbia	Lead Cadmium Zinc	Steel & Pipe Manufacturing	46.8 3.35 524	< 0.2 < 0.05 5.4	5 1 * NL
Scotland	Hexavalent Chrome	Chromium Ore	111	< 0.02	5
New Jersey	Lead	Pigment and Dye Manufacturing	77	< 0.25	5
Missouri	Lead	Secondary Lead Smelting	60	0.5	5

* No TCLP limits established for zinc by EPA

MBS treatments ranged between 2 and 10 weight percent

Additional MBS Treatment Projects continued

MBS Treatment Results

Project Location	Metal	Source	Pretreatment TCLP mg/L	Average Post Treatment TCLP mg/L	TCLP Limit mg/L
Connecticut	Lead Cadmium	Brass Manufacture	33 6	< 0.1 < 0.01	5 1
Minnesota	Mercury	Steel Mill	10	0.005	0.025
Massachusetts	Lead	Skeet Shooting Range	34	< 0.1	5
New York	Lead	Lead Paint from Bridge	40	1.0	5
Canada	Tri Chromium Hex Chromium	Buried Chromatic Acid	97.3 96.0	< 0.03 < 0.03	Total 5
Utah	Lead	Foundry and Smelting	13.0	< 0.03	5

MBS treatments ranged between 2 and 10 weight percent

MBS Treatment Results for Different Mercury Contaminated Soil Types

Contaminated Matrix Type	Untreated Hg TCLP mg/L	MBS Treated Hg TCLP mg/L	TCLP Limit for Hg mg/L
Clay	29.6	< 0.04 *	0.025
Caliche	2.54	< 0.04 *	0.025
Clay/Caliche	3.74	< 0.04 *	0.025
Silty/Sands	1.85	< 0.02	0.025
Silty/Sands	1.85	0.0051	0.025
Silty Sands	11.0	< 0.005	0.025

* Achieved under prior TCLP limits when limit was 0.2 mg/L

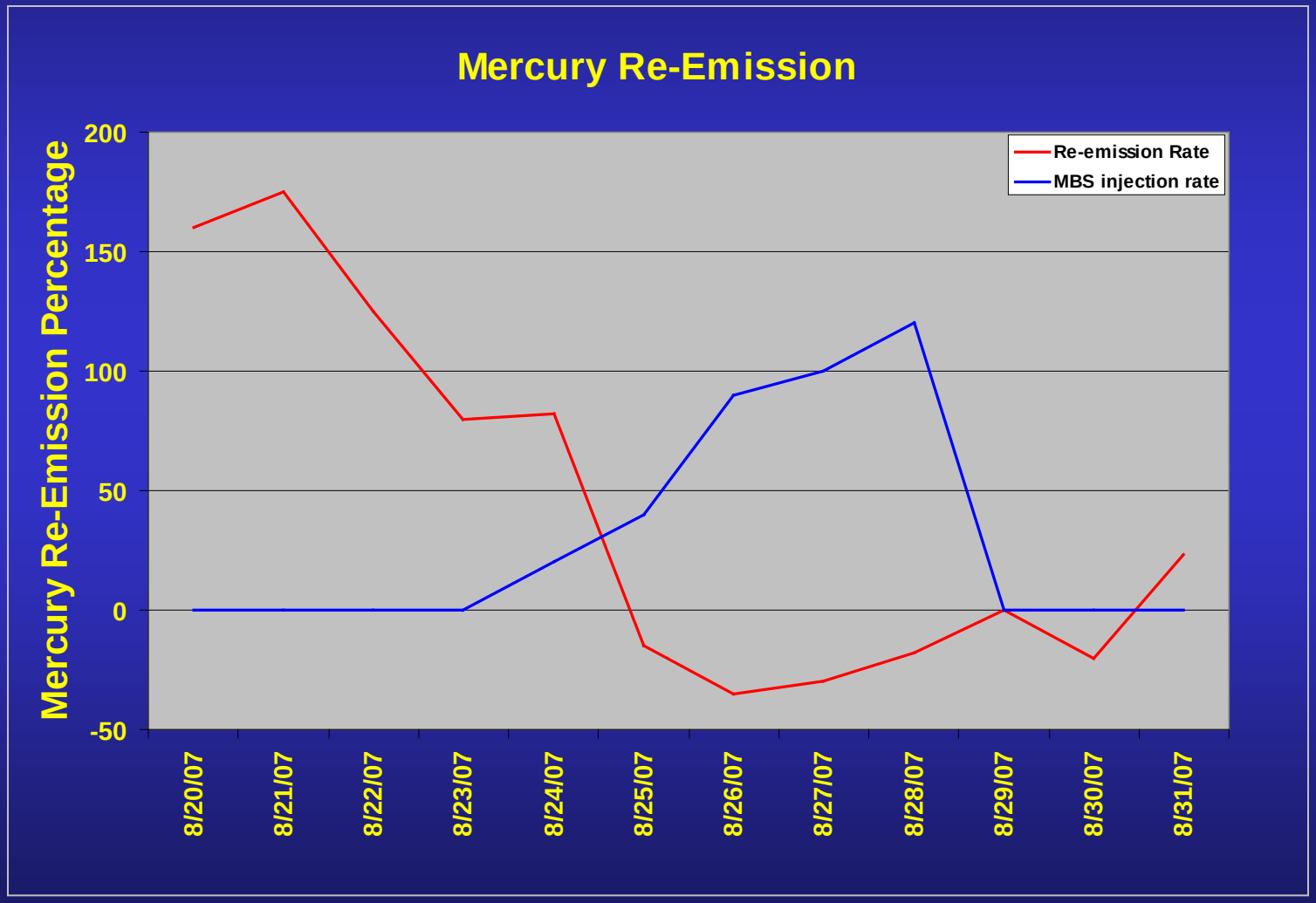
MBS Treatment for Mercury Control in Coal Fired Power Plants

The Institute for Combustion Science and Research and Environmental Technology performed mercury testing to investigate mercury emission and activity across a Flue Gas Desulfurization device at the Endicott Power Generation Station in Michigan. This work was performed for Solucorp and Babcock and Wilcox

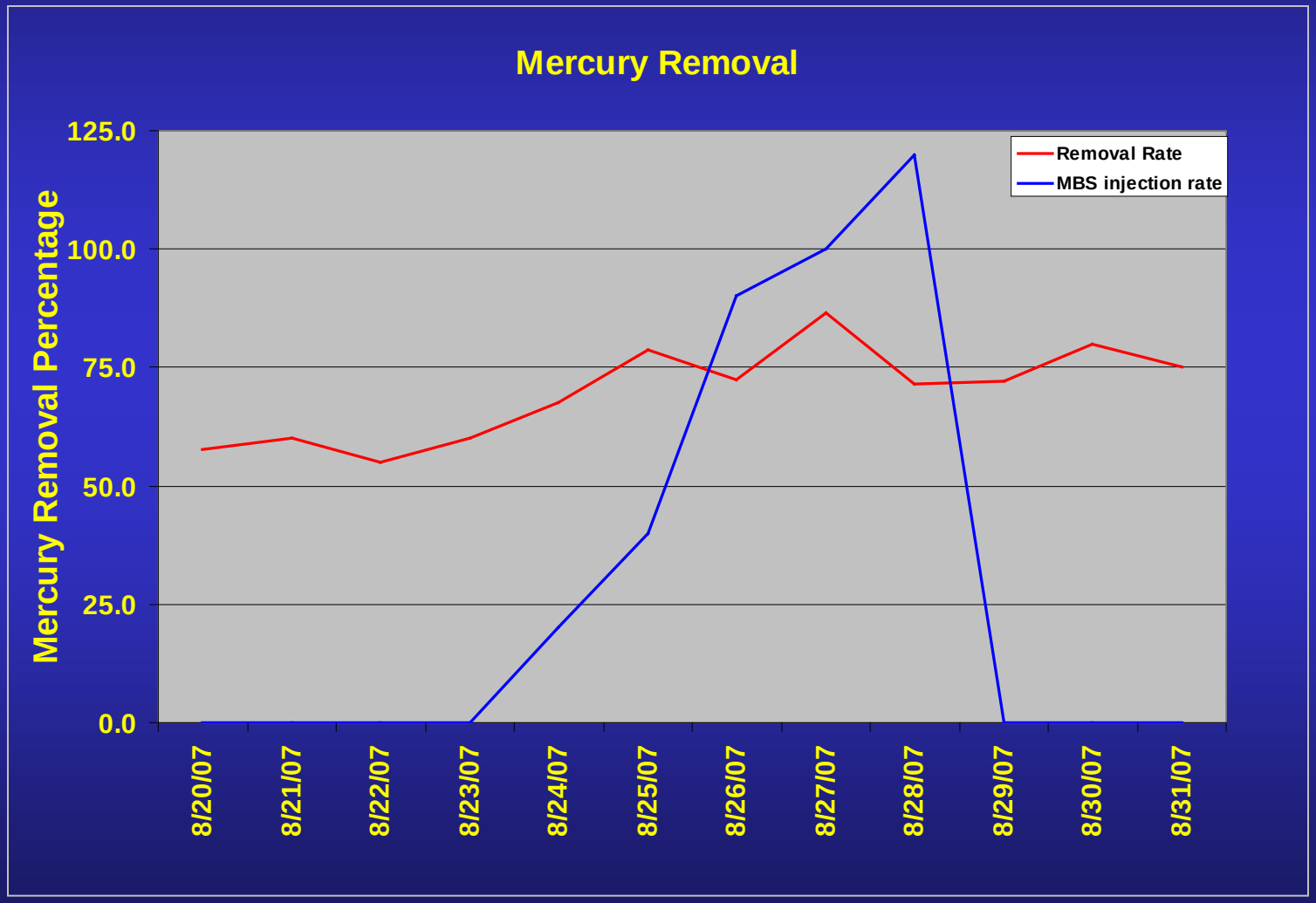
Main objective was to investigate the effect of MBS on the re-emission of mercury

This work was not published and it considered confidential therefore only two graphs will be presented from the information presented in the report (Ref 3)

MBS Treatment for Mercury Control in Coal Fired Power Plants continued

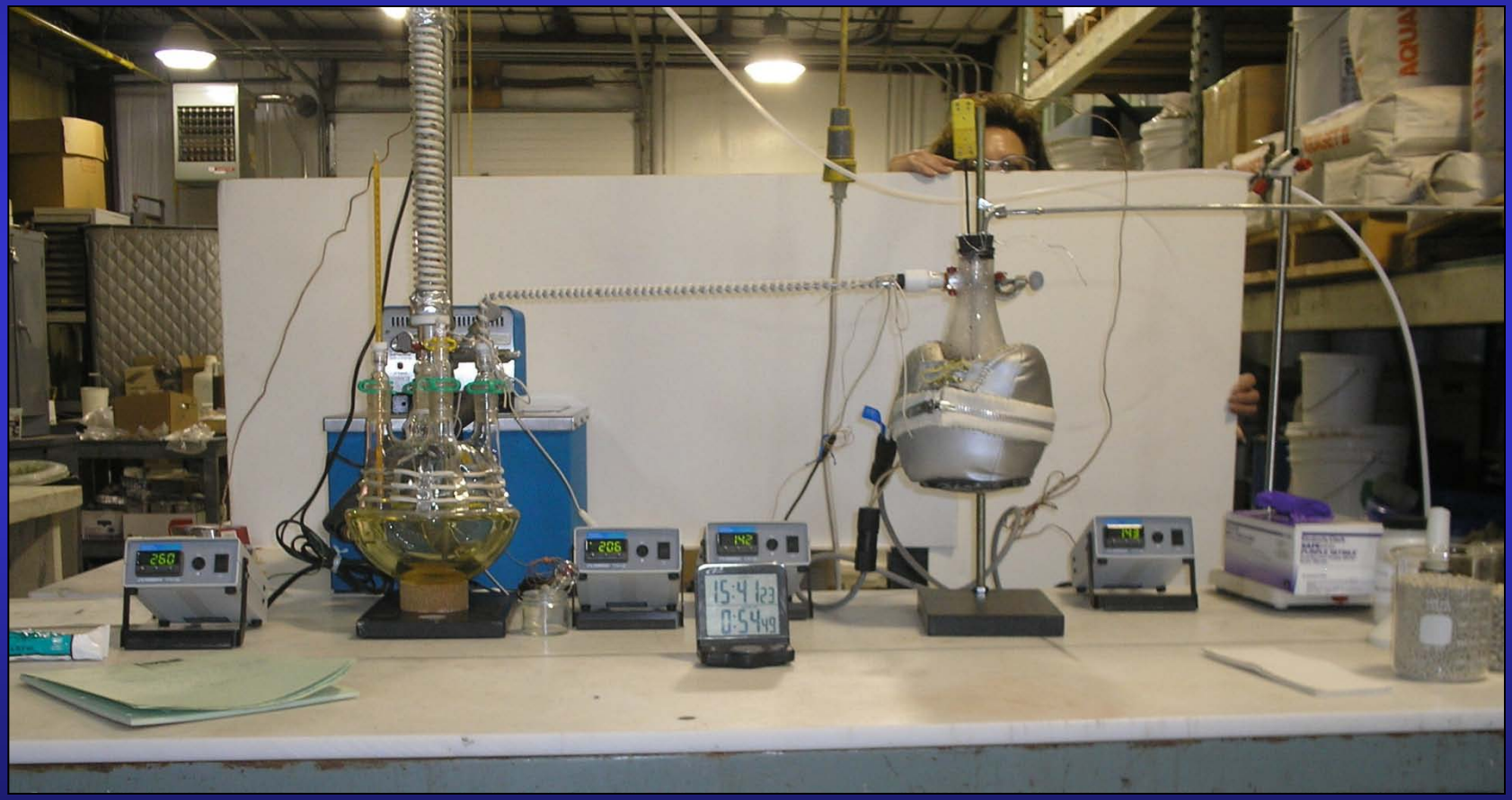


MBS Treatment for Mercury Control in Coal Fired Power Plants continued



Mercury Treatment in Simulated Flue Gas

MBS/Mercury Treatability Studies were performed at the MSE test facility in Butte, Montana in early 2012



MBS Mercury Test Apparatus

Mercury Treatment in Simulated Flue Gas

continued

MBS / Mercury Treatability Studies Results

Sample Number	MBS Weight Percent	PAC Weight Percent	Moisture Content Percent	Average Total Mercury Concentrations * mg/Kg
1	0	100 (baseline)	17	96
2	100	0	17	502
3	10	90	17	230
4	100	0	0	398

* Analyzed using EPA SW-847 Method 7471 Mercury in Solids and Semisolids

No Acid Gases, NOx or SOx were generated by MBS during the treatability testing

Based on the test results a Full Scale Test was implemented at the Cement Plant (Ref 4)

Full Scale Mercury Treatment at a Cement Plant

No Acid Gases, NOx or SOx were generated by MBS during the full-scale testing

Testing was conducted for 18 days in August 2012

Mercury reduction results in flue gas

Day	MBS Weight Percent	PAC Weight Percent	Mercury Percent Reduction
1	9.19	90.81	90.94
2	9.19	90.81	97.56
3	9.19	90.81	98.08
4	9.52	90.48	97.08
5	9.52	90.48	98.69
6	9.52	90.48	98.36
7	9.52	90.48	97.98

Full Scale Mercury Treatment at a Cement Plant

continued

Mercury reduction results in flue gas

Day	MBS Weight Percent	PAC Weight Percent	Mercury Percent Reduction
8	9.71	90.29	97.81
9	9.71	90.29	97.60
10	9.71	90.29	95.08
11	13.23	86.77	98.42
12	13.23	86.77	98.48
13	13.23	86.77	98.02
14	16.85	83.15	97.68
15	16.85	83.15	93.25
16	16.85	83.15	98.56
17	16.85	83.15	96.87
18	16.85	83.15	97.13

Average TCLP Results for Hg in spent PAC/MBS Mixtures – 97.45 mg/L

Full Scale Mercury Treatment at a Cement Plant

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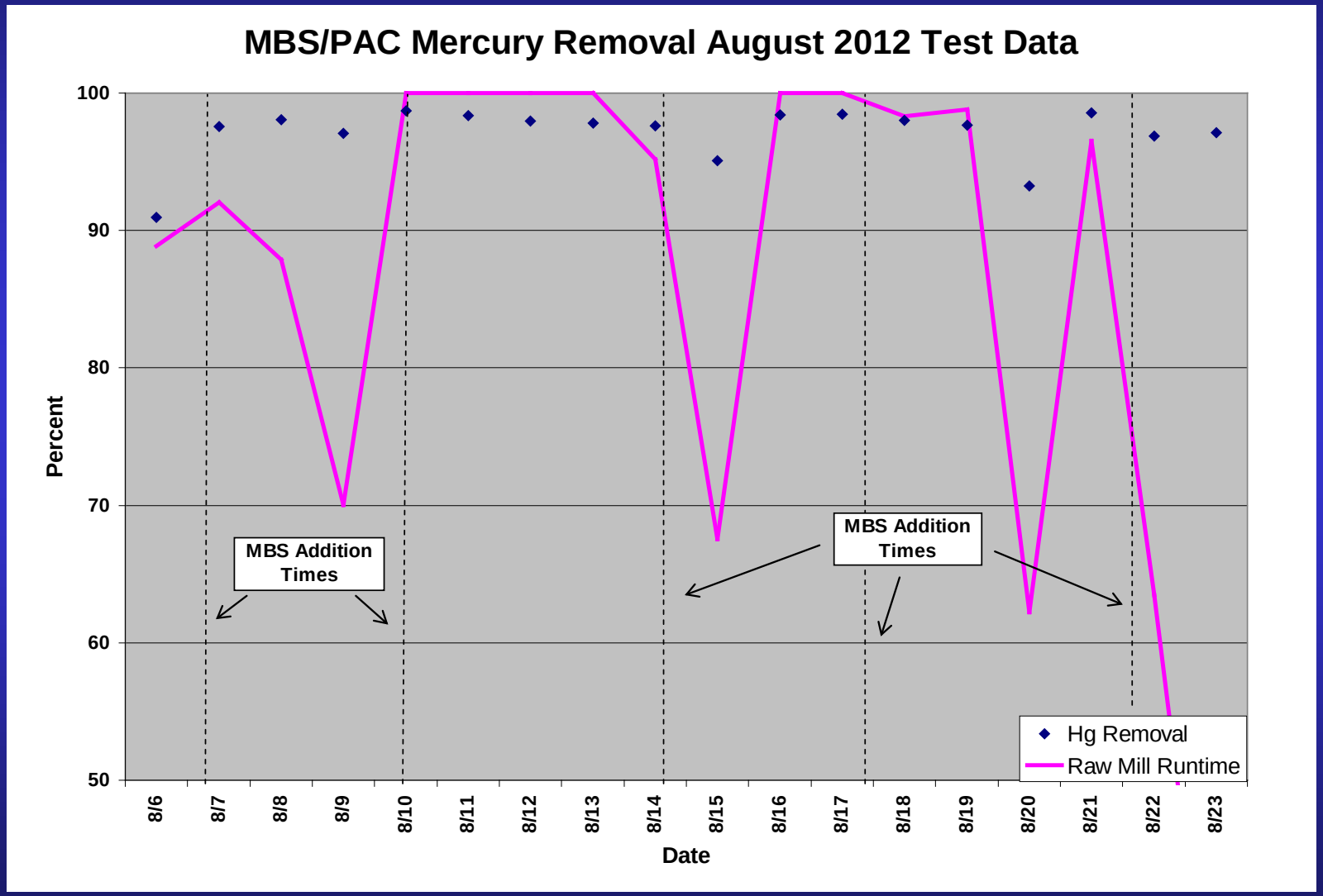

Full Scale Mercury Treatment at a Cement Plant

continued

Conclusions:

Removal of mercury ranged from a low value of 93.25% to a high value of 98.69%. Average Hg removal was 97.45%.

MBS can remove very significant quantities of mercury from the cement plant off-gas within the carbon bag house and not release that mercury during those periods of higher temperature when the raw mill is not operating. If MBS was added at higher doses than what was added during the full-scale run, the mercury removal from the off-gas should be higher than the values realized during the full-scale test.

MSE Treatability Studies for Mercury-Contaminated Soil at the Y-12 Plant, Building 81-10 Area, Oak Ridge Tennessee (2003 Ref 5)

Phase I – Grout and Soil Additive Testing for In Situ Hg Reduction

Over a dozen potential grout and soil additives were identified through a solicitation posted in Commerce Business Daily

Eight products were obtained for testing

After initial screening tests, two products were selected for additional testing: Krystal Bond and MBS

Krystal Bond reduced soil hydraulic conductivity by an order of magnitude but was not effective at reducing leachable Hg (SPLP limit of 0.2 ppm was exceeded)

MSE Treatability Studies for Mercury-Contaminated Soil at the Y-12 Plant, Building 81-10 Area, Oak Ridge Tennessee continued

Phase I – Grout and Soil Additive Testing for In Situ Hg Reduction

MBS reduced the leachable Hg concentrations several orders of magnitude below the SPLP treatment limit of 0.2 ppm

MBS had little effect on the soils hydraulic conductivity – as expected

Ceramicrete identified at the end of Phase I testing for hydraulic conductivity control

MSE Treatability Studies for Mercury-Contaminated Soil at the Y-12 Plant, Building 81-10 Area, Oak Ridge Tennessee

Phase I I – Ceramicrete Testing with MBS and Sodium Sulfide

The Three Grout Formulations Tested:

- Ceramicrete – neat (baseline)
- Ceramicrete with MBS
- Ceramicrete with Sodium Sulfide (Na_2S)

Test Results:

- Ceramicrete – neat – no appreciable reduction in leachable Hg
- Ceramicrete with MBS – non detect for SPLP leachable Hg
- Ceramicrete with Na_2S – 0.42 ppm to non detect SPLP leachable Hg (SPLP project treatment limit of 0.2 ppm)

MSE Treatability Studies for Mercury-Contaminated Soil at the Y-12 Plant, Building 81-10 Area, Oak Ridge Tennessee

Phase I I I – Large Scale Ceramic Cement Testing with MBS and Sodium Sulfide

- Three different types of ceramic cement were tested and a robust grout was identified
- As an additive MBS was identified to make the grouting process successful for both mercury stabilization and hydrogen sulfide mitigation
- MBS alone is a valuable mercury remediation tool

MSE Treatability Studies for Mercury-Contaminated Soil at the Y-12 Plant, Building 81-10 Area, Oak Ridge Tennessee continued

Phase I I I – Large Scale Ceramic Cement Testing with MBS and Sodium Sulfide

Na_2S showed an increase in leachable Hg at both high and low concentrations:

- Low concentrations – not enough Na_2S
- High concentrations – formation of HgS_2^{-2} ion

No increase in leachable mercury at higher doses of MBS
Therefore MBS appears to be a more appropriate material for use in a field application where mercury concentration is either unknown or highly variable

Go / No-Go Testing for Dewatering and Treating Soil or Sediments Simultaneously (2011 Ref 7)

Materials:

- Metals Treatment Agent – MBS
- Dewatering Superabsorbent Polymer – Waste Lock 770

Surrogate soil was spiked with lead, mercury, cadmium, and chromium and 30 and 40 weight % water was then added to spiked soil

Three addition methods tested:

- MBS mixed into soil then Waste Lock 770 was added and mixed
- Waste Lock 770 mixed into the soil then MBS was added and mixed
- MBS and Waste Lock added simultaneously and mixed

Testing proved that both products can be added simultaneously to treat and dewater soil or sediments and pass TCLP

Abstracts were submitted to WM13 and Battelle Sediments Conference 2013

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