

**Remediation Assessment  
130 Liberty Street Property**

**Technical Memorandum  
*R1: Surface Remediation in Gash Area Post  
Abatement***

**Report Date: May 2004**

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## Summary

As a result of the collapse of the World Trade Center towers ("WTC Event") the building located at 130 Liberty Street, New York, NY (the "Building") was contaminated with WTC Dust and WTC Hazardous Substances.<sup>1</sup> Tests were conducted in two phases to develop data on the effectiveness of commercially available products to remediate WTC Hazardous Substances from Building surfaces. The surfaces tested included concrete (lightweight concrete supported slabs with and without flooring adhesive) and metals (interior side of aluminum curtain wall column covers, unpainted structural steel, galvanized metal deck, and painted metal). These tests were performed in areas of the Building that had been subjected to an asbestos abatement procedure. All interior finishes and systems had been removed, fireproofing had been removed from structural steel and metal decking, all surfaces except the floor had been pressure washed and all surfaces were subjected to detail remediation as necessary to pass a visual inspection.

Surfaces with materials that were commonly found in the Building were selected for testing. In this way the results of the test could be used to determine remediation requirements for the majority of Building surfaces. Simple surface geometries were chosen to facilitate initial testing.

*Phase I.* The objective of *Phase I* was to find a solution of cleaning chemicals that would allow the simultaneous remediation of all contaminants. This would allow each remediation pass to be completed with a single chemical washing for all targeted WTC Hazardous Substances rather than the multiple washings that would result from using a different cleaning chemical for each targeted WTC Hazardous Substances. As labor is the major cost component of a remediation, a solution effective on all contaminants has enormous economic advantage over a series of remediations using cleaning chemicals specific to individual contaminants. There were no such solutions of cleaning chemicals commercially available to address all of the WTC Hazardous Substances.

Hence, a solution of chemicals was formulated and tested. Chemicals known to be effective in past projects or in the literature on individual contaminants were compared to commercially available cleaning chemicals and solutions containing a mixture of cleaning chemical agents. Several remediation solutions (one for metal surfaces and one for concrete) were as effective in the concurrent removal of all WTC Hazardous Substances as cleaning

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<sup>1</sup> RJ Lee Group, "Contamination Report Pursuant to Testing Protocol-01 *Interior Spaces* Summary Report," December, 2003.

chemicals targeted for individual WTC Hazardous Substances when used individually. Based on this pilot test, remediation solutions were selected for *Phase II* testing with multiple remediation cycles on concrete and metal surfaces.

*Phase II.* The objective of *Phase II* was to determine the effectiveness of these solutions at removing WTC Hazardous Substances from targeted surfaces in the Building. Test surfaces representative of the majority of surface materials in the Building were targeted. These surfaces included galvanized steel, painted metal, unfinished aluminum, structural steel, and concrete. The two selected remediation solutions were tested in five areas located within the "Gash Abatement Area" on Floors 20-24 of the Building. These areas had undergone an asbestos abatement and were cleared for re-occupancy by workers without the need for respiratory protection. Air filtration units equipped with new HEPA-carbon filtration were used to positively pressurize the test areas to isolate them from the Building and the remainder of the *gash* area. Each of the five surface types received four sequential remediation cycles. Metal surfaces (most unpainted metal and painted metal surfaces) were remediated to near or below Appropriate Levels of most WTC Hazardous Substances. However, the remediation process failed to remove mercury from scale and rust on structural steel other than on the surface thereof. It was found that chemical cleaning alone was inadequate to completely remediate concrete surfaces. Additional remediation methods were identified for further testing. An initial test of one of these methods (bead blasting) was promising and warrants further testing.

## Key Findings

- The asbestos abatement performed prior to this testing removed all visible WTC Dust. However, WTC Hazardous Substances remained substantially above Appropriate Levels on most test surfaces before this chemical remediation test.
- *Phase I* testing demonstrated that two remediation solutions were as effective when used concurrently as the individual cleaning chemicals targeted for a particular WTC Hazardous Substance used separately.
- Chemical remediation was more effective on smooth and relatively impervious surfaces such as galvanized sheet metal, painted metal, aluminum and structural steel.

- The removal efficiency of the remediation solutions varied with both surface type and WTC Hazardous Substance in this pilot testing. A full scope study to define statistical correlations for each analyte on each surface type was left to a further study.
- A single application of remediation solutions did not reduce WTC Hazardous Substances to Appropriate Levels. Consistent reduction of WTC Hazardous Substances to at or below Appropriate Levels has not been demonstrated; but, if possible, multiple cycles of remediation would be required.
- After four sequential chemical remediation cycles, lead, asbestos and cadmium remained above Appropriate Levels on most surfaces (details in Table 4).
- Additional chemical testing is needed to address detailed issues for extrapolation to more extensive and complex Building surfaces. At least four remediation cycles need to be included in future test plans.
- Adhesive residues need to be removed from lightweight concrete floors before remediation with the remediation solutions. Mechanical removal of the residual adhesive was effective.

## Conclusion

Standard asbestos abatement practices, involving HEPA vacuuming, wet wiping, and including pressure washing, failed to reduce WTC Hazardous Substances on the surfaces to at or below Appropriate Levels.<sup>2</sup> This pilot test demonstrated that chemical remediation methods, in combination with other standard practices, can potentially achieve reductions of WTC Hazardous Substances from Building surfaces but ultimately failed to reduce WTC Hazardous Substances to at or below Appropriate Levels. Pilot test results cannot be directly extrapolated to the full Building with all of its diverse and complex surfaces. Additional testing is needed to determine remediation effectiveness on complex surfaces and on a scale proportionate to the entire Building.

See reports on follow-up testing for additional results.<sup>3,4,5</sup>

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<sup>2</sup> Drago, Noel C. (Ambient Group, Inc.), "Re: Floors 2,3,7 to 18 at 130 Liberty Street Ambient Project #211909," letter, April 29, 2003.

<sup>3</sup> RJ Lee Group, "Technical Memorandum R4: Cell System, Wire Pull Test and Cable Contamination," April, 2004.

<sup>4</sup> RJ Lee Group, "Technical Memorandum R3: Ductwork Remediation," May, 2004.

## 1.0 Purpose

Prior reports have demonstrated that the surfaces in the Building are contaminated with WTC Hazardous Substances.<sup>6</sup> Review of the literature and industry abatement standards provided no direct information on effective remediation methods, given the complex mixture of WTC Hazardous Substances.<sup>7</sup> In order for Deutsche Bank to determine whether it is possible to remediate WTC Hazardous Substances to Appropriate Levels,<sup>8</sup> a variety of remediation solutions were investigated. This test was conducted to identify remediation solutions suitable for remediation of WTC Hazardous Substances and to evaluate their effectiveness to remediate WTC Hazardous Substances from the surfaces described in Section 2.0.

## 2.0 Description of Surface Types Evaluated

The following surfaces were tested (in all instances test areas that were relatively flat and easily accessible were selected).

*Lightweight Concrete.* Lightweight concrete is used on top of galvanized metal decking to form a composite structural floor supported on the steel frame of the Building. This material is porous and permeable; a description of typical concrete floor surfaces in the Building has been provided previously to the Insurers.<sup>9</sup> This test does not include concrete in foundation slabs or walls, which are not composed of lightweight concrete.

*Lightweight Concrete with Adhesive.* These surfaces consist of lightweight concrete described above, which had residues of adhesive remaining after removal of carpeting or other floor coverings.

*Aluminum.* The interior surfaces of the exterior column covers are part of the curtain wall and are composed of extruded aluminum.

*Galvanized Steel.* The metal decking underlying lightweight concrete floors is composed of galvanized steel sheet metal formed with square flutes to increase stiffness. The cross section of the flutes is large enough to provide

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<sup>5</sup> RJ Lee Group, "Technical Memorandum H3: Remediation of Steel," May, 2004.

<sup>6</sup> RJ Lee Group, All Contamination Reports, December, 2003.

<sup>7</sup> RJ Lee Group, WTC Dust Signature Reports, December, 2003.

<sup>8</sup> Center for Toxicology and Environmental Health, "Appropriate Levels of Contamination for the Building," December, 2003.

<sup>9</sup> RJ Lee Group, "Insurance Claim Report, Volumes I, II, and III," May, 2003.

easy access for remediation and testing. The type of metal decking tested was representative of that found throughout the Building.

*Painted Metal.* The tested surfaces were painted hollow core metal doors. These were chosen for testing as they are representative of many components of the Building. There are many painted metal surfaces including trim, doors, MEP equipment, piping and conduit in the Building.

*Structural Steel.* The unpainted and oxidized steel surfaces tested were steel components making up the structural steel frame of the Building that support the concrete floors, walls and other Building elements and included both columns and beams.<sup>10</sup>

### 3.0 Procedure

This was a pilot test, performed in two phases. The results of *Phase I* determined the remediation solutions that were tested in *Phase II* on targeted surfaces.

#### 3.1 Phase I Procedure

*Phase I* was designed to select remediation solutions for remediation of WTC Hazardous Substances from various surface types within the Building. Specifically, commercially available water-based chemical formulations were applied to the surfaces described above in Section 2.0. The surfaces were tested to determine the pre- and post-remediation levels of WTC Hazardous Substances.

Two remediation solutions were selected for testing based on technical discussions with the manufacturer<sup>11,12,13,14</sup> on requirements for simultaneous application for remediation of multiple target analytes and chemical compatibility of the cleaning chemicals. One remediation solution was chosen for concrete and one for metal and plastic. The remediation solutions were mixed and provided by the manufacturer. These remediation solutions were tested against cleaning chemicals targeting single analytes.

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<sup>10</sup> RJ Lee Group, "Contamination Report Pursuant to Testing Protocol-25 *Structural Steel* Summary Report," December, 2003.

<sup>11</sup> Hg Cleaning Solution-102 or HgCS-102, (Catalog #RP-103), Chemical Solution International Corporation, Houston TX.

<sup>12</sup> HCMS-101, (Catalog #RP-104), Chemical Solution International Corporation, Houston TX.

<sup>13</sup> Pipe X-Metal X, (Catalog #RP-102), Chemical Solution International Corporation, Houston TX.

<sup>14</sup> Less Than 10, (Catalog #RP-101), Chemical Solution International Corporation, Houston TX.

The remediation solutions evaluated are listed below:

- Sodium Thiosulfate (3% Solution): Removal of mercury from concrete, metal, and plastic.
- HgCS-102: Removal of mercury from concrete, metal, and plastic.
- Ledizolve: Removal of lead from surfaces.
- HMCS-101: Removal of heavy metals (excluding mercury) from metal, and concrete.
- PipeX-MetalX Removal of PCBs and similar organic compounds from surfaces excluding concrete.
- Less Than 10 (LT10): Removal of PCBs and similar organic contaminants from concrete.
- Solution of Less Than 10 (LT10), HgCS-102 and HMCS-101: Removal of mercury, other heavy metals, and organics from concrete.
- Solution of PipeX-MetalX, HgCS-102 and HMCS-101. Removal of mercury, other heavy metals, and organics from metal and painted metal surfaces.

*Test Location Preparation.* Locations were selected for the testing that had previously undergone removal of tenant improvements and asbestos abatement as part of the repair work in the *gash* area. In these areas all tenant improvements including furniture, walls, ceilings, lights, ductwork, conduit, and fireproofing had been removed. This left only the supported concrete slabs, interior of the curtain wall, structural steel and galvanized steel deck. Fireproofing had been removed by wet scraping followed by pressure washing. All surfaces of the deck, structural steel and curtain wall were further remediated by pressure washing. The floor was remediated by mopping. All surfaces were visually inspected for the occurrence of visible dust and debris and areas that failed were subjected to additional wet cleaning (see Appendix). After passing a rigorous visual inspection, the air in the remediated space was sampled and the area was cleared for occupancy by construction workers without personal protective equipment (PPE) when the air samples met pre-established clearance criteria.<sup>15,16</sup> Abatement procedures are summarized in the Appendix.

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<sup>15</sup> RJ Lee Group, Inc., "RE: RS-01, Gash Final Air Clearances," memo, March 10, 2003.

<sup>16</sup> RJ Lee Group, Inc., "RE: RS-01, Gash Final Air Clearances," memo, April 29, 2003.

The *Phase I* test area on the 19<sup>th</sup> floor was cleared for use by construction workers, and physically isolated from the balance of the *gash* area and from the Building by sheet plastic barriers. Prior to testing, the test surfaces were demarcated with tape, general photographs were taken, and areas were assigned identification codes.

*Remediation Test.* Each remediation solution was spray-applied to completely wet the surface and the surface was scrubbed with a stiff bristle brush. After a residence time of approximately 15 minutes, the remediation solution was removed with a wet/dry vacuum and with spray-applied potable water. The rinse water was removed with a wet-vacuum equipped with HEPA filtration, and the surface was allowed to air dry.

*Sampling.* Pre-remediation wipe samples were obtained from the surfaces before being remediated. Post-remediation wipe samples were obtained from an adjacent area on the same surfaces after remediation.

*Analysis.* Pre-remediation and post-remediation surface samples were analyzed using industry standard analytical laboratory methods.<sup>6</sup>

### 3.2 Phase II Procedure

*Phase II* was designed to evaluate the multiple cycle effectiveness or “removal efficiency” of remediation solutions selected in *Phase I* for remediation of WTC Hazardous Substances.

Based on success in *Phase I*, two remediation solutions were selected: one for concrete and one for metal and plastic. The solutions, mixed and provided by the manufacturer, were:

- Solution of Less Than 10 (LT10), HgCS-102 and HMCS-101: Removal of mercury, other heavy metals, and organics from concrete.
- Solution of PipeX-MetalX, HgCS-102 and HMCS-101. Removal of mercury, other heavy metals, and organics from metal and painted metal surfaces.

*Test Location Preparation.* *Phase II* testing was performed in test enclosures in the *gash* area on Floors 20 through 24. All materials and equipment, including floor coverings (e.g., carpet and resilient floor tile), interior walls, and ductwork had been removed from the test area by the abatement procedures described in the Appendix. The test areas were isolated from the balance of the Building and from the outside by physical barriers. Openings in the windows and walls were sealed with 6-mil polyethylene sheeting. A two-chamber personnel/waste decontamination unit was assembled to

control access to each test area on each floor. Air filtration units equipped with new HEPA-carbon filtration were used to positively pressurize the test areas.

Prior to testing, the test surfaces were demarcated with tape, general photographs were taken, and areas were assigned identification codes.

Lightweight concrete test surfaces that contained adhesive were first remediated using a "bead blaster" technique to remove the adhesive prior to the application of the remediation formulation.

*Chemical Remediation Test.* Each remediation solution was spray-applied to completely wet the surface; the surface was scrubbed with a stiff bristle brush. After a residence time of 15 minutes (60 minutes for one test on concrete with adhesive), the remediation solution was removed with a wet vacuum or rags, and the surface was rinsed by spray-applying potable water. The rinse water was removed with a wet-vacuum equipped with HEPA-carbon filtration, and the surface was allowed to air dry.

*Sampling.* Pre-remediation wipe samples were taken from the surfaces at four locations on each test surface before remediation. Areas adjacent to each pre-remediation wipe sample were remediated one, two, three, or four times respectively, as described above. A post-remediation wipe sample was taken from each site after completion of the respective remediation cycles.

Bulk samples were collected from concrete to investigate possible transport of WTC Hazardous Substances into the concrete by the remediation solution.

*Analysis.* Pre-remediation and Post-remediation surface and bulk samples were analyzed using industry standard analytical laboratory methods.<sup>6</sup>

## 4.0 Results

### 4.1 Phase I Results

Gross contamination was removed prior to the *Phase I* and *Phase II* tests by the asbestos abatement procedure to a visually clean standard. However, WTC Hazardous Substances remained substantially above Appropriate Levels after the pressure washing abatement on 69% of test surfaces as shown in Table 1. The yellow highlighting indicates exceedance of the respective Appropriate Level for specific Analyte/Surface combinations. Zeros in the table represent non-detects for all samples of that analyte on that surface. Remediation efficiency was not calculated for samples with non-detect initial conditions.

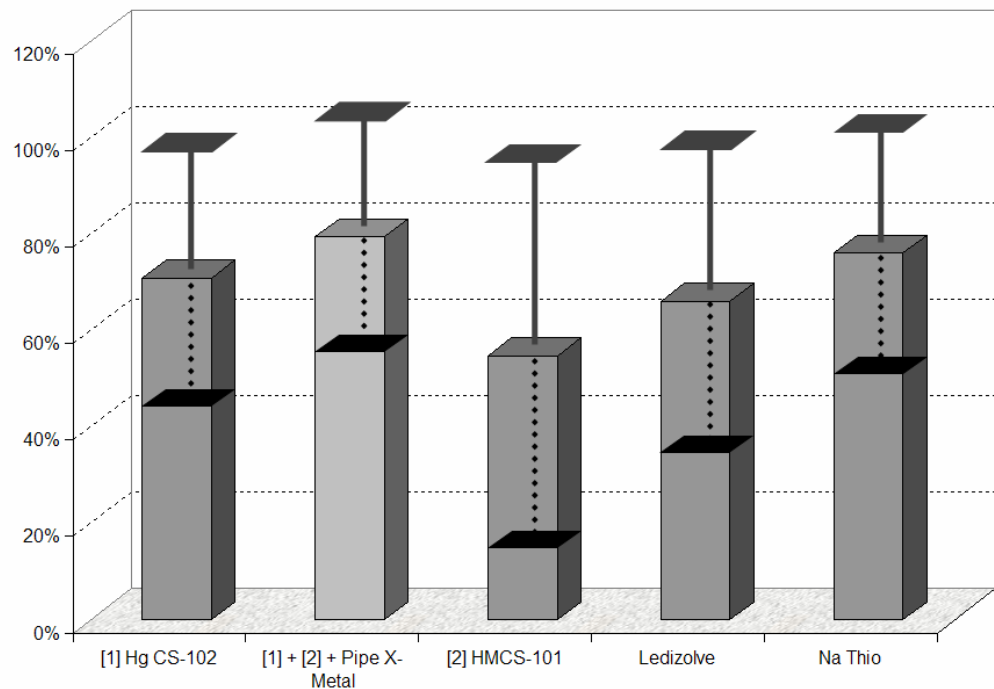
**Table 1. Average WTC Hazardous Substance Contamination on Test Surfaces After Abatement, Before Remediation Testing in Phase I & II.**

		Beryllium ( $\mu\text{g}/\text{ft}^2$ )	Mercury ( $\mu\text{g}/\text{ft}^2$ )	Cadmium ( $\mu\text{g}/\text{ft}^2$ )	Lead ( $\mu\text{g}/\text{ft}^2$ )	Asbestos ( $\text{s}/\text{cm}^2$ )	Dioxins ( $\text{pg}/100\text{cm}^2$ )
Surface Averages	Concrete Adhesive	0.106	0.007	1.5	10.6	123,870	0.45
	Concrete	0.078	0.28	1.7	26.8	398,923	4.5
	Curtain Wall Column Cover	0.013	.011	0.23	8.4	35,462	0.14
	Metal Decking	0.00	0.27	0.12	14.1	2,388	0.003
	Metal Door	0.00	0.006	0.59	1.8	10,160	0.018
	Steel	0.096	0.036	1.5	10.8	3,036	0.009
Summary Averages	Overall Average	0.049	0.102	0.93	12.1	95,640	0.86
	Concrete Average	0.092	0.143	1.6	18.7	261,396	2.5
	Metal Average	0.027	0.081	0.60	8.8	12,761	0.043
Appropriate Level comparisons	Appropriate Level	0.036	0.011	0.15	1.82	156	0.25
	Concrete Ratio to Appropriate Level	256%	1302%	1050%	1029%	167562%	995%
	Metal Ratio to Appropriate Level <sup>17</sup>	76%	735%	403%	481%	8180%	17%

*Yellow highlight indicates exceedance of respective Appropriate Level for each analyte.*

<sup>17</sup> Concentration represented as percent of Appropriate Level (e.g., a concentration that is half the Appropriate Level is 50%).

The average percent reduction in surface concentration of WTC Hazardous Substances achieved in the *Phase I* remediation tests on metal and painted metal and concrete surfaces is presented in Figure 1 and Figure 2, respectively. There was no significant difference in the effectiveness of the various remediation solutions tested. This is evident from the overlapping error bars, which demonstrate that all values are within one standard deviation of each other. On the average, all remediation solutions tested were greater than 69% effective in reducing the concentration of WTC Hazardous Substances on metal test surfaces and 57% on concrete surfaces. Based on these initial tests HgCS-102, HMCS-101 and PipeX-MetalX was selected for further testing on metal and painted metal surfaces and HMCS-101, HgCS-102, and LT10 was selected for further testing on lightweight concrete surfaces.



**Figure 1. Average Percent Reduction in Concentration of WTC Hazardous Substances on Metal Surfaces after one Remediation Cycle (Phase I).**

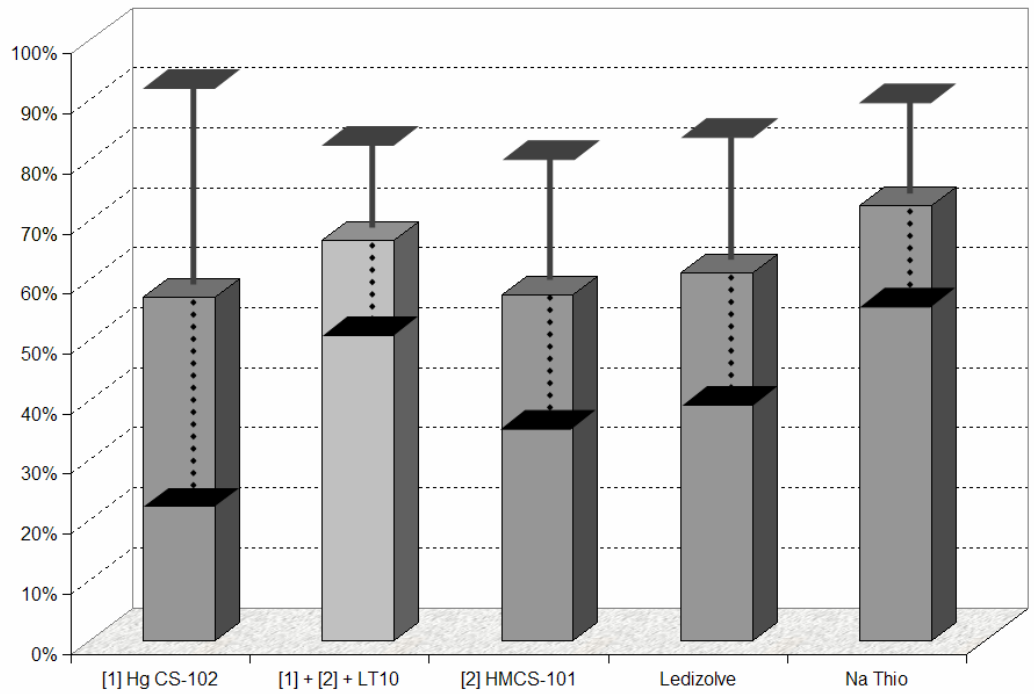


Figure 2. Average Percent Reduction in Concentration of WTC Hazardous Substances on Concrete Surfaces after one Remediation Cycle (Phase I).

Table 2 compares the effectiveness of the single cleaning chemicals which are designed to remediate specific contaminants in comparison to the performance of the remediation solutions evaluated in these pilot tests. The highlighted cells in this table show the most effective cleaning chemical or remediation solution for selected analytes. These data demonstrate that the remediation solutions tested were comparable to or better in effectiveness than HgCS-102 and sodium thiosulfate for mercury, Ledizolve and HMCS-101 for lead, and all individual cleaning chemicals tested for dioxins. It was observed that mixing the cleaning chemicals did not reduce their effectiveness when compared to the performance of the cleaning chemicals individually.

**Table 2. Percent WTC Hazardous Substance Removed by Tested Remediation Solutions in Comparison to Single Cleaning Chemicals (Phase I).**

Analyte	Comparison Cleaning Chemical	Metal		Concrete	
		Comparison Result	[1] + [2] + Pipe X-Metal	Comparison Result	[1] + [2] + LT10
Mercury	Sodium Thiosulfate	74%	100%	77%	100%
	HgCS-102	67%		74%	
Lead	Ledizolve	59%	79%	50%	73%
	HMCS-101	54%		48%	
Dioxins	Average Single Solutions	90%	100%	48%	76%

The green background indicates the best performing cleaning chemical or remediation solutions for the group.

After the single remediation cycle performed in *Phase I*, the percent of contaminant remaining on lightweight concrete and metal (oxidized structural steel, galvanized steel, painted metal, and aluminum combined) surfaces is shown for each WTC Hazardous Substance in Table 3. The limited samples of this pilot test require follow-up testing to improve the reliability of these data.

**Table 3. Average Percent WTC Hazardous Substances Remaining on Concrete and Metal Surfaces after One Test Remediation Cycle (Phase I).**

Contaminant	Surface Type	
	Concrete	Metal
Lead	100%	38%
Cadmium	100%	54%
Mercury	100%	32%
Asbestos	3%	21%
Dioxins/Furans	52%	10%
Average	71%	31%

## 4.2 Phase II Results

Table 4 summarizes the average concentrations of WTC Hazardous Substances on the surfaces tested in *Phase II*. Comparison to Table 1 reveals substantial reduction in the number of exceedances of Appropriate Levels from the pretest concentrations. Based on the distribution of contaminants observed on the test surfaces, 25% of the samples were above the Appropriate Level and 75% of samples were below the Appropriate Level after four remediation cycles. On average, asbestos showed the greatest residual concentration above Appropriate Levels.

**Table 4. Minimum Average Concentration of WTC Hazardous Substance Contamination on Test Surfaces After Four Remediation Cycles Tested in Phase II.**

		Beryllium ( $\mu\text{g}/\text{ft}^2$ )	Mercury ( $\mu\text{g}/\text{ft}^2$ )	Cadmium ( $\mu\text{g}/\text{ft}^2$ )	Lead ( $\mu\text{g}/\text{ft}^2$ )	Asbestos ( $\text{s}/\text{cm}^2$ )	Dioxins ( $\text{pg}/100\text{cm}^2$ )
Surface Averages	Concrete Adhesive	0.002	ND	0.16	ND	ND	0.022
	Concrete	0.03	0.00	0.51	4.79	444	0.0001
	Curtain Wall Column Cover	0.01	0.008	0.08	1.79	30,153	0.0003
	Metal Decking	0.02	0.007	0.09	1.71	178	ND
	Metal Door	0.02	ND	0.10	1.52	1,778	0.025
	Steel	0.02	0.008	0.277	41.630	178	0.000
	Overall Average	0.017	0.006	0.20298	10.29	6,546	0.010
Summary Averages	Concrete Average	0.0154	0	0.333	4.79	444	0.01
	Metal Average	0.01789	0.008	0.1378	11.7	8,072	0.008
	Appropriate Level	0.036	0.011	0.15	1.82	156	0.25
Appropriate Level comparisons	Concrete Ratio to Appropriate Level	43%	0%	222%	263%	285%	4%
	Metals Ratio to Appropriate Level	50%	70%	92%	641%	5174%	3%

Green represents that the value is less than or equal to the Appropriate Level

Yellow represents that the value is greater than Appropriate Level

For the purpose of comparison of values against Appropriate Levels, samples with a result of non detect which did not achieve the target detection limit of one-half the Appropriate Level were excluded from the computation of averages.

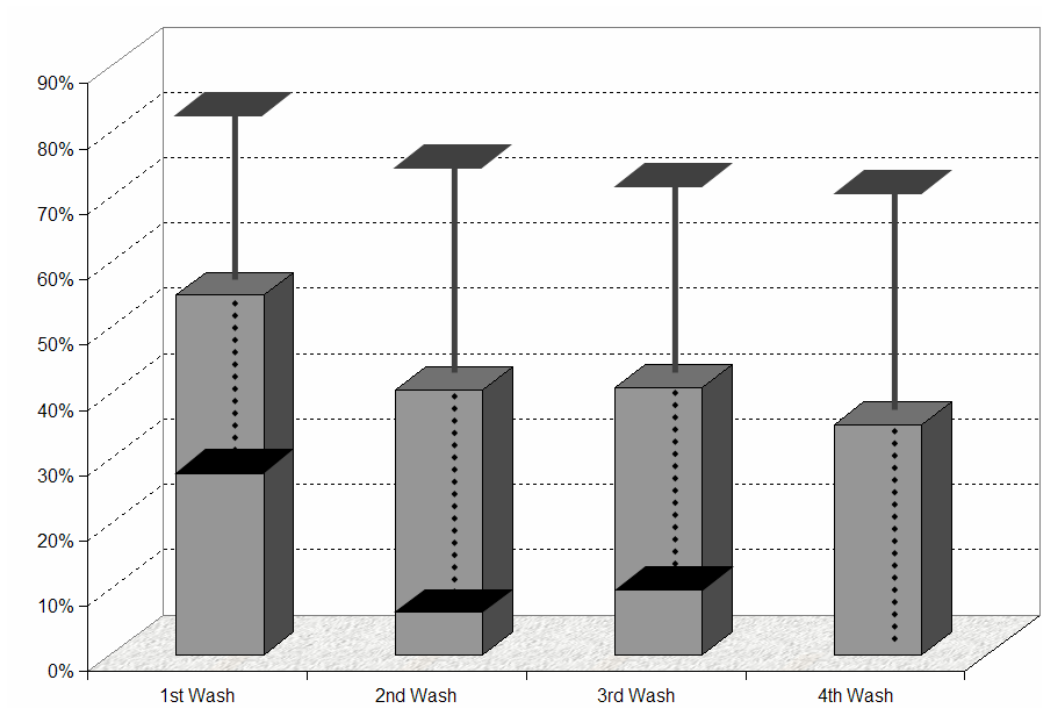
Figure 3 and Figure 4 show the *Phase II* results in terms of remediation efficiency for each successive remediation. Adhesive on lightweight concrete was removed by bead blasting prior to application of remediation solutions for these remediation tests. Although removal of adhesive prior to remediation removed a substantial portion of the contamination after a single remediation, the residual surface concentrations still exceeded the Appropriate Levels. This remediation procedure is promising but requires additional testing.

Figure 5 and Figure 6 translate these efficiency results into “remediation curves”, showing the contamination levels remaining on the surface at the end of each successive remediation cycle as a percent of initial contamination, averaged over all WTC Hazardous Substance analytes.

Table 5 summarizes the concrete bulk analysis results before and after each remediation cycle. There is no evidence that the remediation solution either increases or reduces bulk concentration of WTC Hazardous Substances in the concrete.

**Table 5. Bulk Concrete sample results show no impact by remediation solution.**

	Pre- Remediation	Post- Remediation 1	Post- Remediation 2	Post- Remediation 3	Post- Remediation 4
<b>Dioxins(ppm)</b>	4.9	0.169	0.178	0.16	0.118
<b>Beryllium (ppm)</b>	0.197	1.28	0.395	0.23	0.47
<b>Lead (ppm)</b>	19.19	12.74	19.65	12.5	14.1
<b>Cadmium (ppm)</b>	ND	ND	ND	ND	ND



**Figure 3. Average Percent Reduction of Concentration for All Analytes on Metal Surfaces using HgCS-102, HMCS-101 and Pipe-X Metal X (Phase II).**

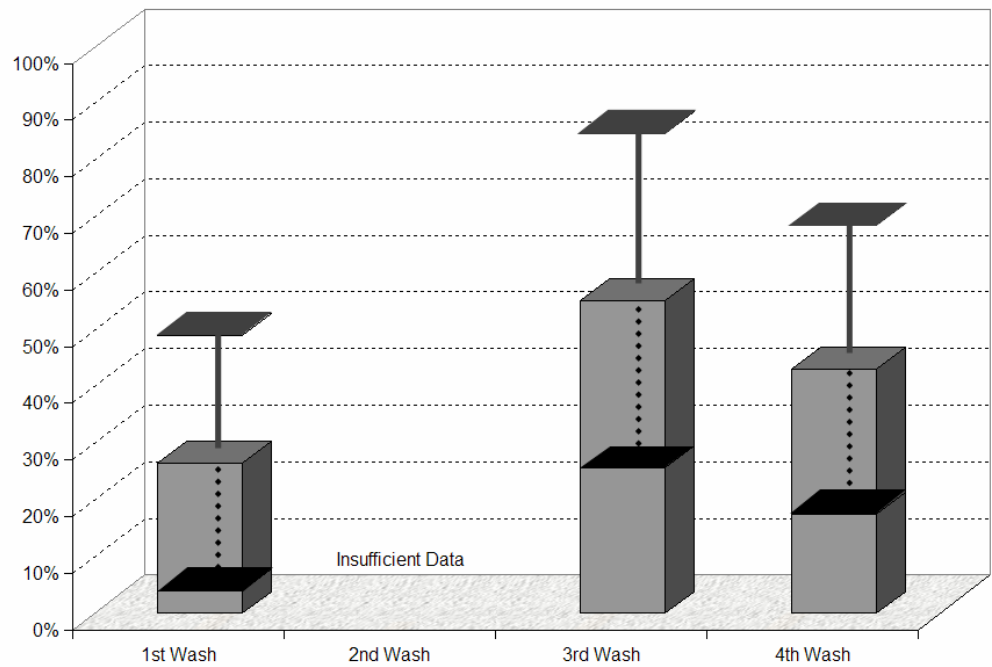


Figure 4. Average Percent Reduction in Concentration for All Analytes on Concrete Surfaces using HMCS-101, HgCS-102 and LT10 (Phase II).

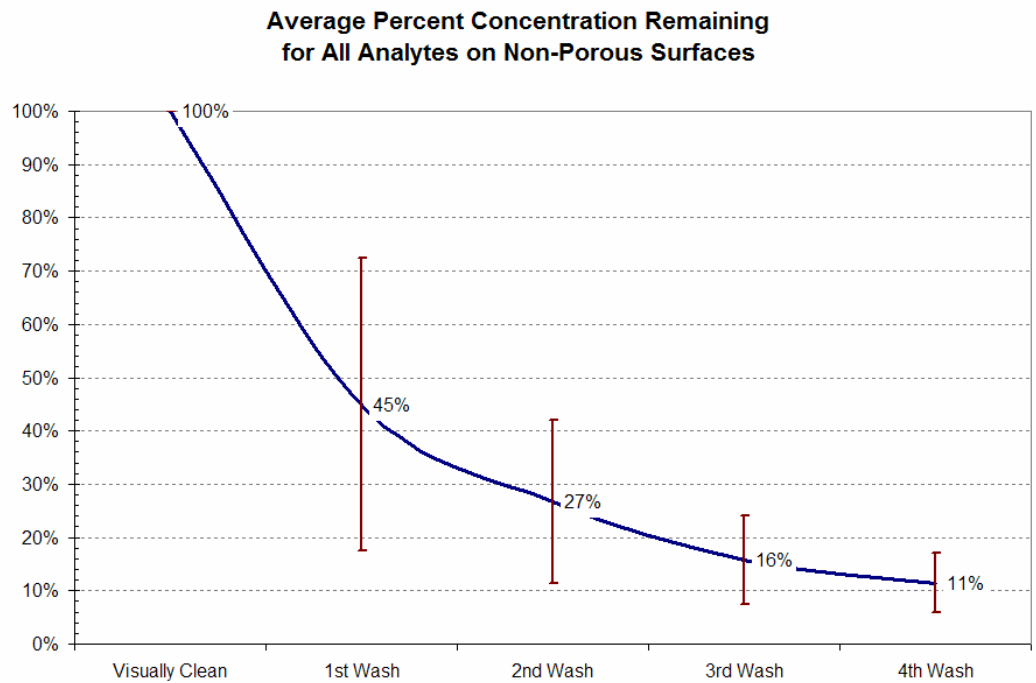
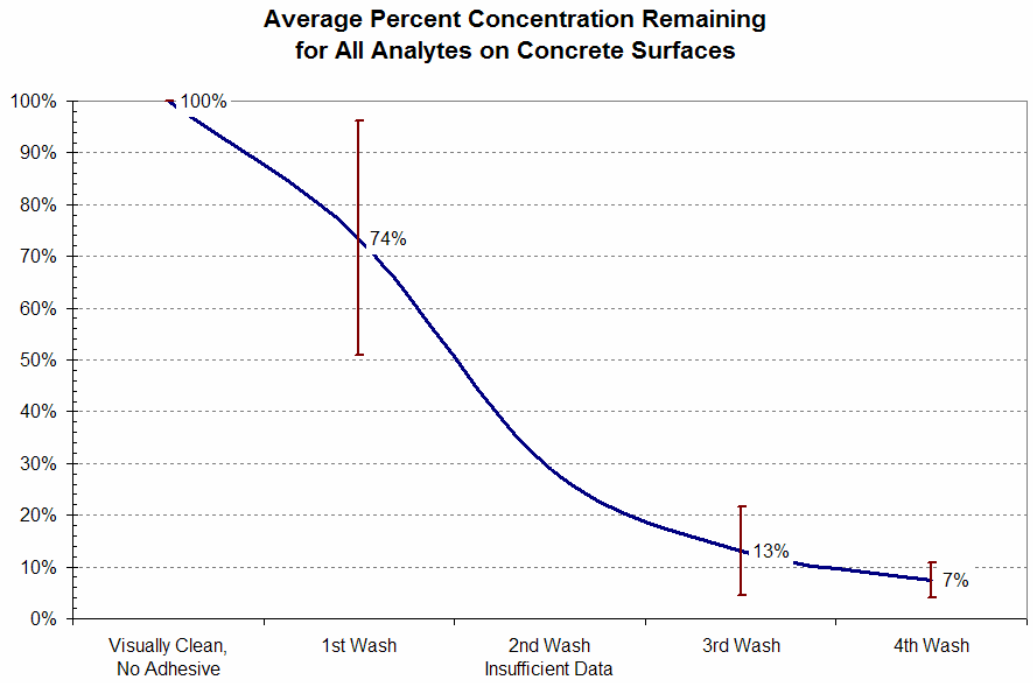


Figure 5. Average Percent Concentration Remaining for All Analytes on Metal Surfaces (Phase II).



**Figure 6. Average Percent Concentration Remaining for All Analytes on Concrete Surfaces (Phase II).**

## Appendix

### *Summary Asbestos Abatement performed in gash prior to Phase I and Phase II Remediation Testing*

Prior to any remediation testing, the asbestos-containing materials in the *gash* area were abated by a NYCDEP licensed asbestos abatement contractor as a filed asbestos abatement project.<sup>2,18,19</sup> Pressure washing was used as an intermediate process in the abatement; areas that failed visual inspection after pressure washing were further abated using standard asbestos industry practices such as wet wiping.

The fireproofing was abated according to asbestos abatement procedures as follows: Fireproofing was wetted with surfactant amended water using a sprayer and removed from the deck, beams and columns with hand scrapers. The scraped surface was then washed with a power washer. The pressure washed metal deck, beams and columns were then nylon brushed, HEPA vacuumed, and wiped with wet rags. The 6-mil polyethylene sheeting was then removed from the windows and concrete floor. The surfaces were then wet mopped, HEPA vacuumed, and wet wiped. When the abatement contractor completed a floor, it was visually inspected. Upon passing the visual inspection clearance air sampling and wipes were conducted.<sup>20</sup> Clearance was determined for asbestos according to the New York City Department of Environmental Protection (NYC DEP) regulations,<sup>19</sup> dioxins in air at 3pg/m<sup>3</sup>, PCBs (Arochlor 1254) in air as 0.5mg/m<sup>3</sup>,<sup>21</sup> and metals OSHA Action Levels<sup>22</sup> and/or ACGIH TLV.<sup>23</sup> After air clearance, the air filtration units were turned off. The polyethylene sheeting covering the *gash* area and the Column Line 6 wall, and the decontamination chamber remained in place.

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<sup>18</sup> New York City Department of Environmental Protection (NYC DEP), "Title 15, Chapter 1 - Asbestos Control Program, Subchapter C," <http://www.nyc.gov/html/dep/pdf/asbestos.pdf>; accessed May 5, 2004.

<sup>19</sup> New York City Department of Environmental Protection (NYC DEP), "Title 15, Chapter 1 - Asbestos Control Program," <http://www.nyc.gov/html/dep/pdf/asbestos.pdf>; accessed May 5, 2004.

<sup>20</sup> New York City Department of Environmental Protection (NYC DEP), "Title 15, Chapter 1 - Asbestos Control Program, Subchapter D," <http://www.nyc.gov/html/dep/pdf/asbestos.pdf>; accessed May 5, 2004.

<sup>21</sup> U.S. Occupational Safety and Health Administration (OSHA), "Table Z-1 Limits for Air Contaminants," 29CFR1910.1000 Table Z-1, [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9992](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992); accessed May 6, 2004.

<sup>22</sup> U.S. Occupational Safety and Health Administration (OSHA), "Air Contaminants," 29CFR1910.1000. 1971.

<sup>23</sup> American Conference of Governmental Industrial Hygienists (ACGIH), "2003 TLVs and BEIs," based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, Cincinnati, OH. 2003.