Sampling and Analysis of Cyber Media to Determine whether it Meets the Definition of a Hazardous Waste - 15208

Dr. Dwight J Stockham
Sandia National Laboratories, New Mexico

ABSTRACT

Sandia National Laboratories, New Mexico (SNL/NM) was tasked to support The Department of Energy (DOE) in the disposal of classified cyber media. Certain cyber media have lead and silver. Various cyber media types were identified because they may have a hazardous waste characteristic. The overall objective of this sampling effort is to obtain representative samples of specific types of cyber media and analyze those samples to collect data to determine definitively if the cyber media are hazardous waste.
Ten different samples were obtained from the unclassified waste stream and shredded to meet the sampling criteria. The samples were shipped to an offsite analytical laboratory with a Chain of Custody.

INTRODUCTION

This Sampling and Analysis Plan (SAP) documents the methodology to be used for sampling and analysis of cyber media to determine if certain types of cyber media exhibit the Resource Conservation and Recovery Act (RCRA) toxicity characteristic and are hazardous waste. The samples collected in accordance with this SAP will be analyzed for RCRA toxicity characteristic (TC) and underlying hazardous constituent (UHC) metals.

The data provided by the offsite analytical laboratory would be used to determine if the types of cyber media sampled and analyzed are toxic as defined by RCRA. The analytical data also will support waste characterization requirements of potential treatment and disposal facilities, and ensure proper transportation of the waste, in accordance with applicable Federal, State and Local laws and regulations.

Process knowledge indicates that cyber media may contain lead above RCRA TC concentration limits since circuit boards present in cyber media can potentially contain solder with lead. There is no analytical data, however, to determine definitively if RCRA TC or UHC metals are present in the waste above TC concentrations.

DESCRIPTION

Process knowledge indicates that cyber media may contain lead above RCRA TC concentration limits since circuit boards present in cyber media can potentially contain solder with lead. There is no analytical data, however, to determine definitively if RCRA TC or UHC metals are present in the waste above TC concentrations. Certain types of cyber media are currently assumed to be hazardous waste since they contain printed circuit boards that may contain solder with lead. Sandia National Laboratories/ New Mexico needs analytical data to determine conclusively if these types of cyber media are hazardous waste or if they are only solid waste. The cyber media

to be sampled and analyzed was obtained from various line organizations throughout SNL/NM. The data provided by the offsite analytical laboratory would be used to determine if the types of cyber media sampled and analyzed are toxic as defined by RCRA. The analytical data also will support waste characterization requirements of potential treatment and disposal facilities, and ensure proper transportation of the waste, in accordance with applicable Federal, State and Local laws and regulations.

Sampling Rationale, Locations and Frequency

Certain types of classified cyber media are currently assumed to be hazardous waste since they contain printed circuit boards that may contain solder with lead. The analytical data is needed to determine conclusively if these types of cyber media are hazardous waste or if they are only solid waste. The cyber media to be sampled and analyzed was obtained from various line organizations throughout SNL/NM.

In order to obtain a representative sample, unclassified cyber media (the same types as found in classified media) from many different manufacturers were been collected from various organizations. This cyber media can be divided into nine types as shown in Table I below along with the types and quantities of electronic media to sample in Table II

TABLE I – Cyber Media Types

Type Number	Cyber Media Type
1	Desktop computer hard drives
2	Blackberry phones
3	Personal Digital Assistants (PDAs)
4	Laptop computer hard drives
5	Laptop computers
6	Secure Digital (SD) cards
7	Flash drives
8	USB flash drives (Thumb drives)
9	Memory boards

TABLE II Types and Quantities of Electronic Media to Sample

Media Type	Vendor	Quantity
Hard Drives	Maxtor	3
	Western Digital	1
	Seagate	3
	IBM	1
	Simpletech	1
Total		9
Blackberrys	Various Kinds	20

PDAs	HP	10
	Dell	1
	Sony	1
Total		12
Laptop Hard drives	Hitachi	3
	Conner	1
	Seagate	2
	IBM	1
	Axiom	1
Total		8
Laptops	Dell Latitude D600	1
	Apple	1
	HP Compaq tc4200	1
	IBM ThinkPad, Type 2687	1
	Lenovo ThinkPad, Type 6477	1
Total		5
Flash or SD Cards (Lg)	Kodak	2
	Lexar	1
	Kingston	2
	Viking	1
	Simple Tech	1
	Callunacard	1
Total		8
Flash or SD Cards (Small)	Cannon	2
	Dane-Eelc	1
	DG Vision	1
	Edge	1
	Handspring Backup Module	1
	HP	1
	IBM	1
	Kingston	14
	Kodak	2
	Lexar	3
	Linksys	1
	SanDisk	12
	Simple Technology	1
Total		41

Flash Drives	CEFC (Blue)	44
	MagicRam Micro Flash	43
Total		87
Thumb Drives		
	ActivCard	16
	Combustion Research Facility	1
	Cruzer Micro 2GB	1
	diskGO Secure	5
	FLEXnet	1
	Gemalto	2
	Genepix Pro 5	1
	Infocus	1
	Iomega	1
	IronKey	9
	JMC	1
	Kanguru	1
	Lexar	1
	Linksys	1
	Logitech	2
	Memorex	1
	Olympus	1
	Pen Drive Plus	2
	Phison	2
	Pocket Disk 128 MB	1
	PQ1 Intelligent Stick	1
	Ra	1
	Safenet	1
	Samsung	2
	SanDisk	1
	Simple Tech	3
	Sony	1
	Stealth MXP Bio by MXI Security	1
	SuperFlash Drive	1
	Texas Instruments	1
	TransCAD	1
	Unknown	5
	Wolverine	1
Total		71
Memory Boards	Altera Max	1
	AMPc	1
	Apacer	2
	Axiom	1

	Dell	3
	DIGI Track by Hirsch Electronics Corp	5
	DiskOnChip M-Systems	3
	Edge	1
	Elpida	2
	hynix	12
	IBM	1
	Infineon	1
	Kingston	7
	Lettering System Font Card	2
	M Product of Singapore	2
	Nanya	2
	Samsung	15
	SanDisk	2
	SST	1
	Toshiba	1
	Unknown	3
	Visiontek	1
Total		69

For each type of cyber media in Table 1 above, one device from each manufacturer collected will be shredded into pieces that will pass through a 9.5 mm sieve (as required by the TCLP). The shredded material will be thoroughly mixed and two 100-gram composite samples will be taken for each type of cyber media. If 200 grams of each media type cannot be collected in this manner, then the number of devices per manufacturer collected can be increased. If necessary, additional devices of the same type can be shredded and added to the sample, at the discretion of the sample collector, to obtain at least 200 grams of sample material. See the attached spreadsheet *Cyber Media To Sample* for a list of available media to sample for each type of media.

All samples were submitted on AR/COC 615216. Table III below provides additional details on sample fractions, analytes, and appropriate containers.

TABLE III –Sampling List for AR/COC 615216

Type Number	Sample Number	Sample Bottle	Analysis[1]
1	095229-001	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
	095229-002	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
2	095230-001	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
	095230-002	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]

3	095231-001	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
	095231-002	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
4	095232-001	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
	095232-002	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
5	095233-001	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
	095233-002	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
6	095234-001	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
	095234-002	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
7	095235-001	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
	095235-002	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
8	095236-001	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
	095236-002	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
9	095237-001	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]
	095237-002	Poly bottle	TCLP for TC and UHC metals (not Hg) [1]

[1] For metals, use SW-846 Method 1311 (TCLP) then use SW-846 Method 6010C (ICP-AE) or Method 6020A (ICP-MS), or equivalent methods.

The sample amounts required for each type of laboratory analysis, as specified by SMO, are presented in Table IV below.

TABLE IV – Sample Amount Requirements

Sample Amount	Analysis
200 g	TCLP for Sb, As, Ba, Be, Cd, Cr, Pb, Ni, Se, Ag, and Tl

All samples were submitted on AR/COC 615216. The sample and fraction numbers presented in Table IV will be used to uniquely identify and track the samples collected during this sampling event. All samples will be analyzed with a 30-day turn-around from the analytical laboratories.

Sample Management, Documentation and Shipment

After collection and release, samples will remain in control of the Sampling Project Leader until they are transferred to the SMO.

A chain of custody form will accompany the samples to SMO and the off-site laboratory. SMO personnel in accordance with company procedures will perform packaging and shipping of off-site samples.

Quality Control

Trip Blanks – None
Field Blanks – None
Field Duplicate – Nine
Equipment Blank – None
Matrix Spike/Matrix Spike Duplicate – As specified by contract
Sample Duplicate – As specified by contract
Method/Reagent Blank – As specified by contract
Surrogate Spikes – As specified by contract
Laboratory Control Samples – As specified by contract

NOTE: Laboratory QC sample requirements are specified by agreements between the SMO and contract analytical laboratories. Specific requirements are detailed in the Statement of Work for Analytical Laboratories, Sandia National Laboratories/New Mexico (SOW).

Data Reduction

The sample results will be compared directly to the applicable regulatory threshold specified in 40 CFR §261.24, Table 1 to determine if the waste exhibits the RCRA toxicity characteristic. If sample results meet or exceed a TC regulatory threshold, the waste stream will be designated toxic for that constituent and will be characterized and managed as hazardous waste. If characterized as hazardous waste, any UHC metals (antimony, beryllium, nickel, and thallium) exceeding the concentrations provided in 40 CFR 268.48, the Universal Treatment Standards, will be assigned as UHCs for that waste.

If all sample results are less than the TC regulatory thresholds, the waste stream will be managed as solid waste only.

CONCLUSIONS

It is important that used electronic equipment be managed properly. Used electronic equipment contains hazardous elements and compounds, including lead, mercury, and cadmium, which can be toxic if released into the environment when disposed. Lead is found in circuit boards, and in the glass panels and funnels of Cathode ray Rube (CRT) monitors and televisions, etc. Mercury is found in switches and relays of older computer central processing units (CPUs) and backlighting lamps. Older sets use CFLs, or compact fluorescent tubes, which contain mercury. Cadmium is found in laptop batteries, semiconductors, and various cables and wires, etc. Sandia National Laboratories typically does not keep computer equipment beyond 3 years so the

majority of the older items are not currently being used so mercury was not included in the sampling and analyses. There could possibly be older units still in inventory. If these happen to show up for disposal they will be treated as if they have mercury and be managed accordingly.

One difficulty in testing used electronics items lies in the sample preparation requirements for the TCLP. There are two ways the test could be run for used electronics equipment: (1) Each individual material in an item can be individually tested, and a mass balance run to determine the assumed concentration mathematically; (2) The unit as a whole could be reduced in particle size and a composite sample taken. Test results from these two methods can differ significantly, and may not accurately represent the environmental risk of disposal. Additionally, the results from one model of one particular piece of equipment may differ significantly from other models even from the same manufacturer. Generalized tests results are further complicated because there are hundreds of current and historical manufacturers of equipment, and models change regularly. Instead of testing every component, handling used electronic equipment under the hazardous scrap metal exemption is a cost-effective alternative that allows generators to be in compliance whether or not their used electronics items fail the TCLP. The best options for us, was to reduce the unit as a whole in particle size and a composite sample was taken.

The concentrations of Pb in the TCLP extracts of certain samples were found higher than the regulatory level of 5 mg / L. However, the concentrations of the other TCLP metals in all the TCLP extracts were below the regulatory limit. Among the eight heavy metal elements Ag, As, Ba, Cd, Cr, Hg, Pb, and Se on the EPA D list, Pb is the predominant one that causes the toxicity characteristic of PC components. Although Ag exists in large amounts in most IC packages and CPUs and Ba exists in certain amounts in some boards, they are not leachable under the TCLP test conditions and do not pose toxicity characteristic hazards. The other five elements are very insignificant in total contents and do not have the potential to cause a toxicity characteristic concern. The results indicate that PDAs, SD Cards and Memory Boards fail TCLP for lead by a substantial amount. The reason may be due to the small item size relative to the circuit board. The Pb concentrations in the TCLP extracts of the PDAs was 6.69 and 9.05 mg / L which is 1.5 – 2.0 times the regulatory level of 5 mg / L. The Pb concentrations in the TCLP extracts of the memory boards was 33.72 and 52.10 mg / L which is 6 – 10 times the regulatory level of 5 mg / L. The Pb concentrations in the TCLP extracts of the flash drives was 105 and 106 mg / L which is 20 times the regulatory level of 5 mg / L for classifying them as hazardous wastes. The contents of barium and silver were found to be low in concentration in the cyber media components. The contents of other four elements in all the PC components were hardly detectable or were non-detectable. As discussed above there was no need to include mercury in this sampling plan.

The sample sizes and sampling results can be found in Appendix A. Results can be found in Appendix B.

REFERENCES

1. Environmental Protection Agency EPA. 1992a. “Method 1311: Toxicity characteristic leaching procedure.” SW-846 test methods for evaluating solid wastes, http://www.epa.gov/epaoswer/hazwaste/test/main.htm (Jan. 7, 2003)
2. Jang, Y. C., and Townsend, T. G. (2003). “Leaching of lead from computer printed wired boards and cathode ray tubes by municipal solid waste landfill leachates.” Environ. Sci. Technol. 37, 4778–4784.
3. National Safety Council. Electronic Product Recovery and Recycling Baseline Report; National Safety Council’s Environmental Health Center: Washington, DC, 1999.
4. Yang, G. C. C. (1992). “Environmental threats of discarded picture tubes and printed wire boards.” J. Hazard. Mater, 34, 235–243.

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Appendix A
Sample Management

Sample No		Matrix	Preserv	Analysis	Container	Min size	Date	Cyber Media	Gross wt (g)	Net Wt (g)
95229		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Hard Drives	362.7	325.1
95229		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Hard Drives	375.9	338.3
95230		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Blackberrys	220.7	183.1
95230		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Blackberrys	203.2	165.6
95231		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	PDAs	190.5	152.9
95231		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	PDAs	190.6	153
95232		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Laptop HDs	310.9	273.3
95232		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Laptop HDs	306.5	268.9
95233		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Laptops	214	176.4
95233		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Laptops	225.2	187.6
95234		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	SD Cards	250.2	212.6
95234		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	SD Cards	249.6	212
95235		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Flash Drives	233.8	196.2
95235		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Flash Drives	236.3	198.7
95236		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Thumb Drives	220.8	183.2
95236		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Thumb Drives	228.8	191.2
95237		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Memory Boards	287.9	250.3
95237		Solid	None	TCLP Metals	Plastic	100 g	1/21/14	Memory Boards	314.4	276.8

Appendix B
Sampling Results (milligrams/liter)

Cyber Media	Analyte	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Nickel	Selenium	Silver	Thallium
Hard Drives	95229-01	0.07	ND	0.87	ND	ND	0.20	3.52	1.55	ND	0.02	ND
Hard Drives	95229-02	0.06	ND	0.86	ND	ND	0.15	2.25	1.29	0.12	0.017	ND
Blackberrys	95230-01	ND	ND	1.67	ND	ND	0.08	1.06	3.04	ND	ND	ND
Blackberrys	95230-02	ND	ND	1.80	ND	ND	0.07	1.66	3.05	0.11	ND	ND
PDAs	95231-01	ND	0.11	2.32	ND	ND	0.05	9.05	3.21	ND	ND	ND
PDAs	95231-02	ND	0.08	2.02	ND	ND	0.05	6.69	4.43	ND	ND	ND
Laptop HDs	95232-01	0.08	ND	1.57	ND	ND	0.09	3.70	3.32	0.07	0.01	ND
Laptop HDs	95232-02	0.07	ND	1.59	ND	ND	0.13	2.88	3.24	0.08	0.01	ND
Laptops	95233-01	ND	ND	3.46	ND	ND	ND	0.04	ND	ND	ND	ND
Laptops	95233-02	ND	ND	3.38	ND	ND	ND	0.05	ND	0.11	ND	ND
SD Cards	95234-01	0.06	ND	3.36	ND	ND	0.10	2.28	1.10	0.11	ND	ND
SD Cards	95234-02	0.07	ND	3.33	ND	ND	0.09	3.04	1.16	0.10	0.01	ND
Flash Drives	95235-01	ND	0.07	2.05	ND	ND	0.02	105.00	1.09	0.08	ND	ND
Flash Drives	95235-02	ND	ND	1.95	ND	ND	0.02	106.00	1.02	0.08	ND	ND
Thumb Drives	95236-01	0.05	ND	3.29	ND	ND	0.03	3.14	1.09	ND	0.01	ND
Thumb Drives	95236-02	0.05	ND	3.46	ND	ND	0.03	2.99	0.96	0.10	0.01	ND
Memory Boards	95237-01	0.04	ND	4.30	ND	ND	0.04	52.10	2.19	0.09	ND	ND
Memory Boards	95237-02	0.05	ND	4.29	ND	ND	0.03	33.70	2.08	ND	ND	ND