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Treated Wood Waste Identification and Characterization

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Auspices Statement
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Introduction

At LLNL different program areas may encounter treated wood waste and need to determine the appropriate disposal method. Disposal option decisions are to be made by the generator, environmental analyst (EA) and, if needed, support from RHWM. If the generator decides to use the Treated Wood exemption, the regulatory guidance and characterization support is provided in this paper. For additional support RHWM can be contacted through the assigned area Field Technician. Otherwise if the generator and the EA decide to opt for the exemption path then the regulations and controls referenced in this paper have to be initiated and followed.

Pressure treated wood presents an issue for identification and waste processing. It has the potential to be in construction waste in facility structures and in outside construction, such as porches, steps, landscaping borders. The difficulty is in easy identification and characterization without costly analytical support and obtaining information in the post D&D phase of an operation. The following guidance presents an easy solution to this characterization issue. This paper is limited to Chromated Copper Arsenate (CCA) and other related metal treated wood. The local availability and the lack of an alternative to direct chemical analysis for identification and characterization prevented the inclusion of organic wood preservatives in this study.

Background

Pressure treatment is a process that forces chemical preservatives into the wood. Wood is placed inside a closed cylinder, and then vacuum and pressure are applied to force the preservatives into the wood. The preservatives help protect the wood from attack by termites, other insects, and fungal decay. The products are new, used and continued use.

There are various types of treated wood used.

Wood preservatives are registered pursuant to Federal Insecticide, Fungacide, and Rodenticide Act (FIFRA). It does not include lead based paint, fire retardants, or formaldehyde.

The three broad classes of preservatives typically used when pressure treating wood are: Waterborne, Creosote, and Oil-borne (penta).

Wood treated with waterborne preservatives is typically used in residential, commercial and industrial building structures. Creosote is primarily used for treating railroad ties, guardrail posts, and timbers used in marine structures. Oil-borne (penta) is most often used for treating utility poles and cross arms.

Several typical waterborne preservatives are used in building applications; mainly CCA in older applications. A number of alternative preservatives are available. These include Alkaline Copper Quat Type C (ACQ-C), Alkaline Copper Quat Type D, Carbonate formulation (ACQ-D Carbonate), CBA-A and Copper Azole Types A and B (CA-B), as well as Sodium Borate (SBX/DOT) and Zinc Borate preservatives.

CCA treated wood products are still produced for use in some industrial, highway, and agricultural applications. These uses will include poles, piles, guardrail posts, and wood used in saltwater marine exposures.

TWW has always been a hazardous waste but it does not fit into the normal hazardous waste scheme. It has limited treatment options and the household exemptions do not fit. AB 1353 provides alternative options for handling TWW instead of the full hazardous waste laws. AB 1353 limits recycling of treated wood and requires TWW must be land disposed in California. This option is authorized under Health and Safety codes:

- 25150.7, 25150.8-AB1353 (TWW)
- 25143.1.5-Utility exemption
- 25180 et seq.-DTSC authority/penalties
- 25404 et seq.-CUPA authority
- Labor Codes
- 6300 et seq. -Cal OSHA
- Code of Federal Regulations
- 40 CFR 261.4(b) (9)-CCA intended use exemption
- Scope and Applicability is covered under California Title 22 sections 67386.1 and 67386.2

Pre experimental process

The identification and characterization of TWW is very important for determining the proper disposal paths. There are many possible sources of TWW at LLNL. These sources come from D&D, landscaping, remodeling and abandoned wood stock, etc. To meet the requirements of the regulations, the wood must be sampled and analyzed to determine if metals are present. For normal sampling and analysis it is sometimes difficult to obtain a sample, and the analysis tends to be costly and time consuming. The sampling requires wood accessibility and the ability to obtain a representative amount. The analysis requires a complete metal suite including Total Threshold Limit Concentration (TTLC), Soluble Threshold Limit Concentration (STLC) and Toxicity Characteristics Leaching Procedure (TCLP) to determine if the wood is treated and to determine the waste type.

The introduction of the portable XRF technique affords a number of advantages, including a faster turnaround for the characterization and an accurate waste type determination. Using the XRF in situ for large projects with multiple wood sources allows for immediate characterization and segregation with large areas of candidate wood sources. In order to demonstrate the use of the XRF identification and characterization techniques, various wood types and sources were collected, sampled and analyzed by standard TTLC, STLC and TCLP analysis methods and the portable XRF method.

Experimental

Various wood types both potentially treated and untreated were sampled and analyzed to demonstrate the proposed identification technique described in this paper. Various wood types were analyzed by portable XRF, acid digestion (TTLC) and extraction (STLC, TCLP) techniques. See Table 1 for results and attached figures of the tested items.

Table 1
DATA RESULTS SUMMARY

Description	XRF Result (PPM)	TTLC Reg. Limit mg/kg	TTLC Result mg/kg	STLC Reg. Limit mg/L	STLC Result mg/L	TCLP Reg. Limit mg/L	TCLP Result mg/L	Reg. Characterization	Reg. codes
Blank	--	--	--	--	--	--	--	--	--
As	<1.3	**500**	0.49	**5.0**	< 0.05	**5.0**	<0.05	N/A	N/A
Cr	<17.6	**2500**	0.15	**5.0**	0.01	**5.0**	<0.01	N/A	N/A
Cu	<6.1	**2500**	1.00	**25**	1.80	**N/A**	<0.03	N/A	N/A
CCA-1	--	--	--	--	--	--	--	--	--
As	5.96 +/- 0.56	**500**	1.68	**5.0**	0.18	**5.0**	0.11	N/A	N/A
Cr	<17.6	**2500**	0.48	**5.0**	0.03	**5.0**	0.03	N/A	N/A
Cu	15,480 +/- 603	**2500**	***2250***	**25**	***321***	**N/A**	41	Cal.	**Cal. 352**
CCA-2	--	--	--	--	--	--	--	--	--
As	5338 +/-240	**500**	***5560***	**5.0**	***151***	**5.0**	***16***	***RCRA***	***D004***
Cr	5284 +/-197	**2500**	***6140***	**5.0**	***71.6***	**5.0**	3.0	Cal.	**Cal. 352**
Cu	4517 +/- 206	**2500**	***4080***	**25**	***284***	**N/A**	17.7	Cal.	**Cal. 352**
T-1541	--	--	--	--	--	--	--	--	--
As	5487 +/- 163	**500**	100	**5.0**	***44.7***	**5.0**	***11***	***RCRA***	***D004***
Cr	5749 +/- 314	**2500**	17.5	**5.0**	4.93	**5.0**	0.41	N/A	N/A
Cu	3837 +/- 200	**2500**	401	**25**	***145***	**N/A**	9.52	Cal.	**Cal. 352**
B-419	--	--	--	--	--	--	--	--	--
As	<1.3	**500**	0.39	**5.0**	<0.05	**5.0**	<0.05	N/A	N/A
Cr	<17.6	**2500**	0.32	**5.0**	0.03	**5.0**	<0.01	N/A	N/A
Cu	<6.1	**2500**	1.10	**25**	0.19	**N/A**	0.05	N/A	N/A
2X4	--	--	--	--	--	--	--	--	--
As	<1.3	**500**	0.54	**5.0**	<0.05	**5.0**	0.07	N/A	N/A
Cr	<17.6	**2500**	0.20	**5.0**	0.02	**5.0**	<0.01	N/A	N/A
Cu	10570 +/-1268	**2500**	***4270***	**25**	***386***	**N/A**	65.3	Cal.	**Cal. 352**

Description	XRF Result (PPM)	TTLC Reg. Limit mg/kg	TTLC Result mg/kg	STLC Reg. Limit mg/L	STLC Result mg/L	TCLP Reg. Limit mg/L	TCLP Result mg/L	Reg. Characterization	Reg. codes
Polyresin	--	**--**	--	**--**	--	**--**	--	--	--
As	<1.3	**500**	0.66	**5.0**	<0.05	**5.0**	<0.05	N/A	N/A
Cr	<17.6	**2500**	2.42	**5.0**	0.02	**5.0**	<0.01	N/A	N/A
Cu	<6.1	**2500**	1.90	**25**	0.27	**N/A**	<0.03	N/A	N/A
Zn*	9813+/-1256	**5000**	4900	**250**	201	**N/A**	28	Cal*	**Cal. 352**
Pallet support		**--**	--	**--**	--	**--**	--	--	--
As	<1.3	**500**	<0.49	**5.0**	<0.05	**5.0**	<0.05	N/A	N/A
Cr	<17.6	**2500**	<0.15	**5.0**	0.02	**5.0**	<0.01	N/A	N/A
Cu	19,870 +/-1025	**2500**	***7170***	**25**	***354***	**N/A**	38.9	Cal.	**Cal. 352**

* Although TTLC results for Zn are below hazardous waste limits, the analytical results are sufficiently close to the regulatory limit that prudence suggests that in this case managing the wood as hazardous waste is recommended.

Results/Discussion

The data in Table 1 lists XRF, TTLC, STLC, TCLP results and comparison regulatory limits.

Note: TTLC and STLC (California Title 22 regulations) have different drivers than TCLP (Federal regulations RCRA); the two sets of regulations have some different metals and codes. The TTLC chromium value of 2500 mg/kg (chromium and/or chromium III compounds) was used instead of the 500 mg/kg (chromium VI compounds), since over time the valance of the added chromium may change and affect the solubility.

The blank and B419 samples are not regulated. The wood samples CCA-1, the 2X4, the pallet supports and the polyresin are California regulated. The CCA-2 and T-1541 wood samples are Federal and California regulated. These samples (CCA-2 and T-1541) represent CCA pressure treated wood before CCA was removed from general residential and most commercial uses. The polyresin sample is treated (XRF data) but the wet chemical analysis results fell below the regulatory limits for As, Cu and Cr. The XRF scans detected zinc at elevated levels demonstrating that the wood treatment was not for CCA, but for a zinc substitute (zinc borate). The other results were examples of wood from the removal of arsenic and chromium from the pressure treated process and replaced by copper and zinc preservatives. This recent technique is exemplified by the CCA-1, the 2X4, the polyresin and the pallet support samples. These items identify the presence of California only regulated metals, copper and zinc.

The evaluation of analytical results shows there is significant variation between the results obtained from the TTLC, STLC and TCLP wet chemical analysis and the XRF results. The variation in concentrations of metals detected can range from a few ppm to orders of magnitude. These differences can be explained based on three observations:

Figure I and IX the 4X4 wood block show irregular depth saturation of the pressure treatment metal salts. Also Figure IV and X show the same lack of metal salt penetration.

1) The preparation of the samples for the wet chemical analysis requires the wood to be ground into small particles and mixed to obtain a uniform sample. This preparation evenly distributes the untreated wood at the center with the treated wood on the exterior of the sample.
2) The non destructive XRF technique uses an X-ray penetrating scan, but has limited depth due to the Kev strength of the X-ray. The X-ray only penetrates the treated surface of the samples and does not reach the untreated portions at the center of the sample.
3) Therefore, the mixed sample preparation for wet analysis provides a more accurate representative sample of the whole wood, whereas the XRF only represents the surface and near surface content of the wood sample. This is of course dependant on the type of weathering and the type of salt deposition used and the shape and type of the wood.

Figure III, the thinner plywood sample CCA-2, has the best correlation between the wet chemical analysis and XRF due to its depth and shape where the pressurized penetration will be more uniformly saturated. The cross section cutting will generate a better sample, since the shallow depth and shape will allow for a more uniform deposition and the green color indicates minimum weather exposure.

Considering all of the data and the facts presented, the XRF is considered the best overall approach for a quick and accurate result and subsequent characterization of the wood items. The results and characterization will at times be conservative but more applicable, since a large XRF reading of 3,000-10,000 ppm is indicative of pressurized treatment. In all cases the XRF will give reliable results and accurate subsequent characterization with reasonable standard deviations of 5-10% for multiple scans.

Summary comments

The comparison of the results from the XRF and the wet chemical analysis methods, reveals the characterization of samples as regulated treated wood matches very well, other than the T-1541 sample which had inconsistent saturation of preservative. When the XRF showed metal salt content in the thousands of parts per million, the wet chemical analysis method failed the regulatory limit for the specific limit. The wet chemical analysis value for chromium in the CCA-2 sample was also lower than the regulatory limit even though the salt value by XRF was high. These results highlight the value of using the XRF method for checking possible TWW, since the wet analysis method may tend to misidentify. Therefore, when performing actual in-situ field evaluations, the XRF scans will indicate large metal concentrations (1000s of mg/kg) for metal treated wood. The XRF technique transforms the field evaluation into a rapid ‘yes’ or ‘no’ determination for identifying metal TWW. Therefore, when the XRF results are high and the wet chemical results are low, even passing the digestion and extraction regulatory limits the samples should be considered regulated. The low chemical results may be a diluted value, but does not remove the fact that the wood has undergone metal salt pressure treatment and should be considered TWW.

Figures

The Figures I thru VIII show the different wood types investigated. The descriptions and sources are as follows:

Figure I –	Reference blank from commercial lumber sources, assume no treatment chemicals present.
Figure II –	Pressurized lumber from known LLNL source with generator knowledge that the wood is pressurized CCA chemicals are present.
Figure III –	Pressurized lumber from an offsite lumber yard, that provides lumber for specific acceptable commercial uses such as railroad, saltwater marine structures, etc.
Figure IV –	Potential sample from an LLNL D&D site, T1541.
Figure V –	Potential samples from another LLNL D&D site, B419.
Figure VI –	Commercial lumber source from stock.
Figure VII –	Commercial lumber polyresin type to demonstrate possible alternative CCA treatment.
Figure VIII –	Commercial lumber source support pieces in between pallet and stock lumber, uncertain chemical content.
Figure IX –	Same as Figures II and IV showing uneven distribution of colors (chemical salt content) also the staple impressions demonstrate the pressurized treatment.
Figure X –	Same as Figure IV T1514 closer picture showing the uneven treatment saturation and the typical staple markings.

Photo figures showing the types of sampled and analyzed wood

Figure I
Reference blank from commercial source

Figure II
Pressurized lumber-Cu/Cr/As from LLNL source

Figure III
Pressurized lumber-Cu/Cr/As from commercial source

Figure IV
D&D lumber

Figure V
Lumber from building D&D

Figure VI
From commercial source

Figure VII
Poly resin from commercial source

Figure VIII
Pallet support from commercial source

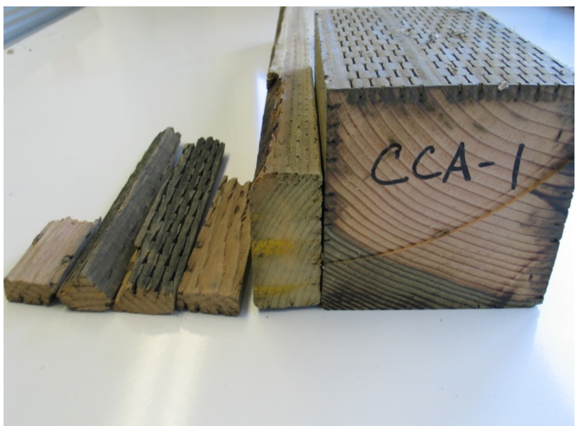

Figure IX
Visual comparison of treated wood from two different sources

Figure X
From T1541