

Leaching of Copper, Chromium and Arsenic from CCA Treated Wood in Sanitary Landfill Leachate

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Objective

The objective of the research presented here is to assess the potential leaching of discarded chromated copper arsenate- (CCA-) treated wood products in MSW landfills.

Materials and Methods

Sample Collection

- The un-weathered samples were created by purchasing southern yellow pine dimensional lumber from a retail outlet and sending coupons of this wood to different treatment facilities for wood preservation (CCA and CCA-R).
- Weathered samples of CCA treated wood were collected from a variety of demolition sites and waste disposal facilities. Detail of sample collection is presented in Table 1.

Sample Preparation

All samples were processed to meet the TCLP requirement of having a particle size no larger than 0.95 cm at its narrowest dimension. The weathered samples were size reduced using a power drill with 8.7 mm drill bit to drill through the cross section of the wood. The drill cuttings were collected in plastic bags for later analyses. Each of the eight weathered CCA-treated wood samples used in this study represented composite cutting samples from seven individual CCA treated boards.

Landfill Leachate Collection

Leachate samples were collected from six MSW landfills in Florida. The landfill details are described in Table 2. The landfills are designated as sites A through F. Leachate samples were collected from the sump of the landfill leachate collection system. It was bailed using a Teflon bailer at all sites except at sites B and E where they were collected using the existing pumping system installed at the landfill. The leachate samples were collected in HDPE containers, transported to the laboratory and stored at 4°C until further analyses.

Introduction

Pressure treated wood products contain heavy metals to prevent biological decay. Scrap treated wood from construction activities and demolished treated wood structures are typically disposed in landfills. To examine the potential mobility of metals from pressure treated wood disposed in landfills, wood samples were leached using leachate from lined landfills and the concentrations of arsenic, chromium and copper were measured. Both un-weathered and weathered chromated copper arsenate- (CCA-) treated wood sample were evaluated. Results were compared to leaching measured using the toxicity characteristic leaching procedure (TCLP) and the synthetic precipitation leaching procedure (SPLP).

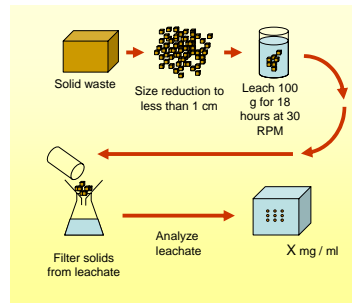
Table 1: Sample details

Sample	Sample description	Estimated age (yr)	Standard retention
Un-weathered CCA			
CCA	Southern yellow pine	2.0	0.243
CCA-R	Southern yellow pine	2.0	0.284
Weathered CCA			
CCA-1	Steps and walkway to temporary buildings.	1.5	0.300
CCA-2	Dimensional lumber & piles from demolished Playground	10.0	0.256
CCA-3	Blocks collected from a demolition site along the I-10 Highway.	-1	0.213
CCA-4	Dimensional lumber from the demolished fence of a residence	-1	0.204
CCA-5	Dimensional lumber from a demolished deck	20.0	0.476
CCA-6	Dimensional lumber from the demolished Fence of a church	10.0	0.255
CCA-7	Dimensional poles from a demolished structure in a park, Sample 1	10.0	0.263
CCA-8	Dimensional poles from a demolished structure in a park, Sample 2	10.0	0.297
UN	Southern yellow pine	2.0	0.009
-1 age is not available			

Table 2: Leachate sampling site details

Landfill site	Metric tons (per day)	Operation status of the landfill	Acres of lined cell collected for
Site A	600	Closed	125
Site B	750	Both active and capped cells	104
Site C	1200	Active	34
Site D	550	Active	20
Site E	366	Closed	27
Site F	800	Both active and capped cells	12

Figure 1: Laboratory leaching procedure



Laboratory Leaching Procedures

Eight leaching fluids were utilized in this study. Six out of the eight leaching fluids were prepared from landfill leachates collected from the landfills in Florida. The other two leaching protocols used were TCLP and the SPLP. The TCLP test is a standardized method used to determine if a solid waste is a TC hazardous waste. The SPLP test is used to predict leaching under conditions where rainfall is expected to be the prime leachant; it has been used to estimate the leaching that might occur in an inert landfill like a construction and demolition (C&D) debris landfill.

Results

Landfill leachate characterization

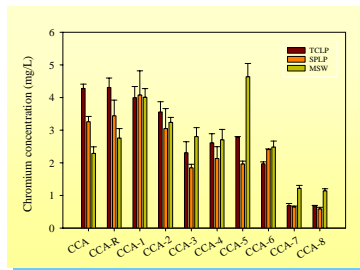
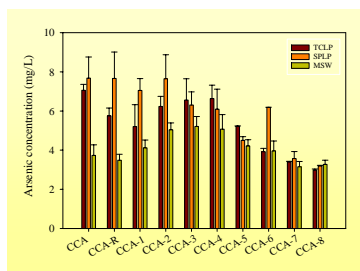
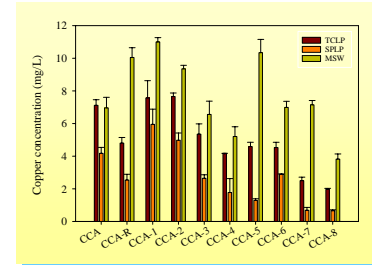
Table 3 summarizes the analyzed parameters and the chemical characteristics of the leachates in the six landfills. The pH of the leachates ranged from 6.5 to 8.2. These pH values are typical of other Florida landfills. Conductivity readings correlated with the TDS value as expected.

Table 3: Characterization of landfill leachates

Parameters	Site A	Site B	Site C	Site D	Site E	Site F
pH	6.53	8.10	8.22	7.92	7.97	7.89
Conductivity (mS/cm)	4.62	20.1	3.84	13.3	19.4	12.3
TDS	2620	9610	1960	5540	7960	5880
Alkalinity (mg/L as CaCO₃)	1250	6850	1550	5300	8050	4350
COD (mg/L)	792	9570	1260	2150	3080	2530
Anions & cations (mg/L)						
Sulfide	<0.008	31.65	0.072	0.132	0.225	7.75
Chloride	296	2150	1502	402	1950	1270
Sulfate	7.91	33.0	11.0	2.42	17.6	141.2
Ammonia	20.6	1490	125	833	2630	1160
Calcium	275	177	174	67	44.1	128
Potassium	24	813	123	604	746	356
Sodium	532	1920	367	1395	1990	1550
Organic acids (mg/L)						
Acetate	35.0	582	273	13.5	40	366
Propionate	22.60	176	32	11.3	19	13
Isobutyrate	74.0	172	129	101	100	126
Butyrate	<1.0	82	29	1.8	23	7.5
Isovalerate	<1.0	159	56	0.4	13.3	59
Valerate	<1.0	52	36	0.26	3.0	<1.0
Metals (mg/L)						
Arsenic	<0.005	0.16	<0.005	0.07	0.06	0.03
Copper	<0.01	<0.01	<0.01	0.16	0.56	<0.01
Chromium	<0.05	0.25	<0.05	<0.05	0.10	0.06

Leaching of arsenic, copper and chromium

- The mean As concentration in the un-weathered CCA treated wood leachate was 7.41 mg/L for TCLP and 7.17 mg/L for SPLP. The weathered wood leachates had As concentration in the range of 3.0 to 6.6 mg/L for TCLP and 3.2 to 7.6 mg/L for SPLP. The As concentration in the extract using the landfill leachate was in the range of 1.49 to 5.91 mg/L for un-weathered samples and 1.97 to 6.57 mg/L for weathered treated wood samples.
- In general the As and Cr concentrations leached using the landfill leachate samples varied somewhat among the sites, but tended to be similar or somewhat lower than the TCLP and SPLP concentrations.
- Copper leaching was greatest when extracted with the landfill leachate.



Conclusions

The un-weathered CCA-treated wood, and five out of eight weathered CCA-treated wood samples exceeded the TCLP limit for arsenic. If CCA-treated wood was not otherwise exempt from classification as a hazardous waste, the discarded CCA-treated wood would frequently require management as a hazardous waste. Some CCA-treated wood is disposed in lined landfills. If all the CCA-treated wood are disposed in lined landfills, the potential increased concentration of arsenic in the leachate may exist. While this option for CCA-treated wood disposal is preferred option over disposal in an unlined landfill, increased arsenic concentrations in the leachate may occur leading to increase cost of disposal.

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