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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC 20460

OFFICE OF PREVENTION, PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM:

Subject: Review of the effects of post treatment processing on leaching of metals from wood following chromated copper arsenate (CCA) or acid copper chrome (ACC) treatment.

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Data Submitter:
Forest Products Research Laboratory, LLC

Chemical Names:
Chromic Acid and Cuprous Oxide

CAS #: 7738-94-5 and 1317-39-1
EPA File Symbol: 75832-R
DP #: 306150
PC Code: 021101 and 025601
Decision #: 329914
MRID No.: 462823-01

Background:

Chromated copper arsenate (CCA) has a history of being used as a wood preservative in lumber for residential uses, and was extremely useful because of its strong fixation to the wood surface. However, Forest Products Research Laboratory, LLC (FPRL) has submitted an application for registration of ACC 50, 75832-R, as an alternative to CCA. As part of this application, to meet the requirement of an aquatic leaching study, FPRL has submitted MRID 462823-01. This review analyzes this study and compares two methods which can be employed for determining the leaching behavior of wood preservatives. [1]

Documentation Provided:

1. Study titled: Effects of post treatment processing on leaching of metals from wood following chromated copper arsenate or acid copper chrome treatment, conducted by J.J. Morrell and Camille Freitag (MRID #462823-01).
2. EXX-03, Standard Method for Determining Preservative Fixation of Waterborne Wood Preservatives.
3. E11-97, American Wood-Preservers' Association, Standard Method of Determining the Leachability of Wood Preservatives.

Discussion:

- In comparing the method employed in the study with the AWPA EXX-03 and E11-97 guidelines, the following table has been derived to display the similarities and differences between the three. The study employs conical cores, not blocks, and for this reason, it is only compared to the EXX-03 method and not E11-97 in the Detailed Considerations. However, EXX-03 and E11-97 are compared to each other.
- It is important to differentiate that in EXX-03 and MRID No. 462823-01, there are parent boards, subsections, and then cores drawn from the subsections. In E11-97, there are parent boards and subsections. The subsections (blocks) in E11-97 are parallel with the cores in the other two methods because they are from which retention times are calculated.

ITEM	Method EXX-03	Study Method 462823-01	Method E11-97
Title	*Standard Method for Determining Preservative Fixation of Waterborne Wood Preservatives*	*Effects of post treatment processing on the leaching of metals from wood following chromated copper arsenate or acid copper chrome treatment*	*Standard Method of Determining the Leachability of Wood Preservatives*
Purpose	To determine the time required for fixation of reactive waterborne preservatives at given temperatures.	To determine the leaching behaviors of CCA and ACC. Data is obtained from the cores removed from treated wood and then stored under varying post-treatment	To determine the leachability as a percentage of the original preservative, and is designed for waterborne

[1] According to Mr. Dennis Morgan, FPRL representative, AWPA EXX-03 will replace AWPA E11-97. However in order to determine the similarities and differences between these two methods, RASSB has performed a comparison of these two methods.

		conditions.	preservatives. Leach rate can be determined if analysis is conducted on individual samples rather than a composite sample so a graph can be constructed to show %component leached over time.
Type of Wood	Any species of interest containing sufficient sapwood, preferably greater than 10mm (0.4 inches).[2]	Southern Pine and Hem-fir lumber, no sapwood indication (Kiln dried heartwood).	Southern Pine sapwood
Parent wood conditioning/ storage pre-treatment	None specified.	None specified.	Wood should be stored in room (23°C and 50 % relative humidity, equivalent to a moisture content of 9-10%).
Size of Parent Wood	2" x 6" x 12' (2" x 6" x 3.66m)[3]	2" x 4" x 16'	25mm boards (prefer newly cut boards that are immediately kiln dried without anti-stain treatment).
Size of Subsections	2" x 6" x 4'(2" x 6" x 1.22m)[2]	2" x 4" x 4'	19mm cubes (6.9mL volume, determined by caliper)
Characteristic of Parent Wood	Free of resin, mold, and fungi.	No indication of characteristics considered.	Free of resin, mold and fungi. Wood needs to exhibit 2.5-4 rings per 10mm and contain 40-50% summerwood. Quartersewn is preferable to flat sewn.
Treatment apparatus	Vacuum/pressure equipment. Full and modified treatment cycles may be used.	Pressure treatment via full cell process to target specific retentions.	A suitable desiccator or bell jar shielded to protect personnel in the event of breakage, a treatment beaker, suitable separatory funnel or auxiliary flask (for holding the solution), and a vacuum gauge or manometer. Alternate equipment such as a vacuum/pressure vessel may be used.
Leaching vessel	15mL centrifuge tube	125mL polypropylene bottles with caps	500mL Erlenmeyer flask with a ground glass stopper, magnetic stir bar, and plastic mesh to separate

[2] (inch/25.4mm) x (10mm)
[3] (x ft) x (m/3.28048ft)

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			specimen from stir bar.
Conditions of treating the samples	Pre-treatment, the three 12' boards are cut into 4' subsections (A, B, C). Each of the sections are treated using different retentions.[4] Post-treatment, each section is cut into 16" samples.	Pre-treatment, the 16' boards were cut into 4' subsections (1A, 1B, 1C, 1D), which were segregated into 12 groups of 10. The four samples from each original board (1A, 1B, 1C, 1D) are treated in the same charge then allocated to one of the four treatment conditions.	Pre treatment, the boards are cut into the 19mm blocks. For each of the three retention levels, at least 9, preferably 12, blocks from a single weight range group are to be assigned to each retention level.[5]
Conditions of Storage of wood boards post-treatment	One 16" portion will be selected from each section (A, B, C) and each group of portions will be conditioned at different temperatures (4° 22°, and 50°C). Humidity controlled chambers or wrapping samples in plastic film can be used to retain the moisture in the wood. The moisture content in the sapwood shall be less than 20%.	Four scenarios of post-treatment storage were employed. The set of boards that were steamed (90°C), were stored and piled in a room at 20°-23°C, two other sets of non-steamed were either open or wrapped in plastic at room temperature, and the last set was stored at 5°C.	Not specified, references to follow preservative supplier's recommendations which may include exposing the blocks to elevated temperatures with limited drying or other specifications.
Conditions of Sampling	Immediately after treatment, if drying is not involved in fixation, 12 borings (0.2" W x 0.4" L)[6] will be obtained from each 16" sample and stored in tight plastic bags. The corer shall be rinsed between borings. These bags will be secured in vessels containing liquid water under various temperatures (4° 22°, and 50°C).	Cores (0.5cm W x 1cm L (0.2" W x 0.4)[7]) were removed from the 38mm (2")[8] side of the board for all treatments 0 (immediately), 6, 12, 24, 48, 72, 96, 120, 144, and 408 (from those piled without wrapping) hours after treatment. In addition, cores were extracted 1872 hours after treatment from the boards in the cold-stored, 5°C. The corer was not rinsed between borings.	After following specifications for storage post-treatment, the blocks[9] are placed in the room with temperatures of 23°C and 50 % relative humidity, equivalent to a moisture content of 9-10% for 21 days. The blocks are the actual sample.
Fixation and drying of the samples	Option 1: The samples are to be wrapped to prevent drying. Option 2: The borings are placed in air-tight plastic bags and secured in vessels containing liquid water (e.g. desiccators or wide mouth jars) to prevent drying.	There is only one methodology employed in which 30 of the 4' sections were piled and not wrapped post-steaming, 60 were either left opened or wrapped (these 90 boards were exposed to room temperature), and the last 30 were stored at 5°C with no wrapping indication.	This is the same as the information provided in "Conditions of Storage of wood boards post-treatment," because the blocks are the actual sample.

[4] The three retention levels should be levels intended for commercial use (e.g. UC3B, UC4A, and UC4B).
[5] Retention levels are to be 0.5x, 1x, and 2x the retention specified or estimated for service..
[6] In accordance with AWPA Standard M2-01, Section 4.2.
[7] (inch/2.54cm) x (x cm) = x inches
[8] (inch/25.4mm) x (x mm) = x inches
[9] Blocks are actual sample, so there is no extraction of cores.

	Option 3: If drying is involved in the procedure for preservative fixation, the sample boards shall be maintained open to the atmosphere, and additional borings shall be removed at each sampling interval used to determine moisture content. Additional trials may be needed to determine the effect of rate of drying on fixation.[10]		
Sampling intervals (retention/ temperature specific)[11]	50° borings should be tested frequently, 22° borings are recommended to be sampled on day 1, 3, 7, 14, 21, and 28, and 4° borings tested weekly, even monthly.	All the samples were tested at the same intervals; just the 408 hr and 1872 hr (~3mo.) interval are condition specific.	After 21 days, six blocks with the most uniform retention level[12] are chosen to be sampled. Sampling is done at 6, 24, and 48 hours. After that, sampling is done at 48 hour intervals for 14 days.
Process for leaching	Sampling is done by either static or sonication methods. Static: Borings are leached for 4 hours in 10mL of distilled water, contained in a 15mL centrifuge tube. To prevent flotation of borings, it may be necessary to vacuum treat the borings with water prior to extraction. Sonication: Borings may be leached by sonication for 15 minutes. To verify sufficient power in the ultrasonic bath, sonication leach results shall be compared to the standard 4-hour leach for a minimum of three samples.	The borings were placed in 100mL of distilled water, and removed after 4 hours.	The borings were placed in deionized water in a 500 mL Erlenmeyer flask but the amount of water is not specified. The leachate water is refreshed after every sampling interval.
Temperature of the leach water	Not specified	Not specified.	Not specified.
Analysis of the	Remove the boring from the	ICP for detection of Cu and	Use an appropriate

[10] There is no proposed procedure for this rate effect determination.
[11] Variation seen in sampling interval because the rate of fixation is dependent on retention and temperature.
[12] This retention is calculated with an equation provided in the protocol that is applicable through taking the mass and volumes per instruction.

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leachate sample	solution and acidify the leachate solution to <2 with nitric acid. Then analysis should be carried out by either atomic absorption or inductively coupled with plasma spectroscopy techniques, such as AWPA Standard A11-93 or A21-00.	Cr. Additional testing was carried out to estimate the levels of hexavalent chromium in the leachate by using a modification of Method 3500.[13]	method of analysis, and if AWPA standard methods are not appropriate due to the low concentrations involved, use generally accepted analytical methods and provide a description.
Analysis of the wood boring	The boring shall be digested in concentrated nitric acid (typically, 15mL 70% nitric acid) and analyzed using either AWPA Standard A11-93 or A21-00.	There was no analysis carried out.	Analyze as a composite, the six leached and the three unleached blocks for each preservative component. Method not specified.
Calculation criteria	Preservative retention shall be calculated from the leachate and boring analyses. Also, the three "normalized" leachate values shall be averaged per retention, temperature, and time. These average-normalized values shall be plotted (y) vs. time of fixation (x). The time required for preservative fixation shall be determined where the leachate values "level-off." If there is a need to predict fixation times vs. temperature, the data that is generated in this method can be used to predict such if the temperature (x) is plotted vs. time required for fixation (y) for the three retentions. In using the best-fit curve techniques, equations can be generated to produce the time required for fixation at as specific retention.	Plots were generated to display the levels of Cu and Cr under the varying conditions. The specific endpoint (where leachate levels off on graph) for fixation was established at 2ppm.	The ultimate calculation is to report the total quantity of each preservative component present in the leachate. Report it as a percentage of the combined total component present in both the leachate and the assayed leached blocks. This is to be supplemented with a graph showing the percentage of preservative component leached over time. Also a report of the mass balance for each preservative component in each retention group is recommended to estimate the accuracy of the analytical results.

Detailed Considerations:

Comparison of EX-003 and E11-97[14]

It appears that Method E11-97 is designed such to be more flexible in which it allows for a better representation of the actual scenario of wood treatment. It suggests use of the preservative

[13] Registrant provides a detail of the preparation of the sample for this analysis as well as method of conclusion.
[14] See footnote 1

supplier's recommendations for deciding on temperatures to be used during conditioning of the wood. There is no variation in the wood that is used in this methodology, only Southern Pine is employed. The variables examined in this protocol are the leaching behavior at three different retentions (0.5x, 1x, and 2x, where 'x' is the retention specified or estimated for service) at specific temperatures. The primary calculation is based on the amount of preservative leached expressed as a ratio to the total preservative present. Due to the species of wood being held constant, employment of this methodology allows for a keen awareness of the relationship between environmental conditions (retention rates and temperature) and the quantity (specified calculation is the % leached) of leaching.

In the protocol, EXX-03, wood species of interest are treated at three different retention rates and analyzed. However, these retentions are intended for commercial use and are not chosen from those specific for service (e.g. UC3B, UC4A and UC4B). The purpose of Method EXX-03 is to collect data in order to determine the time required for fixation by observing the leaching behavior of the different constituents of the preservative. The comparison is made between leachate collected from the wood treated at different retention rates and stored at various temperatures. This addresses more specifically, the rate or time required for fixation. While there appears to be more varying factors in EXX-03, both protocols serve the same purpose of addressing the different leaching behavior of the preservative constituents.

The other significant difference between the two protocols is in reference to the testing material as well as the frequency of collecting leaching data.

- In Method EXX-03, leaching tests are conducted using borings (5 mm diameter and 10 mm length) cut from treated wood samples (2" x 6" x 1.22m). In Method E11-97, leaching tests are conducted using whole treated wood blocks (19 mm cubes).
- Method EXX-03 presents that the borings of different temperature groups are sampled at different frequencies such that 50°C borings should be tested frequently, 22°C borings are recommended to be sampled on day 1, 3, 7, 14, 21, and 28, and 4°C borings tested weekly, even monthly. The time required for preservative fixation is then determined when the leachate values "level-off" and remain unchanged. However, in Method E11-97, the collection of leachate is typically stopped after 14 days, not at a "level-off" value.

Comparison of MRID No. 462823-01 with EX-003: while this study did not cite every aspect of the EX-003 protocol, it is most parallel with this protocol, and that is why the comparisons were established between the two.

- It is important for the registrant to indicate the parent characteristics of the wood in MRID No. 462823-01 because resin, mold, and fungi can impact the data generated.
- The corer was not rinsed between borings. This is of some concern because there is no verification that the coring device didn't react with the Cr in the wood.
- It is not clear as to how many boards of each species were used, Southern-Pine and Hem-fir, and which ones were exposed to what conditions (temperatures and wrapping) for storage post-treatment. It is important to indicate this information because wood type can influence the rates of fixation. Only an assumption based on logic can be made about the

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distribution of the wood species, which is anticipated as follows considering the statement made by the registrant in that there were 12 groups of 10 (120 boards).

> 15 parent hem-fir and 15 parent pine
> 60 subsections hem-fir (hf) and 60 subsections pine (p) formed (4' each)
> 15/60 hf and 15/60 p exposed to steam, 30/60 hf and 30/60 p exposed to room temperature, and the remaining 15/60 hf and 15/60 p exposed to 5°C.

- There is uncertainty with respect to the leaching procedure, as to whether or not the water was changed after every single leachate level reading (even though based on the available data, it does appear that the water was changed). The reasons are as follows:
  - There were a large number of cores (120 cores are assumed to be generated after all of the core extractions from every treatment group: 30 from the 20°-23°C, 60 from the room temperature, and 30 from the 5°C). This is something that can impact the second concern if there is a large quantity of cores present in the 100mL.
  - There is not enough information available with respect to the properties of CCA and ACC in water. The reason for this concern is if there is pre-existing CCA or ACC present in the leachate being tested (due to accumulation over time as a result of not changing the water), there is question as to whether or not this saturation with the chemical, will impact the leaching rate. This could influence the data significantly in terms of validity, and result in potential underestimation of how much of the chemical is actually leaching off.

- There was no analysis of the wood borings that were extracted. An analysis of the cores would be helpful in supplementing the conclusions as to how much of a chemical was leached off. Both AWPA protocols employ a core/wood block analysis, such that it is recommended that it be practiced in this study as well.

Other comments with respect to MRID No. 462823-01

This study was designed to observe the effects of post treatment processing on leaching of metals from wood. There is a comparison between the fixation of chemicals in CCA and ACC treated wood. In the study, resulting leachate from the treated wood were analyzed for copper (Cu), total chromium (Cr), and hexavalent chromium (Cr^{+6}). The Cu and Cr analysis were conducted using ion coupled plasma (ICP) spectroscopy and the Cr^{+6} analyses were conducted using a modification of Method 3500, which is a colorimetric method. Arsenic was tested for in CCA, but no methodology was provided. This is not extremely critical because the presence of As was not at the heart of the study.

Only limited information on the analytical methods used in the study were provided. The study did not provide copies of the analytical method protocols or information such as representative chromatograms, method validation data, laboratory fortification data, and sensitivity. Therefore, it is difficult to analyze the validity of the methods used. The study cites that the proposed

AWPA Standard EXX-03 was followed at different instants such as for the decision of time intervals for sampling. However, Method EXX-03 was not consistently employed throughout MRID No. 462823-01.

The half lives for the chemicals were able to be calculated in assuming exponential decay and applying a regression analysis. However, it is observed that the half life of the same chemical varies between retention rates and wood types. It is difficult to distinguish what factor to attribute to this variation, whether it is retention rates, wood types, or both factors combined. The Tables 2 (a-d) depicts the half lives for each treatment group.

Table 2a: wood samples steamed, open, and stored at 20-23^{0}C

Treatment Group	Half Life (hr) Cr	Half Life (hr) Cu	Half Life (hr) Cr^{+6}	Half Life (hr) As
CCA: Hemlock Fir - 0.46pcf	32	341	32	---
CCA: Pine - 0.52pcf	42	558	40	---
ACC: Hemlock Fir - 0.63pcf	49	50	38	---
ACC Hemlock Fir - 0.52pcf	56	60	44	---
ACC: Pine - 0.61pcf	53	58	43	---
ACC: Pine- 0.31pcf	66	76	53	---

Table 2b: wood samples non-steamed, open, and stored at 20-23^{0}C

Treatment Group	Half Life (hr) Cr	Half Life (hr) Cu	Half Life (hr) Cr^{+6}	Half Life (hr) As
CCA: Hemlock Fir - 0.46pcf	37	35	54	---
CCA: Pine - 0.52pcf	65	89	37	---
ACC: Hemlock Fir - 0.63pcf	81	64	73	---
ACC Hemlock Fir - 0.52pcf	81	75	79	---
ACC: Pine - 0.61pcf	78	76	69	---
ACC: Pine- 0.31pcf	70	95	75	---

Table 2c: wood samples non-steamed, wrapped, stored at 20-23^{0}C

Treatment Group	Half Life (hr) Cr	Half Life (hr) Cu	Half Life (hr) Cr^{+6}	Half Life (hr) As
CCA: Hemlock Fir - 0.46pcf	34	40	28	---
CCA: Pine - 0.52pcf	30	55	17	---
ACC: Hemlock Fir - 0.63pcf	42	36	35	---

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ACC Hemlock Fir - 0.52pcf	41	46	40	---
ACC: Pine - 0.61pcf	47	60	34	---
ACC: Pine- 0.31pcf	43	60	34	---

Table 2d: wood samples non-steamed, open, and stored at 5^0C

Treatment Group	Half Life (hr) Cr	Half Life (hr) Cu	Half Life (hr) Cr^{+6}	Half Life (hr) As
CCA: Hemlock Fir - 0.46pcf	360	281	354	394
CCA: Pine - 0.52pcf	496	374	500	256
ACC: Hemlock Fir - 0.63pcf	449	280	427	---
ACC Hemlock Fir - 0.52pcf	412	308	423	---
ACC: Pine - 0.61pcf	511	373	463	---
ACC: Pine- 0.31pcf	585	519	510	---

For all of the chemicals addressed in the above tables, the colder storage conditions of 5°C appear to extend the half life of the element, individual of the wood species and retention (Table 2d). It appears that the half-lives of elemental chromium and hexavalent chromium are generally consistent, but have minor fluctuation attributable to different retention rates and wood types. As for elemental Cu, the process of steaming increases the half-life significantly when originating from wood treated with CCA. However, for the wood treated with ACC, Cu exhibits a more consistent half life, regardless of whether or not it was from a steamed or non-steamed batch.

Aside from the half-life discussion, quantities of the constituents of the leachate were analyzed. Data was collected at specific time intervals such that comparisons could be made as to whether or not steaming, temperature changes, and wrapping impact the rate of leaching. While it initially appears that ACC leaches higher amounts of Cr for a longer period of time than CCA (regardless of wood type), there are no data supporting that wood type doesn't affect the leaching data that was provided. It appears from the data provided in Table 2 of MRID No. 462823-01 that the wood species does have an effect on the leaching behavior. This data table has been reproduced as Table 3, so that the highlighted numbers of concern can be noted.

Table 3: Reproduced data table from Table 2 of MRID No. 462823-01

Time required for Cr levels in leachate solutions from hem-fir and southern pine lumber treated with CCA to 0.50 pcf and ACC to 0.31-0.52 or 0.60 pcf to reach <2ppm.						
Chemical	Average Retention (pcf)	Wood Species	Time Required for <2ppm Cr in Leachate (hr)			
			Wrapped, non-steamed[15], 20°C	Unwrapped, non-steamed[16], 20°C	Steamed, unwrapped[17]	Cold, unwrapped[18], 5°C
CCA	0.46	Hem-fir	72[a]	72[a]	0	600[c]
ACC	0.52		96	96	72	1070
ACC	0.63		120[b]	240[b]	48	>1872
CCA	0.52	S. Pine	48[a]	96[a]	0	1070[c]
ACC	0.31		120	240	120	>1872
ACC	0.61		240[b]	240[b]	96	>1872

In observing the behavior of CCA from specific batches, 0.46pcf batch compared with 0.52pcf (noted with superscript "a"), it can be concluded that there is a difference in the behavior of CCA between the wood species (compare hem-fir to s. pine in wrapped, non-steam, and compare hem-fir to s. pine in unwrapped, non-steamed). This is also the same case with ACC treated wood at retention rate of 0.63pcf and 0.61pcf (noted with superscript "b").

With respect to exposure to colder storage temperatures, the behavior of CCA further supports that the material of the board used does affect the time determined to reach <2ppm (noted by superscript "c"). As for the ACC treated wood, the leachate from the samples of the S. Pine boards treated at both high and low retention exhibited amounts of Cr significantly higher than 2ppm (0.61pcf = 4.19ppm and 0.31pcf = 2.9ppm), supporting that colder temperatures hinder the rate of chemical fixation.

The data tables that the registrant provides depict the actual amount of chemicals in the leachate, in which there are some observed trends. Appendix 1 includes the raw data with respect to the leachate measurements. The registrant does not provide any calculations with respect to the rate of leaching. However, because of the uncertainty as to whether or not the board type can affect the leaching data, the scope of the analysis is limited to a comparison between the data categories indicated.

[15] Added for condition clarification
[16] Added for condition clarification
[17] Added for condition clarification
[18] Added for condition clarification

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1. ACC treated southern pine at the two different retention rates of 0.61pcf and 0.31pcf.

2. A rough comparison is also made between the leaching behaviors of the CCA treated hem-fir @ 0.46pcf and the ACC treated hem-fir @ 0.52pcf (not the CCA treated pine and ACC treated pine because the retention rates were quite different). However, it is important to recognize that there is a difference of 0.06pcf between the retentions of these two chemicals such that the quantity of the leachate for the CCA vs. ACC at the same time interval can not be compared for the leaching rate analysis. It would have been more useful to compare the ACC 0.52pcf with the CCA 0.52pcf, but the ACC wood was hem-fir while the CCA wood was pine.

1. **Table 4: Condensed data obtained from raw data for this specific analysis of ACC treated southern pine.**

	Sampling interval (hr)						
Wood type, retention rate, (Chemical)	0	6	12	24	48	72	96
	Steamed, unwrapped, stored at room temperature						
ACC: Pine - 0.61pcf (Cr)	19.9	8.5	17.4	14.6	5.37	3.52	2.37
ACC: Pine - 0.31pcf (Cr)	12	9.61	11.7	9.29	4.38	5.12	2.66
	Non-Steamed, unwrapped, stored at room temperature						
ACC: Pine - 0.61pcf (Cr)	46.6	43.7	35	32.6	23	13.5	9.4
ACC: Pine - 0.31pcf (Cr)	30.5	NA	26.6	22.5	14.7	11.6	8.35
	Non-Steamed, wrapped, stored at room temperature						
ACC: Pine - 0.61pcf (Cr)	57	53.5	33.7	32.9	17.8	14.6	8.88
ACC: Pine - 0.31pcf (Cr)	28.2	NA	24.2	19.5	12.4	8.16	4.42
	Non-Steamed, unwrapped, stored at 5 degrees Celsius						
ACC: Pine - 0.61pcf (Cr)	56	52.9	55.8	46	36.5	40.1	45.9
ACC: Pine - 0.31pcf (Cr)	32	NA	33.1	28.9	19.2	23.5	28.3
	Steamed, unwrapped, stored at room temperature						
ACC: Pine - 0.61pcf (Cu)	7.4	2.8	6	4.1	1.3	0.9	0.6
ACC: Pine - 0.31pcf (Cu)	3.2	2.1	2.4	1.7	0.8	0.8	0.6
	Non-Steamed, unwrapped, stored at room temperature						
ACC: Pine - 0.61pcf (Cu)	18.9	16.3	12.8	10.7	6.2	2.6	1.7
ACC: Pine - 0.31pcf (Cu)	7.6	NA	5.3	4.2	2.4	1.2	1
	Non-Steamed, wrapped, stored at room temperature						
ACC: Pine - 0.61pcf (Cu)	22.1	19.7	11.1	10.6	5.2	3.2	1.9
ACC: Pine - 0.31pcf (Cu)	6.8	NA	4.5	3.4	2	1.1	0.7
	Non-Steamed, unwrapped, stored at 5 degrees Celsius						
ACC: Pine - 0.61pcf (Cu)	23.4	20.5	20.7	17.7	14	14.7	16.3
ACC: Pine - 0.31pcf (Cu)	8.7	NA	7.4	6.5	5	4.6	5.7
	Steamed, unwrapped, stored at room temperature						
ACC: Pine - 0.61pcf (Cr+6)	24.3	10.8	21.3	13.9	6.6	3.6	2.2
ACC: Pine - 0.31pcf (Cr+6)	13.1	11.8	14	6.9	4.8	4.8	2.4
	Non-Steamed, unwrapped, stored at room temperature						
ACC: Pine - 0.61pcf (Cr+6)	45.8	56.3	46.7	45.3	26.4	13.8	8.8
ACC: Pine - 0.31pcf (Cr+6)	37.8	NA	33.1	27.3	17.6	11.6	8.6

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	Non-Steamed, wrapped, stored at room temperature						
ACC: Pine - 0.61pcf (Cr+6)	63.2	57.6	36	42.8	21.7	12.2	9.5
ACC: Pine - 0.31pcf (Cr+6)	36	NA	30.3	22.6	12	7.4	4.4
	Non-Steamed, unwrapped, stored at 5 degrees Celsius						
ACC: Pine - 0.61pcf (Cr+6)	67.4	64.3	71.3	56.3	39.5	37	48.4
ACC: Pine - 0.31pcf (Cr+6)	32.5	NA	37.7	31.1	19.5	24.9	31.4

Under all the post-storage circumstances provided, for Cu, Cr, Cr^{+6}, the initial collection of the leachate for ACC treated at 0.61pcf produced levels at approximately double the amount of the specified chemical than the leachate collected for ACC treated at 0.31pcf. This suggests that the retention rate will affect the initial amount of leaching because of the amount of the chemical present in the treated boards. Fixation may be occurring to the same extent in two differently treated boards (different retention rates) exposed to identical storage conditions; it appears that there will be more of the chemical in the preliminary leachate collections.

In comparing the effects of *steamed, unwrapped, room temperature* vs. *non-steamed, unwrapped, room temperature* between the same retentions (e.g. 0.61pcf steamed compared with 0.61pcf non-steamed), the data presents an initial higher concentration of Cr, Cu, and Cr^{+6} in the non-steamed groups. This supports that steaming the board appears to increase the rate of fixation of ACC to the wood. Wrapping does not appear to have any significant effect on the presence of the different elements in the leachate for the boards treated at 0.31pcf. For the boards treated at 0.61pcf, leaving the board unwrapped appears to enhance fixation of ACC for all the constituents. The leachate collected from the wood left unwrapped and stored at 5°C appeared to have higher chemical concentration such that the presence of colder temperatures is presumed to delay the rate of fixation of ACC.

2. **Table 5: Condensed data obtained from raw data for this specific analysis of CCA vs. ACC.**

	Sampling interval (hr)						
Wood type/(Chemical)	0	6	12	24	48	72	96
	Steamed, unwrapped, stored at room temperature						
CCA: Hem fir - 0.46pcf (Cr)	2.12	1.27	2.07	0.703	0.75	0.77	0.138
ACC: Hem fir - 0.52pcf (Cr)	6.6	4.69	5.84	5.02	2.39	2.35	1.09
	Non-Steamed, unwrapped, stored at room temperature						
CCA: Hem fir - 0.46pcf (Cr)	25.7	18.3	18.1	15.1	7.43	5.64	1.99
ACC: Hem fir - 0.52pcf (Cr)	30.7	24.8	13.6	13.5	8.8	5.58	4.61
	Non-Steamed, wrapped, stored at room temperature						
CCA: Hem fir - 0.46pcf (Cr)	27.5	22.6	13.3	12.6	7.13	4.65	1.76
ACC: Hem fir - 0.52pcf (Cr)	33.4	19.8	17.4	17.6	7.43	4.48	3.51
	Non-Steamed, unwrapped, stored at 5 degrees Celsius						
CCA: Hem fir - 0.46pcf (Cr)	18.6	15.8	17	18.7	10.6	14	11.6
ACC: Hem fir - 0.52pcf (Cr)	26.1	23.2	26.8	20.5	16.3	16.5	16.8
	Steamed, unwrapped, stored at room temperature						
CCA: Hem fir - 0.46pcf (Cu)	0.5	0.2	0.3	0.2	0.2	0.2	0.2
ACC: Hem fir - 0.52pcf (Cu)	1.6	1.2	1.2	0.7	0.5	0.4	0.2
	Non-Steamed, unwrapped, stored at room temperature						

CCA: Hem fir - 0.46pcf (Cu)	11	5.8	4.6	3.2	1	0.4	0.3
ACC: Hem fir - 0.52pcf (Cu)	11.9	8	3.1	3.3	1.9	1	0.7
	Non-Steamed, wrapped, stored at room temperature						
CCA: Hem fir - 0.46pcf (Cu)	11.6	6.9	3.4	2.2	1	0.5	0.3
ACC: Hem fir - 0.52pcf (Cu)	11.4	5.3	4.4	3.7	1.2	0.6	0.4
	Non-Steamed, unwrapped, stored at 5 degrees Celsius						
CCA: Hem fir - 0.46pcf (Cu)	7.3	6.6	6	6.4	2.1	3.6	1.8
ACC: Hem fir - 0.52pcf (Cu)	8.4	7.6	7.4	6.3	4.7	3.8	3.5
	Steamed, unwrapped, stored at room temperature						
CCA: Hem fir - 0.46pcf (Cr+6)	2.4	1.4	2.2	0.7	0.7	0.4	0
ACC: Hem fir - 0.52pcf (Cr+6)	5.7	4.8	6.6	3.2	2	2.4	0.9
	Non-Steamed, unwrapped, stored at room temperature						
CCA: Hem fir - 0.46pcf (Cr+6)	26.8	26.3	22.3	13.3	6.5	5.5	2
ACC: Hem fir - 0.52pcf (Cr+6)	29.7	26.9	13.6	15.2	9.3	6	4.5
	Non-Steamed, wrapped, stored at room temperature						
CCA: Hem fir - 0.46pcf (Cr+6)	29.1	28.9	19.9	15.1	7.7	4.6	1.8
ACC: Hem fir - 0.52pcf (Cr+6)	37.1	22.8	12.5	19.7	8.4	4.8	3.5
	Non-Steamed, unwrapped, stored at 5 degrees Celsius						
CCA: Hem fir - 0.46pcf (Cr+6)	20.2	22.6	18.1	19.5	1.1[19]	11.5	10.4
ACC: Hem fir - 0.52pcf (Cr+6)	25.8	20.2	29.6	22.3	12.2	11.8	18.8

With respect to the level of Cr found in the leachate, steaming the wood affects the behavior of ACC and CCA in the same fashion such that fixation is enhanced for both preservatives. Wrapping does not appear to have a significant effect on either preservative, and is more of a concern when the retention rates are higher. When wood is stored in colder temperatures, it is anticipated that fixation of the preservative will be delayed. For the first 24 hours of sampling, this is not the case. The leachate collected from the wood stored at colder temperatures had more chemicals detected in the leachate than the leachate obtained from wood stored at room temperature. After 24 hours, the expected temperature influence on fixation does prevail, in which the chemicals for both CCA and ACC treated wood appear more strongly fixed to the wood stored at room temperature. As a result, ACC and CCA appear to behave very similarly in terms of the chemicals that are leached in response to the specified environmental variations.

Conclusion:

In summary, the registrant's submitted study; MRID 462823-01 provides pertinent leaching data with consistent conclusions, and fulfills the environmental fate requirements for an aquatic leaching study.

[19] This value was verified with the data submission and charts that the registrant provided, and it deemed not to be a typo.

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APPENDIX 1: Data tables for leachate analysis under varying conditions.

Table 1: Core Sampling: Removal and Analyses for Total Cr In Leachate (ppm or mg/l)

Treatment Group	Sampling Interval (hr)																Half-life (hr)
	0	6	12	24	48	72	96	120	144	168	240	408	600	840	1080	1872	
Steamed, unwrapped, stored at 20-23°C																	
CCA: Hemlock Fir - 0.46 pcf	2.12	1.27	2.07	0.703	0.75	0.77	0.138	0	0.049	NA	0	NA	NA	NA	NA	NA	32
CCA: Pine - 0.52 pcf	1.75	2.51	1.25	1.18	0.778	0.779	0.208	0.183	0.107	NA	0.12	NA	NA	NA	NA	NA	46
ACC: Hemlock fir- 0.63 pcf	14.6	12.7	9.5	6.97	3.01	1.52	1.49	0.893	0.964	NA	0.9	NA	NA	NA	NA	NA	49
ACC: Hemlock fir - 0.52 pcf	6.6	4.69	5.84	5.02	2.39	2.35	1.09	0.776	0.837	NA	0.5	NA	NA	NA	NA	NA	56
ACC: Pine - 0.61 pcf	19.9	8.5	17.4	14.6	5.37	3.52	2.37	1.81	1.45	NA	1.36	NA	NA	NA	NA	NA	53
ACC: Pine - 0.31 pcf	12	9.61	11.7	9.29	4.38	5.12	2.66	2.41	1.47	NA	1.63	NA	NA	NA	NA	NA	66
Non-steamed, unwrapped, stored at 20-23°C																	
CCA: Hemlock Fir - 0.46 pcf	25.7	18.3	18.1	15.1	7.43	5.64	1.99	0.93	0.476	NA	0.53	0	NA	NA	NA	NA	37
CCA: Pine - 0.52 pcf	26.1	NA	23.6	16.8	5.77	5.05	2.71	1.85	1.26	NA	1.13	0.3	NA	NA	NA	NA	65
ACC: Hemlock fir- 0.63 pcf	50.9	64.5	39.8	39.6	21.1	17.3	8.62	6.91	3.2	NA	4.28	1.96	NA	NA	NA	NA	81
ACC: Hemlock fir - 0.52 pcf	30.7	24.8	13.6	13.5	8.8	5.58	4.61	2.03	1.95	NA	1.53	0.74	NA	NA	NA	NA	81
ACC: Pine - 0.61 pcf	46.6	43.7	35	32.6	23	13.5	9.4	5.92	4.76	NA	2.73	1.4	NA	NA	NA	NA	78
ACC: Pine - 0.31 pcf	30.5	NA	26.6	22.5	14.7	11.6	8.35	4.91	2.75	NA	2.42	0.49	NA	NA	NA	NA	70

Table 1: Core Sampling: Removal and Analyses for Total Cr In Leachate (ppm or mg/l) (continued)

Treatment Group	Sampling Interval (hr)																Half-life (hr)
	0	6	12	24	48	72	96	120	144	168	240	408	600	840	1080	1872	
Non-steamed, wrapped, stored at 20-23°C																	
CCA: Hemlock fir - 0.46 pcf	27.5	22.6	13.3	12.6	7.13	4.65	1.76	0.824	0.526	NA	0.3	NA	NA	NA	NA	NA	34
CCA: Pine - 0.52 pcf	28.1	NA	21.9	12.6	3.25	1.84	1.27	0.483	0.276	NA	0.27	NA	NA	NA	NA	NA	30
ACC: Hemlock fir- 0.63 pcf	60.6	52.2	31.8	27.9	13.2	12.7	5.7	4.39	1.66	NA	1.94	NA	NA	NA	NA	NA	42
ACC: Hemlock fir - 0.52 pcf	33.4	19.8	17.4	17.6	7.43	4.48	3.51	1.97	1.48	NA	0.72	NA	NA	NA	NA	NA	41
ACC: Pine - 0.61 pcf	57	53.5	33.7	32.9	17.8	14.6	8.88	5.83	3.02	NA	2.67	NA	NA	NA	NA	NA	47
ACC: Pine - 0.31 pcf	28.2	NA	24.2	19.5	12.4	8.16	4.42	3.17	1.99	NA	0.89	NA	NA	NA	NA	NA	43
Non-steamed, unwrapped, stored at 5°C																	
CCA: Hemlock fir - 0.46 pcf	18.6	15.8	17.0	18.7	10.6	14.0	11.6	10.9	11.1	11.3	9.62	4.88	3.99	1.2	2.4	0.56	360
CCA: Pine - 0.52 pcf	33.6	NA	37.8	22.8	21	17.7	20.2	20.1	16.3	NA	18.7	14.0	9.12	8.2	5.4	1.95	496
ACC: Hemlock fir- 0.63 pcf	50.4	69.4	64.7	62.2	52.3	65.1	55.6	50	44.2	42.4	27.9	23.9	20.2	12.5	8.1	4.49	449
ACC: Hemlock fir - 0.52 pcf	26.1	23.2	26.8	20.5	16.3	16.5	16.8	18.4	14.7	15.5	14.6	8.39	6.2	4.3	3.2	1.08	412
ACC: Pine - 0.61 pcf	56.0	52.9	55.8	46.0	36.5	40.1	45.9	39.6	44.5	42.9	38	24.5	16.8	16.0	11.5	4.19	511
ACC: Pine - 0.31 pcf	32.0	NA	33.1	28.9	19.2	23.5	28.3	25.8	23.6	27.8	24.4	16.3	14.4	13.4	8.3	2.9	585

Notes:
1. Actual sampling times varied from the nominal. Refer to the raw data sheet for the actual sampling times.
2. NA = No sample taken or sample not analyzed

Table 2: Core Sampling: Removal and Analyses for Total Cu In Leachate (ppm or mg/l)

Treatment Group	Sampling Interval (hr)																Half-life (hr)
	0	6	12	24	48	72	96	120	144	168	240	408	600	840	1080	1872	
Steamed, unwrapped, stored at 20-23°C																	
CCA: Hemlock fir - 0.46 pcf	0.5	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	NA	0.2	NA	NA	NA	NA	NA	341
CCA: Pine - 0.52 pcf	0.5	0.7	0.5	0.5	0.3	0.4	0.4	0.3	0.4	NA	0.5	NA	NA	NA	NA	NA	558
ACC: Hemlock fir- 0.63 pcf	7.0	5.7	3.8	2.2	1.0	0.6	0.4	0.4	0.3	NA	0.5	NA	NA	NA	NA	NA	50
ACC: Hemlock fir - 0.52 pcf	1.6	1.2	1.2	0.7	0.5	0.4	0.2	0.2	0.2	NA	0.1	NA	NA	NA	NA	NA	60
ACC: Pine - 0.61 pcf	7.4	2.8	6.0	4.1	1.3	0.9	0.6	0.5	0.5	NA	0.7	NA	NA	NA	NA	NA	58
ACC: Pine - 0.31 pcf	3.2	2.1	2.4	1.7	0.8	0.8	0.6	0.6	0.4	NA	0.5	NA	NA	NA	NA	NA	76
Non-steamed, unwrapped, stored at 20-23°C																	
CCA: Hemlock fir - 0.46 pcf	11.0	5.8	4.6	3.2	1.0	0.4	0.3	0.1	0.1	NA	0.2	0.0	NA	NA	NA	NA	35
CCA: Pine - 0.52 pcf	11.4	NA	7.6	3.0	0.7	0.6	0.4	0.3	0.3	NA	0.4	0.3	NA	NA	NA	NA	89
ACC: Hemlock fir- 0.63 pcf	25.2	32.3	18.5	16.0	8.4	5.3	2.0	1.4	0.8	NA	0.8	0.4	NA	NA	NA	NA	64
ACC: Hemlock fir - 0.52 pcf	11.9	8.0	3.1	3.3	1.9	1.0	0.7	0.2	0.3	NA	0.3	0.2	NA	NA	NA	NA	75
ACC: Pine - 0.61 pcf	18.9	16.3	12.8	10.7	6.2	2.6	1.7	1.2	0.8	NA	0.7	0.5	NA	NA	NA	NA	76
ACC: Pine - 0.31 pcf	7.6	NA	5.3	4.2	2.4	1.2	1.0	0.7	0.4	NA	0.5	0.3	NA	NA	NA	NA	95

Table 2: Core Sampling: Removal and Analyses for Total Cu In Leachate (ppm or mg/l) (continued)

Treatment Group	Sampling Interval (hr)																Half-life (hr)
	0	6	12	24	48	72	96	120	144	168	240	408	600	840	1080	1872	
Non-steamed, wrapped, stored at 20-23°C																	
CCA: Hemlock fir - 0.46 pcf	11.6	6.9	3.4	2.2	1.0	0.5	0.3	0.2	0.2	NA	0.2	NA	NA	NA	NA	NA	40
CCA: Pine - 0.52 pcf	11.7	NA	5.9	2.1	0.6	0.5	0.5	0.4	0.4	NA	0.5	NA	NA	NA	NA	NA	55
ACC: Hemlock fir- 0.63 pcf	30.2	25.0	12.1	10.2	4.3	2.9	1.6	1.2	0.4	NA	0.5	NA	NA	NA	NA	NA	36
ACC: Hemlock fir - 0.52 pcf	11.4	5.3	4.4	3.7	1.2	0.6	0.4	0.2	0.2	NA	0.2	NA	NA	NA	NA	NA	46
ACC: Pine - 0.61 pcf	22.1	19.7	11.1	10.6	5.2	3.2	1.9	1.3	0.9	NA	1.0	NA	NA	NA	NA	NA	60
ACC: Pine - 0.31 pcf	6.8	NA	4.5	3.4	2.0	1.1	0.7	0.7	0.6	NA	0.5	NA	NA	NA	NA	NA	60
Non-steamed, unwrapped, stored at 5°C																	
CCA: Hemlock fir - 0.46 pcf	7.3	6.6	6.0	6.4	2.1	3.6	1.8	2.1	2.4	1.9	1.5	0.5	0.4	1.0	0.2	0.1	281
CCA: Pine - 0.52 pcf	15.9	NA	17.0	9.0	7.0	4.5	5.3	4.6	3.5	NA	3.4	2.1	1.2	1.0	0.9	0.4	374
ACC: Hemlock fir- 0.63 pcf	25.2	35.2	29.4	29.4	26.1	29.2	25.3	21.5	19.0	19.5	11.1	9.0	5.8	2.4	1.6	0.4	280
ACC: Hemlock fir - 0.52 pcf	8.4	7.6	7.4	6.3	4.7	3.8	3.5	4.7	3.4	3.0	2.1	1.6	0.9	0.4	0.4	0.1	308
ACC: Pine - 0.61 pcf	23.4	20.5	20.7	17.7	14.0	14.7	16.3	13.5	15.9	15.5	13.3	7.2	4.0	3.7	2.3	0.7	373
ACC: Pine - 0.31 pcf	8.7	NA	7.4	6.5	5.0	4.6	5.7	4.8	4.2	5.7	4.3	2.6	2.0	2.2	1.3	0.6	519

Notes:
1. Actual sampling times varied from the nominal. Refer to the raw data sheet for the actual sampling times.
2. NA = No sample taken or sample not analyzed

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Table 3. Core Sampling: Removal and Analyses for CR^{+6} In Leachate (ppm or mg/l)

Treatment Group	Sampling Interval (hr)																Half-life (hr)
	0	6	12	24	48	72	96	120	144	168	240	408	600	840	1080	1872	
Steamed, unwrapped, stored at 20-23°C																	
CCA: Hemlock fir - 0.46 pcf	2.4	1.4	2.2	0.7	0.7	0.4	0.0	0.0	0.0	NA	0.0	NA	NA	NA	NA	NA	32
CCA: Pine - 0.52 pcf	1.9	2.7	1.1	1.1	1.1	0.4	0.0	0.1	0.1	NA	0.0	NA	NA	NA	NA	NA	40
ACC: Hemlock fir- 0.63 pcf	20.1	17.3	11.3	6.3	3.2	1.3	1.3	0.8	0.6	NA	0.5	NA	NA	NA	NA	NA	38
ACC: Hemlock fir - 0.52 pcf	5.7	4.8	6.6	3.2	2.0	2.4	0.9	0.5	0.6	NA	0.2	NA	NA	NA	NA	NA	44
ACC: Pine - 0.61 pcf	24.3	10.8	21.3	13.9	6.6	3.6	2.2	1.9	1.2	NA	0.7	NA	NA	NA	NA	NA	43
ACC: Pine - 0.31 pcf	13.1	11.8	14.0	6.9	4.8	4.8	2.4	1.5	1.2	NA	1.0	NA	NA	NA	NA	NA	53
Non-steamed, unwrapped, stored at 20-23°C																	
CCA: Hemlock fir - 0.46 pcf	26.8	26.3	22.3	13.3	6.5	5.5	2.0	0.7	0.3	NA	0.1	0.4	NA	NA	NA	NA	54
CCA: Pine - 0.52 pcf	27.9	26.1	13.6	8.0	5.3	2.0	1.8	0.9	0.6	NA	0.0	NA	NA	NA	NA	NA	37
ACC: Hemlock fir- 0.63 pcf	67.0	80.5	58.3	51.2	23.1	17.2	8.7	6.4	2.9	NA	3.3	2.0	NA	NA	NA	NA	73
ACC: Hemlock fir - 0.52 pcf	29.7	26.9	13.6	15.2	9.3	6.0	4.5	1.7	1.5	NA	1.1	0.9	NA	NA	NA	NA	79
ACC: Pine - 0.61 pcf	45.8	56.3	46.7	45.3	26.4	13.8	8.8	5.8	4.5	NA	1.9	1.2	NA	NA	NA	NA	69
ACC: Pine - 0.31 pcf	37.8	NA	33.1	27.3	17.6	11.6	8.6	4.3	2.6	NA	1.9	0.9	NA	NA	NA	NA	75

Table 3. Core Sampling: Removal and Analyses for Cr^{+6} In Leachate (ppm or mg/l) (continued)

Treatment Group	Sampling Interval (hr)																Half-life (hr)
	0	6	12	24	48	72	96	120	144	168	240	408	600	840	1080	1872	
Non-steamed, wrapped, stored at 20-23°C																	
CCA: Hemlock fir - 0.46 pcf	29.1	28.9	19.9	15.1	7.7	4.6	1.8	0.9	0.3	NA	0.1	NA	NA	NA	NA	NA	28
CCA: Pine - 0.52 pcf	33.8	NA	27.3	11.3	4.0	1.5	1.0	0.1	0.1	NA	0.0	NA	NA	NA	NA	NA	17
ACC: Hemlock fir- 0.63 pcf	76.2	63.8	35.3	35.1	13.1	11.5	6.4	2.6	1.6	NA	1.0	NA	NA	NA	NA	NA	35
ACC: Hemlock fir - 0.52 pcf	37.1	22.8	12.5	19.7	8.4	4.8	3.5	1.6	1.5	NA	0.4	NA	NA	NA	NA	NA	40
ACC: Pine - 0.61 pcf	63.2	57.6	36.0	42.8	21.7	12.2	9.5	5.2	2.1	NA	1.9	NA	NA	NA	NA	NA	34
ACC: Pine - 0.31 pcf	36.0	NA	30.3	22.6	12.0	7.4	4.4	3.0	1.3	NA	0.5	NA	NA	NA	NA	NA	34
Non-steamed, unwrapped, stored at 5°C																	
CCA: Hemlock fir - 0.46 pcf	20.2	22.6	18.1	19.5	1.1	11.5	10.4	11.2	9.9	7.3	9.1	3.2	3.6	1.0	0.7	0.6	354
CCA: Pine - 0.52 pcf	28.3	NA	28.8	20.6	20.1	15.7	13.2	17.7	13.4	NA	17.1	9.9	12.6	7.2	4.5	1.6	500
ACC: Hemlock fir- 0.63 pcf	61.2	80.4	76.9	70.9	58.4	56.7	53.9	32.9	20.3	35.8	18.3	17.9	16.9	10.3	5.5	4.4	427
ACC: Hemlock fir - 0.52 pcf	25.8	20.2	29.6	22.3	12.2	11.8	18.8	17.7	12.3	10.9	13.0	7.4	4.6	3.4	2.6	1.3	423
ACC: Pine - 0.61 pcf	67.4	64.3	71.3	56.3	39.5	37.0	48.4	37.8	39.1	37.4	19.4	19.4	12.5	12.4	8.4	4.3	463
ACC: Pine - 0.31 pcf	32.5	NA	37.7	31.1	19.5	24.9	31.4	21.3	18.9	23.4	15.8	13.0	6.5	10.4	5.7	2.6	510

Notes:

1. Actual sampling times varied from the nominal. Refer to the raw data sheet for the actual sampling times.
2. NA = No sample taken or sample not analyzed

Table 4. Core Sampling: Removal and Analyses for As In Leachate (ppm or mg/l)

Treatment Group	Sampling Interval (hr)																Half-Life (hr)
	0	6	12	24	48	72	96	120	144	168	240	408	600	840	1080	1872	
Steamed, unwrapped, stored at 20-23°C																	
CCA: Hemlock Fir - 0.46 pcf	0	NA	NA	0	0	NA	0	NA	NA	NA	0	NA	NA	NA	NA	NA	---
CCA: Pine - 0.52 pcf	0	NA	NA	0	0	NA	0	NA	NA	NA	0	NA	NA	NA	NA	NA	---
ACC: Hemlock fir- 0.63 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
ACC: Hemlock fir - 0.52 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
ACC: Pine - 0.61 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
ACC: Pine - 0.31 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
Non-steamed, unwrapped, stored at 20-23°C																	
CCA: Hemlock Fir - 0.46 pcf	NA	6.9	NA	1.7	0	NA	NA	0	0	NA	0	0	NA	NA	NA	NA	---
CCA: Pine - 0.52 pcf	NA	NA	13.9	4.3	0.6	NA	0	0	NA	NA	0	0	NA	NA	NA	NA	---
ACC: Hemlock fir- 0.63 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	---
ACC: Hemlock fir - 0.52 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	---
ACC: Pine - 0.61 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	---
ACC: Pine - 0.31 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	NA	NA	NA	---

Table 4. Core Sampling: Removal and Analyses for As In Leachate (ppm or mg/l) (continued)

Treatment Group	Sampling Interval (hr)																Half-life ($t_{1/2}$) (hr)
	0	6	12	24	48	72	96	120	144	168	240	408	600	840	1080	1872	
Non-steamed, wrapped, stored at 20-23°C																	
CCA: Hemlock Fir - 0.46 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
CCA: Pine - 0.52 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
ACC: Hemlock fir- 0.63 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
ACC: Hemlock fir - 0.52 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
ACC: Pine - 0.61 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
ACC: Pine - 0.31 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	---
Non-steamed, unwrapped, stored at 5°C																	
CCA: Hemlock Fir - 0.46 pcf	NA	7.9	NA	5.9	2.6	NA	2.1	1.2	NA	0.92	0	0	0.197	0.4	0	0.18	394
CCA: Pine - 0.52 pcf	NA	NA	32.2	17.3	10.1	NA	6.5	4.8	NA	NA	2.7	0.74	0.403	0.4	0	0.14	256
ACC: Hemlock fir- 0.63 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0.05	---
ACC: Hemlock fir - 0.52 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0.05	---
ACC: Pine - 0.61 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	NA	<0.1	0	0	0	---
ACC: Pine - 0.31 pcf	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	0	0	0	0	0	---

Notes:
1. Actual sampling times varied from the nominal. Refer to the raw data sheet for the actual sampling times.
2. NA = No sample taken or sample not analyzed