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# Release of Arsenic to the Environment from CCA-Treated Wood: Part II – Leaching and Speciation during Disposal

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## Abstract

Wood treated with chromated copper arsenate (CCA) is primarily disposed within construction and demolition (C&D) debris landfills, with wood monofills and municipal solid waste (MSW) landfills as alternative disposal options. This study evaluated the extent and speciation of arsenic leaching from landfills containing CCA-treated wood. In control lysimeters where untreated wood was used, DMAA represented the major arsenic species. The dominant arsenic species differed in the lysimeters containing CCA-treated wood, with As(V) greatest in the monofill and C&D lysimeters and As(III) greatest in the MSW lysimeters. In CCA-containing lysimeters, the organoarsenic species MMAA and DMAA were virtually absent in the monofill lysimeter and observed in the C&D and MSW lysimeters. Overall arsenic leaching rate varied for the wood monofill (0.69% per meter of water added), C&D (0.36% per m), and MSW (0.84% per m) lysimeters. Utilizing these rates with annual disposal data, a mathematical model was developed to quantify arsenic leaching from CCA-treated wood disposed to Florida landfills. Model findings showed between 20 to 50 metric tons of arsenic (depending on lysimeter type) had leached prior to 2000 with an expected increase between 350 to 830 metric tons by 2040. Groundwater analysis from 21 Florida C&D landfills suspected of accepting CCA-treated wood showed that groundwater at 3 landfills were characterized by elevated arsenic concentrations with only 1 showing impacts from the C&D waste. The slow release of arsenic from disposed treated wood may account for the lack of significant impact to groundwater near most C&D facilities at this time. However, greater impacts are anticipated in the future given that the maximum releases of arsenic are expected by the year 2100.

## Introduction

Traditional disposal pathways for CCA-treated wood are through construction and demolition (C&D) debris facilities, where in some cases the wood may be inadvertently recycled as mulch or wood fuel (1–3). Non-recycled treated wood may be disposed in C&D landfills, which in some states, such as, Florida (4) are not required to be lined. Another disposal alternative is municipal solid waste (MSW) landfills, which are required to be lined. The U.S. federal government has set in place several regulatory procedures, such as the Toxicity Characteristic Leaching Procedure (TCLP), to evaluate the hazardous nature of wastes and whether more

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elaborate containment is necessary upon disposal. The TCLP is a standardized leaching test designed to simulate the acid phase conditions that occur as part of the decomposition process within a MSW landfill. A solid waste subjected to the TCLP, is considered hazardous if the TCLP leachate contains particular constituents above set threshold levels. For example, unless otherwise excluded, a solid waste containing arsenic is considered hazardous waste if the TCLP results exceed 5 mg/L. Although CCA-treated wood has been shown by the TCLP to leach arsenic above 5 mg/L (5–7), it is exempted at the federal level from being classified as a hazardous waste and can be disposed of as regular solid waste (8). Consistent with this policy, efforts are currently underway to divert CCA-treated wood products directly to lined landfills and limit quantities from being recycled as mulch or wood fuel or disposed within unlined C&D landfills.

Studies to evaluate the extent of arsenic releases after CCA-treated wood is disposed to landfills are few and focus primarily on measuring total arsenic. Leachate generated from experimental field test cells and lysimeters show arsenic concentrations between 45 to 96 μg/L (9,10). Gifford et al. (11) found that when CCA-treated wood was co-disposed with soil, the arsenic concentration in the leachate was reduced by 96% from 980 μg/L to 39 μg/L. Furthermore, additional information about the total arsenic concentrations in leachate, and additional metals from the lysimeters used in the current study can be found in Jambeck (12).

As mentioned in the previous paper (13), speciation of arsenic from CCA-treated wood is rarely evaluated during in-service use and in particular during disposal. Speciation is of importance as it defines toxicity which dictates mobility and hence bioavailability. Although arsenic in the CCA formulation is in the form of inorganic As(V), both inorganic As(V) and the more toxic reduced inorganic As(III) species have been observed leaching from new and weathered CCA-treated wood (7). The less toxic organoarsenic species, dimethylarsinic acid (DMAA) and monomethylarsonic acid (MMAA), formed from the biotransformation of inorganic arsenic species (14,15) can also play a role in arsenic leaching rates from disposed CCA-treated wood.

The objectives of the current study were to evaluate the speciation of arsenic leachate generated from disposed CCA-treated wood under different landfill conditions, to utilize the leaching rates to forecast arsenic releases during disposal, and to evaluate the speciation of arsenic from groundwater in the vicinity of C&D landfills, with the intent of documenting to date the current impacts of disposed CCA-treated wood. Landfill conditions were evaluated through a series of field-scale lysimeters (columns) designed to simulate wood monofill, C&D, and MSW landfills containing CCA-treated wood.

## Materials and Methods

### Analytical Methods

Analysis of the arsenic species (As(III), As(V), MMAA and DMAA) of the lysimeter leachate and groundwater were analyzed using High Performance Liquid Chromatography (HPLC) coupled with Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) as outlined in Khan et al. (13), in the previous paper. The detection limit for the arsenic species in the lysimeter samples was 5 μg/L and was estimated by measuring the lowest quantifiable concentration that produced a signal equivalent to 2 times the standard deviation of the blank samples. Blank samples used in this study pertain to lysimeter samples containing no detectable arsenic. Leachate samples were obtained from a lysimeter study conducted by Jambeck (12). Results from a split of these samples which were analyzed for arsenic species is described in the current manuscript. The total arsenic concentration was calculated by summing the individual species concentrations.

## Lysimeter Design

Details of the lysimeter design can be found in Jambeck (12) along with descriptions concerning additional physico-chemical and metals measurements. A figure illustrating the configuration is shown in Figure A within the Supporting Information Section. In summary, six lysimeters (6.1 m high and 30 cm diameter) were erected outdoors to simulate 3 landfill conditions – wood monofill (lysimeters 1 and 2), C&D (lysimeters 3 and 4), and MSW (lysimeters 5 and 6). Lysimeters were set up in pairs in which one served as the control (lysimeters 1, 3, and 5) containing untreated wood, and the other contained CCA-treated wood (lysimeters 2, 4, and 6). The composition of the respective wastes for the six lysimeters and the total amount of arsenic added to the CCA-containing lysimeters (2, 4, and 6) in the form of CCA-treated wood are summarized in Table 1. Arsenic contributions from other components in the waste were quantified by observing the difference between the CCA-containing lysimeters and their corresponding control. It should be noted that the simulated waste added to the lysimeters were sized to 5-cm by 5-cm pieces whenever possible and that during months of little or no precipitation, the lysimeters were supplemented with deionized water. These factors can affect leaching rates and the amount of arsenic released from the treated wood. Leachate samples for arsenic speciation analysis were collected for 345 days (lysimeter 1), 533 days (lysimeter 2), 387 days (lysimeters 3, 4, 5), and 400 days (lysimeter 6).

## Overview of Mathematical Model

In the previous paper (13), a mathematical model was developed to forecast the annual disposal volumes of CCA-treated wood in Florida. The model was based on a mass balance approach in which the CCA-treated wood disposal volumes were forecasted. In order to extend the model for a longer time period to account for leaching during disposal, the amount of CCA-treated wood production was set to zero after the year 2060 for all products, assuming a complete ban on CCA-treated wood. Given the disposal volumes, the mass of arsenic leached during the in-service use of wood was subtracted from the amount that was sent to disposal, resulting in a net retention level of arsenic within treated wood products sent for disposal. These corresponding retention levels (in units of mass of CCA per unit volume of wood) at the point of disposal were 5.6 $kg/m^3$ for lumber and timbers disposed after 10 years, 3.3 $kg/m^3$ for lumber and timbers disposed after 25 years, and 11 $kg/m^3$ for poles disposed after 40 years, on average. Once the wood was disposed, a new leaching rate was utilized to forecast arsenic releases from the wood. The leaching rates observed from the experimental lysimeters (percent leached per meter of water added) were normalized using the yearly infiltration volume. The yearly infiltration volume was estimated at 10% of the average rainfall volumes observed in Florida. This estimate was based on the work of He et al. (16) and Murphy and Garwell (17) who found that infiltration of rainfall into Florida landfills range between 3 to 21%. One limitation of the model is the assumption that leaching rates of arsenic are constant during disposal. It is likely that leaching rates may change with variations in infiltration rates and as the chemistry of the landfill evolves over time. Disposal quantities computed in this study therefore represent an estimate for a scenario characterized by constant leaching rates.

## Groundwater Sampling

Groundwater samples were collected from 21 C&D debris facilities located throughout the state of Florida during November 2002 to February 2003. Sampling occurred during routine groundwater monitoring for State compliance purposes and required the collection of an additional sample for speciation analysis. Upon collection, samples for speciation analysis were placed on ice and shipped overnight to the laboratory. No acid preservatives were added to these samples so as to minimize species transformation due to pH changes. Where possible, samples were collected from at least one background well up-gradient from the C&D debris facility and two or three wells down-gradient in the direction of groundwater flow. Down-

gradient wells were within the C&D debris facility properly line. A total of 23 background samples and 48 down-gradient samples were collected. One facility was unable to provide a background sample and three facilities provided two background samples.

## Results and Discussion

### Lysimeter Results

Differences in the mean arsenic concentrations in the leachates from the control and its corresponding CCA-containing lysimeter were statistically significant for all three lysimeter pairs ($\alpha = 0.05$, $p<0.001$). The total arsenic concentration leached from the control and CCA-containing wood monofill lysimeter averaged 0.009 mg/L and 36.2 mg/L, respectively. For the control and CCA-containing C&D lysimeter, the total arsenic concentration averaged 0.013 mg/L and 2.32 mg/L, respectively. The MSW control and CCA-containing lysimeter leached an average total arsenic concentration of 0.124 mg/L and 0.70 mg/L, respectively.

By the completion of the study, the CCA-containing wood monofill, C&D, and MSW lysimeters leached 6,400 (3840 mg), 167 (293 mg), and 5.2 (93 mg) times more total arsenic than the respective controls (0.6 mg-wood monofill, 1.8 mg-C&D, 18 mg-MSW) (See Figure B in Supporting Information). This represented a loss of 0.69% per meter of water added (wood monofill), 0.36% per m (C&D), and 0.84% per m (MSW) of the total arsenic added, in the form of CCA-treated wood, to the lysimeters. Normalizing these quantities by the estimated infiltration volume per year, the annual leaching rate for the added CCA-treated wood components within each landfill type was computed as 0.094% (wood monofill), 0.048% (C&D), and 0.11% (MSW).

Arsenic concentrations leaching from the wood monofill and C&D lysimeters were relatively constant over time, however, for the MSW lysimeters, arsenic concentrations in the leachate were influenced by the acid forming stage of the MSW degradation and the subsequent drop in pH. Arsenic concentrations were highest at the start of the experiment, when pH values were <6.5, and decreased as the pH increased and stabilized. For the wood monofill and C&D lysimeters, pH values were roughly constant between 5.0 and 7.5 depending upon lysimeter type. Over time, the oxidation-reduction potential (ORP) measurements decreased within all the lysimeters and ranged between +154 and −672 mV (See Table A in the Supporting Information Section). Decreasing ORP values usually cause reducing conditions thus favoring methylation (18). DMAA was the predominant arsenic species for the three control lysimeters. MMAA was always observed in the presence of DMAA (Figures 1, 2, and 3) and this was also noted in the results of the groundwater analysis (Figure 5).

In the wood monofill control, DMAA represented almost 40% of the total mass of arsenic (1.3 mg) that had leached, inorganic As(V) and As(III) represented 31%, and MMAA represented 5%. When compared to the CCA-containing wood monofill lysimeter, inorganic As(V) and As(III) accounted for 70% and 29%, respectively, of the total arsenic (1,860 mg) that had leached and DMAA and MMAA accounted for <1%. Cumulative masses of arsenic leaching from the CCA-containing wood monofill showed inorganic As(III) predominating for about the first 300 days and then inorganic As(V) for the remainder of the study (Figure 1). Since this lysimeter contained only CCA-treated wood and since arsenic within the wood was primarily in the form of inorganic As(V), its final prevalence in the leachate was not surprising. However, the organoarsenic species, DMAA and MMAA, were virtually absent in the CCA-treated wood monofill lysimeter. It is well known that common fungi, yeasts, and bacteria can methylate inorganic arsenic to MMAA, DMAA, and gaseous derivatives of arsine (19). This biotransformation process is believed to be either a detoxification (20) or adaptation mechanism by which microorganisms avoid arsenic toxicity (21,22). On the other hand, high concentrations of metals in soil can harmfully affect microbial activity and cause significant

reductions in microbial biomass (23) and soil respiration (24). Additional testing, beyond the scope of this study, would be needed to determine whether inorganic arsenic concentrations became too toxic for microorganism survival or were too high so as to inhibit biomethylation within the CCA-treated wood monofill lysimeter. It should also be mentioned that CCA contains two other elements, copper and chromium, both of which have been shown to leach substantially from CCA-treated wood (5,6) and could have contributed to the overall toxicity of the leachate (25).

Cumulative masses for the CCA-containing C&D lysimeter showed that inorganic As(V) dominated for about the first 340 days, after which MMAA levels surpassed it (Figure 2). Increasing inorganic As(V) levels seen in the CCA-containing C&D lysimeter are consistent with other studies that show arsenic leaching from CCA-treated wood is predominantly in the form of inorganic As(V) (7,13). Further comparison between both C&D lysimeters show a significant contribution of MMAA and DMAA to the overall mass of arsenic in the CCAcontaining lysimeter while the mass of inorganic As(III) remained relatively low. At some point in the experiment (after 340 days), MMAA levels surpassed those of inorganic As(V). Reasons for the MMAA leap cannot be authenticated at this time and may have been explicable if speciation analysis were to have continued past the 400-day mark. However, it should be noted that the more common microbially-driven transformation pathway for arsenic in soils is inorganic As(V) → inorganic As(III) → MMAA → DMAA (26). Some bacteria are more resistant to the organoarsenic compounds than the inorganic species (20) and biomethylate inorganic species as a means of detoxifying their environment (18). Seeing that MMAA is the precursor for DMAA and it is also considerably less toxic, increasing inorganic As(V) levels may have become a signal for detoxification to begin.

Leachate from the MSW lysimeter containing CCA-treated wood showed inorganic As(III) (44%) as the most predominant species, with inorganic As(V), DMAA, and MMAA comprising 24%, 19%, and 13%, respectively (Figure 3). The higher inorganic As(III) levels may have been attributed to low ORP (−77 mV to −670 mV) and low pH values (as low as 4.4) due to MSW degradation (See Table A in the Supporting Information Section). It is well known that under reducing conditions inorganic As(III) is more thermodynamically stable than inorganic As(V). DMAA represented 78% of the total arsenic observed in the control MSW lysimeter, with inorganic As(III) the next most abundant (17%) and inorganic As(V) (4.7%) and MMAA (0.2%) at very low levels. Comparison between both MSW lysimeters showed that about 20% of the total mass of arsenic leached from the CCA-containing MSW was not attributed to the added CCA-treated wood but as a consequence of the refuse derived fuel (RDF) and biodegradable organic food in the MSW waste. In the CCA-containing MSW lysimeter, much of the inorganic As(III) was released at the start of the experiment and coincided with low initial pH values (<5.0) (Figures 3). This suggests a relationship between inorganic As(III) leaching and acidic conditions. As the pH rose above 5.0, inorganic As(III) concentrations decreased at which time the concentrations of the three other less toxic arsenic species, inorganic As(V), MMAA, and DMAA, increased. The source of DMAA was accredited to natural background concentrations and increasing MMAA levels may have been a response to increasing levels of toxic inorganic As(III) and As(V). Although, the amount of CCA-treated wood added to the C&D and wood monofill lysimeters was much higher than that added to the MSW lysimeter, the MSW lysimeter was characterized by the highest leaching rate. This increase in leaching rate was attributed to the predominance of inorganic As(III), possibly a consequence of low pH, within the MSW lysimeter. Inorganic As(III) is the more soluble and more mobile form of arsenic (27).

## Disposal Model Results

Coupling the disposal volumes in the previous paper with the leaching rates measured in the current paper, the time needed for the arsenic to leach almost entirely from these landfill types is upwards of 800 years (Figure 4). The maximum rate of arsenic leaching (between 20 and 40 metric tons per year) is forecasted to begin around the year 2100 and continue at this rate for many hundreds of years. The maximum rate of leaching would be roughly 2 times faster for a MSW landfill than for a C&D landfill. The total amount of arsenic released from the landfills is estimated at 350 to 830 metric tons by the year 2040, and increasing by a factor of 4 by the end of the current century. The increases would be greater if a complete ban were not to take effect by the year 2060.

## Results from Groundwater Collected from C&D Facilities

The average and standard deviation of the total arsenic concentration (summation of the individual species) were 8 μg/L and 16 μg/L for the background wells, respectively, and 10 μg/L and 13 μg/L for down-gradient wells, respectively. An overall analysis of variance showed no significant difference between the total arsenic detected in background wells and those of down-gradient wells ($p = 0.69$), although average arsenic concentrations detected in both background and down-gradient wells were higher than the natural background levels for total arsenic in Florida's groundwater (2 μg/L) (28).

Of the 21 C&D landfills (Figure C in Supporting Information Section), groundwater samples taken from landfills #1, #6, and #19 showed total arsenic concentrations above 30 μg/L in down-gradient wells. At landfill #1, the total arsenic concentration for groundwater from wells #1b and #1d were 42 and 44 μg/L, respectively, and was attributed to the high background concentration (62 μg/L). For landfill #6, the arsenic concentration detected in the groundwater from wells #6a and #6c were 34 and 31 μg/L, respectively, but there was no accompanying background sample available at this facility for comparative purposes. At landfill #19, groundwater from wells #19a and #19b had arsenic concentrations of 57 and 40 μg/L, respectively, however, no detectable arsenic was observed in the corresponding background water sample, suggesting that the landfill served as the source of arsenic from this particular facility.

Speciation analysis of both background and down-gradient samples showed inorganic As(III) and As(V) as the major arsenic species, with inorganic As(III) predominating in the down-gradient wells and in 20 of the 23 background samples, with the exception at landfills #1, #5, and #14 (Figure 5). For down-gradient samples, the average inorganic As(III) was 5 μg/L and ranged between below detection limits (BDL) to 29 μg/L (with 24 of the 48 samples at or above 5 μg/L). The average inorganic As(V) concentration was <5 μg/L and ranged from BDL to 41 μg/L (with 12 of the 48 samples at or above 5 μg/L). The organoarsenic species, DMAA, was prevalent in 17 of the 48 down-gradient samples (ranging between 5 and 10 μg/L) and trace amounts were observed in three background samples. MMAA, which is the precursor for DMAA, was never detected without the presence of DMAA and was observed in 5 of the 17 samples containing DMAA and not detected in any of the background samples. In the natural environment, small quantities of MMAA when compared to DMAA might be a consequence of MMAA being a short-lived intermediate in the arsenic methylation sequence (29).

Of interest is the finding that the speciation corresponding to the two landfills (#1 and #19) with elevated arsenic concentrations and with corresponding background samples, were characterized by distinct differences in speciation. For landfill #19, the predominant species observed were inorganic forms, As(III) and As(V), and the source was attributable to the landfill itself (and perhaps CCA-treated wood) given the low levels observed in the background well. For landfill #1, the dominant species were the organoarsenic species (DMAA and

MMAA), with the background well showing elevated arsenic levels at this site indicating that the source may not have been from the landfill. Of note is that organic arsenical herbicides are still in use within Florida, and such a potential source could serve as one explanation for the elevated concentration and speciation observed within the groundwater corresponding to landfill #1.

## Overall Results

Distinct differences in speciation were observed between leachates measured in the current study and the previous study. In the preceding paper, only inorganic As(V) and As(III) were observed in the runoff and infiltrated water below the CCA-treated deck, whereas in the current paper organic forms were observed (DMAA and MMAA) in addition to the inorganic forms. Organic forms of arsenic predominated in disposal scenarios where untreated wood was used. This has implications for overall disposal in that untreated wood has a synergistic benefit in producing both lower levels of total arsenic and releasing arsenic in less toxic forms. Over 50% of the arsenic from the CCA-containing C&D lysimeter and about 30% of the MSW lysimeter were in the organoarsenic forms; however, a fraction of the arsenic presumed to be disposed predominantly as As(V) was converted to the more toxic As(III) form. Of interest would be to measure the relative toxicity of leachate from each landfill type during efforts to further evaluate the best method of disposal. Also of interest is the lack of organoarsenic species in the infiltrated water observed below the deck in the previous paper although the total arsenic concentrations were low in comparison to that observed in the CCA-containing C&D and MSW lysimeters. This lack of organoarsenic species is likely due to differences in microbial communities and chemical characteristics of each media.

Another distinction in the results between the two papers is the much slower leaching rates of CCA-treated wood during disposal (0.05 to 0.1% per year) versus that observed for in-service structures (5% per year) suggesting that releases of arsenic from in-service structures are of greater concern for the short term due to a combined effect of faster releases and releases predominantly as inorganic As(V) and As(III). Although the concentrations are higher in the leachate for the CCA disposal scenarios as compared to the leachates from the in-service deck, the overall rate of arsenic release was about 100 times slower than the rate of loss during in-service use. This was due to the limited amount of water in contact with disposed CCA-treated wood relative to CCA-treated wood that is in service. In essence, the disposal scenarios tend to reconcentrate the arsenic and release this concentrated source at a slower rate.

Even though leaching of arsenic from CCA-treated is expected to be slowed during disposal, the prolonged leaching characteristic of disposed CCA-treated wood is expected to impact the environment long into the future. An estimated 17,000 metric tons of arsenic has remained in service by 2000 (13), the cumulative mass disposed to Florida landfills by this time is estimated at 5,200 metric tons. By 2040, the amount of arsenic in in-service wood is expected to decrease to 10,000 metric tons, while the amount disposed to landfills will increase to approximately 26,000 metric tons. This decrease is a consequence of the December 2003 phase-out of CCA-treated wood products for public use. It is therefore not surprising that over time arsenic leaching during service would start to decrease as the volume of in-service products decreases while arsenic disposed to landfills continues to increase. The rate of release from the disposal scenarios however is anticipated to be much slower than that observed during in-service use.

The rate of arsenic leaching from disposed CCA-treated wood depends on the method of disposal. Leaching rates observed in this study from the MSW lysimeter (0.11% per year) was greater than the rates observed in the wood monofill (0.094% per year) and C&D (0.048% per year) lysimeters. Although MSW lysimeters are the current preferred method of disposal for CCA-treated wood because of their bottom liners, the enhanced leaching rates could result in

elevated concentrations of arsenic in the leachate that could possibly limit leachate treatment options, thus increasing ultimate disposal costs.

In Florida, the majority of CCA-treated wood waste is disposed to unlined C&D landfills. Groundwater analysis near C&D landfills show an average arsenic concentration for background wells as 8 μg/L and for down-gradient wells as 10 μg/L. Despite the quantities of arsenic leaching from in-service and disposed CCA-treated wood over the past forty years, it may be too early at this time to observe large impacts to groundwater from arsenic contamination. The relatively low arsenic levels observed in the groundwater (relative to those observed in the lysimeters) can be attributed to the slow release of arsenic from CCA-treated wood once disposed, the adsorptive capacity of the soil for arsenic, and dilution effects. The results of this study indicate that leaching of arsenic during its disposal is increasing due to the cumulative effects of the amount disposed. Such increases, although not obvious in monitoring data collected to date, will likely be observed sometime in the future.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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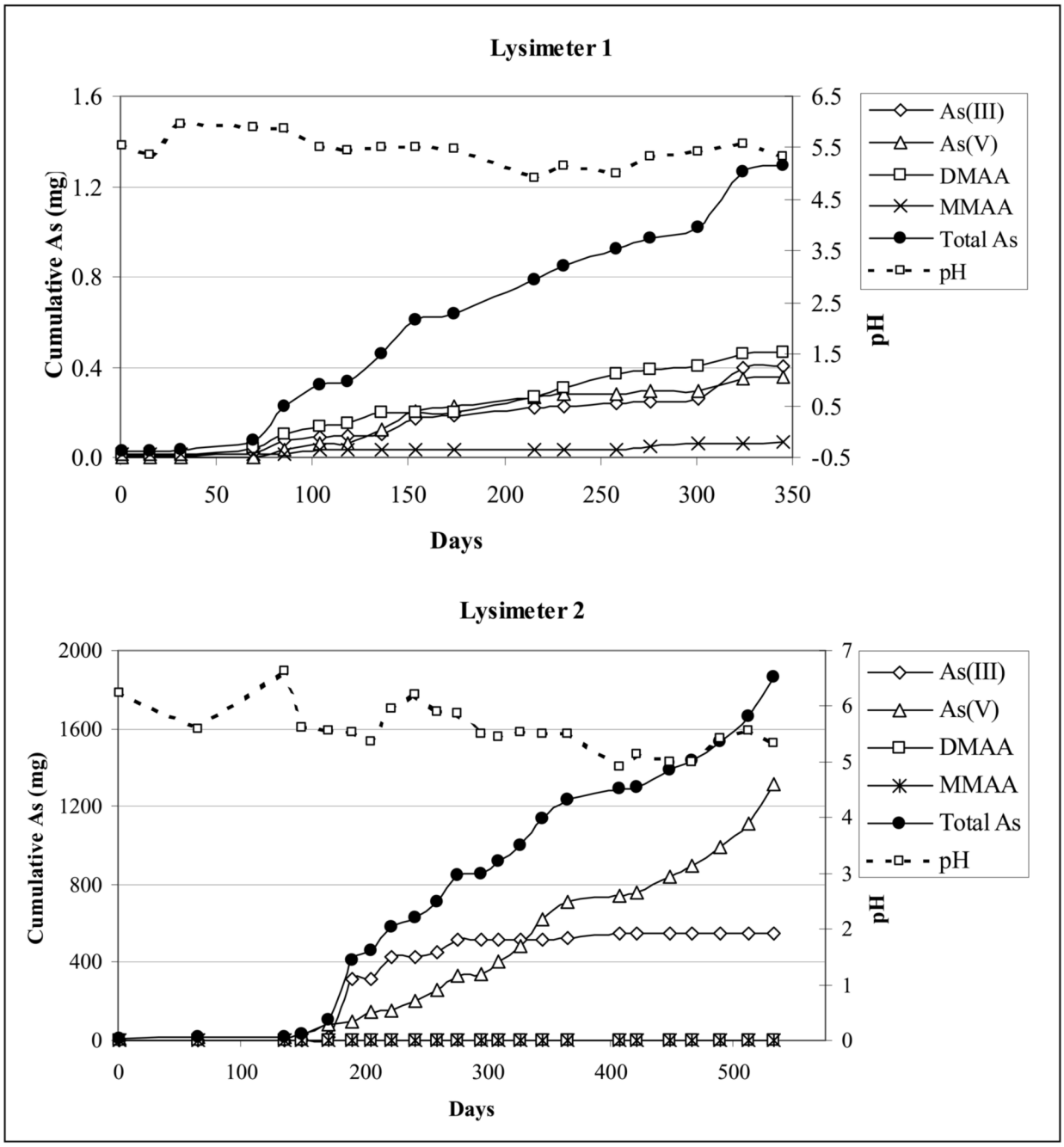


**Figure 1.**
Cumulative mass of arsenic species leached from the Control (top) and CCA-containing (bottom) monofill lysimeter.

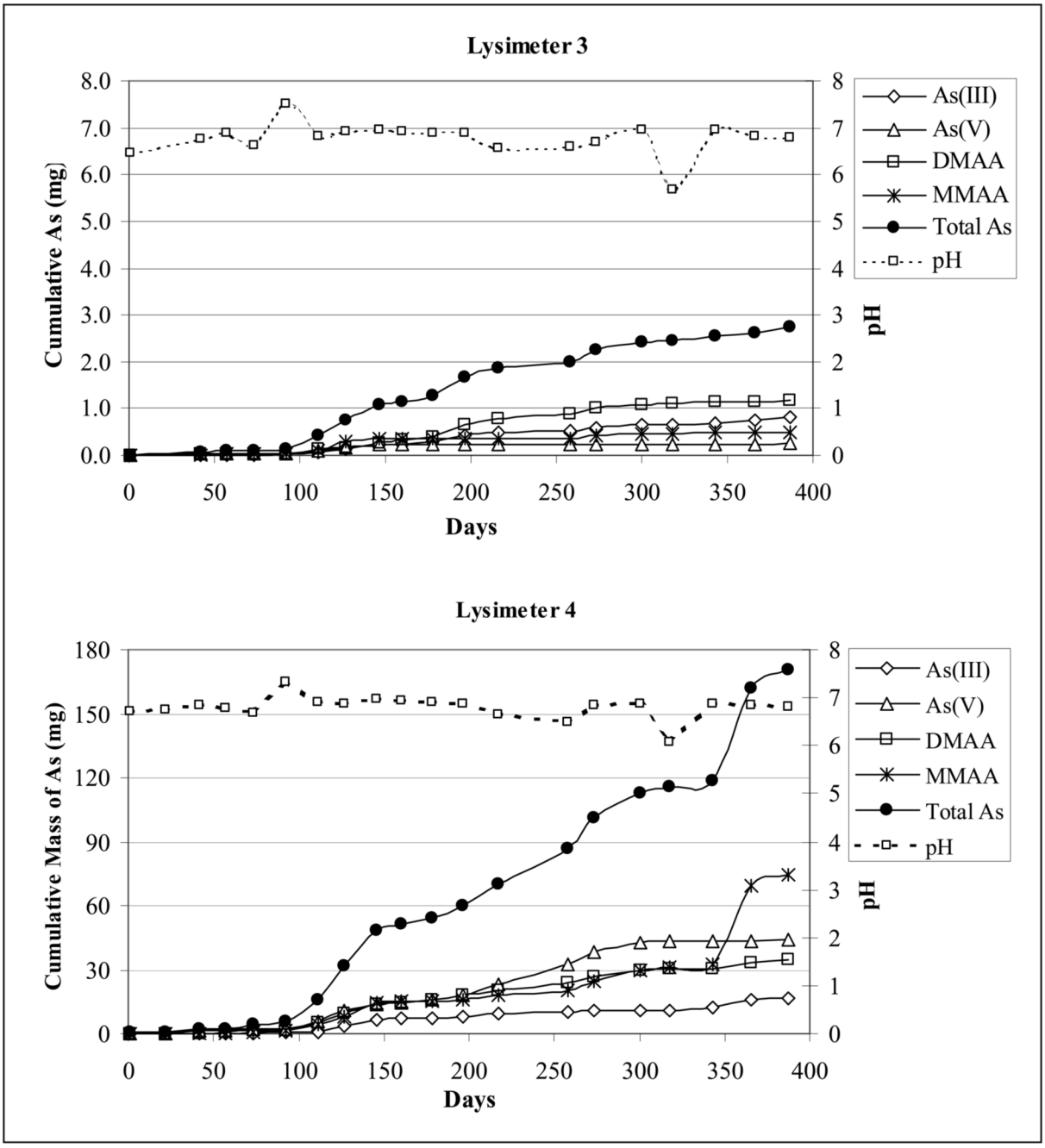


**Figure 2.**
Cumulative mass of arsenic species leached from the Control (top) and CCA-containing (bottom) C&D lysimeter.

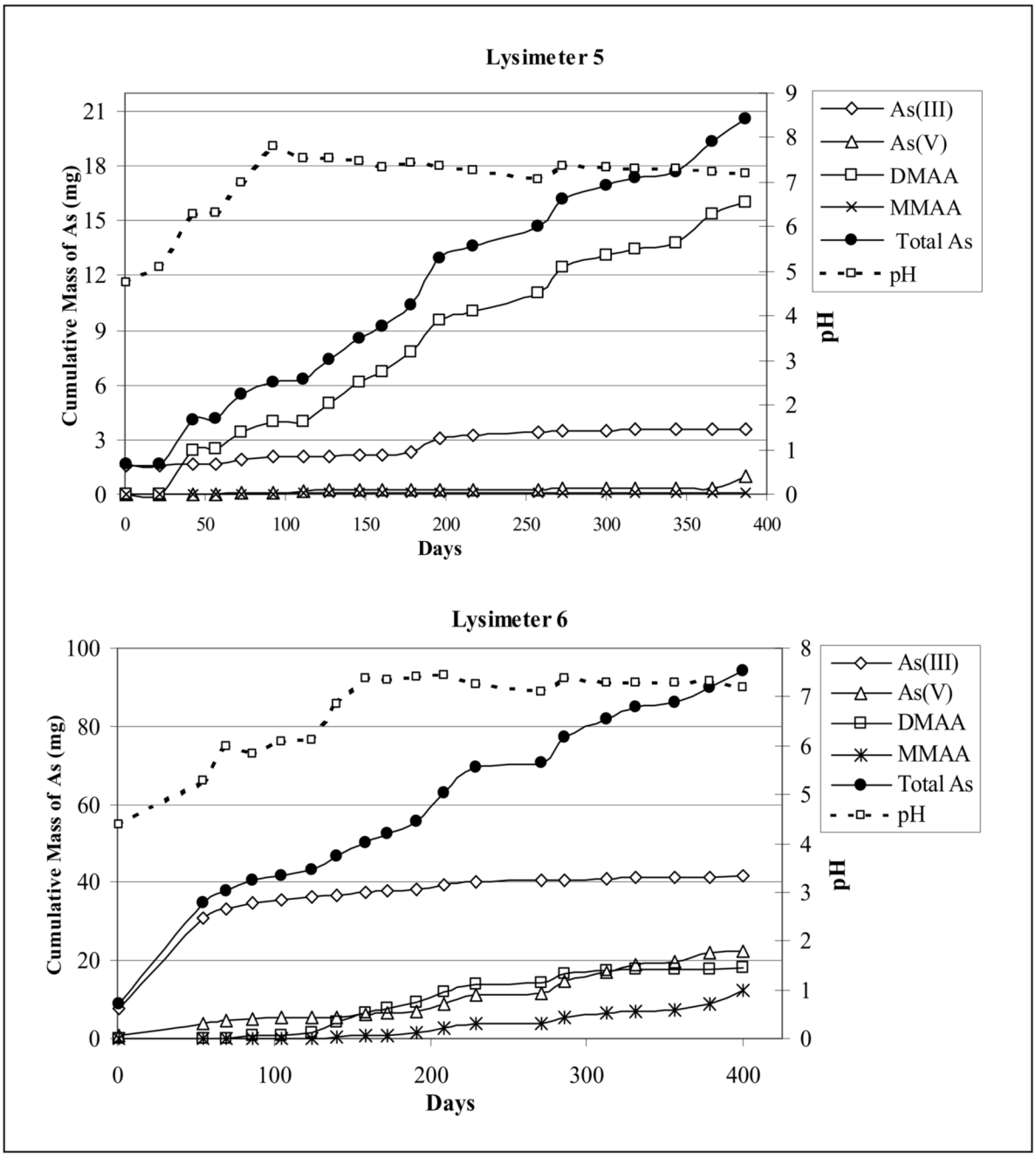


**Figure 3.**
Cumulative mass of arsenic species leached from the Control (top) and CCA-containing (bottom) MSW lysimeter.

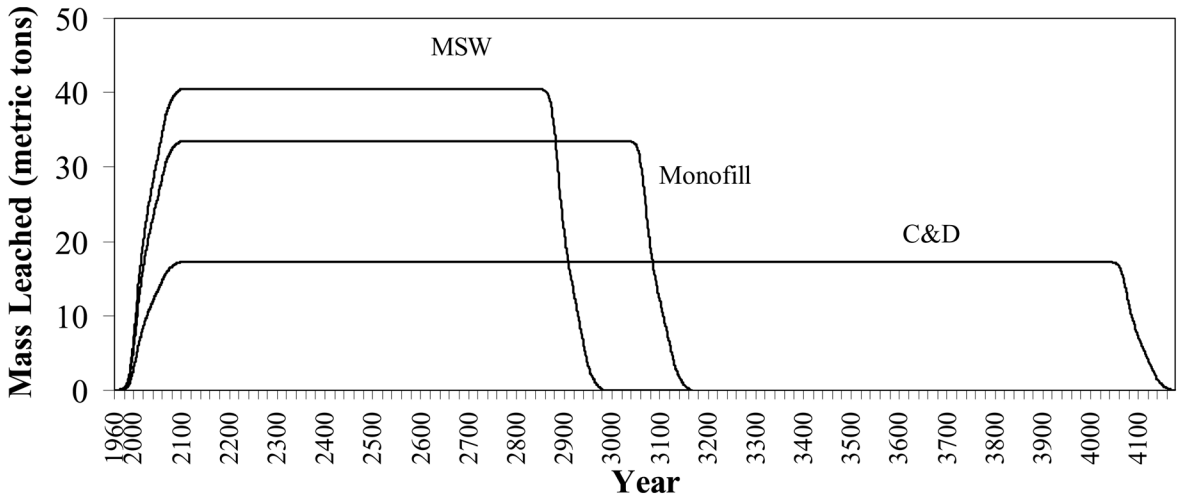


**Figure 4.**
Estimated mass of arsenic leached per year from C&D, monofill, and MSW landfills.

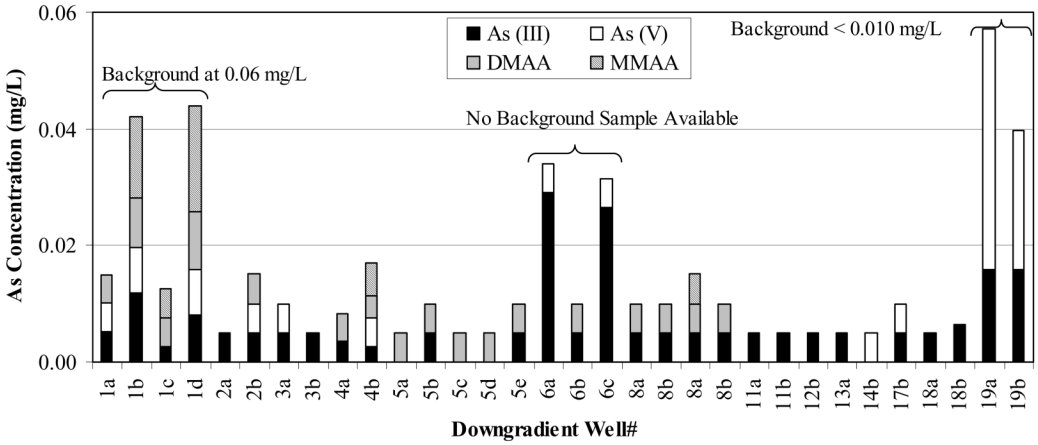


**Figure 5.**

Arsenic speciation distribution for downgradient wells characterized by arsenic concentrations above detection limits. Each number corresponds to one particular C&D landfill facility.

**Table 1**

Percent Mass Composition of Each Lysimeter (12).

| Components | Source[a] | Lysimeter Number and Description | | | | | |
|---|---|---|---|---|---|---|---|
| | | Monofill | | C&D | | MSW | |
| | | Control | CCA | Control | CCA | Control | CCA |
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| Untreated SYP[b], 2″ × 6″ | A | 100 | 0 | 33.7 | 23.6 | 2 | 0 |
| New CCA-treated SYP*, 2″× 4″ | B | 0 | 50 | 0 | 5.05 | 0 | 1 |
| Weathered CCA-treated wood, 2″ × 4″ | C | 0 | 50 | 0 | 5.05 | 0 | 1 |
| Concrete | D | -- | -- | 29.2 | 29.2 | -- | -- |
| Roofing (shingle roll) | B | -- | -- | 13.7 | 13.7 | -- | -- |
| Drywall | B | -- | -- | 12.4 | 12.4 | -- | -- |
| Cardboard (Dry) | E | -- | -- | 8.0 | 8.0 | -- | -- |
| Copper wire, Steel sheet, Aluminum, Steel bar, Fiberglass Insulation (equal proportions by mass at 0.6% each) | B | -- | -- | 3.0 | 3.0 | -- | -- |
| Municipal Solid Waste – Refuse Derived Fuel (RDF) (processed)[c] | G | -- | -- | -- | -- | 89 | 89 |
| Biodegradable organic food waste (represented as dog food) | F | -- | -- | -- | -- | 9 | 9 |
| Total amount of arsenic added in the form of CCA-treated wood | | 0 | 241 g | 0 | 25.5 g | 0 | 4.0 g |

[a] Sources include: A - Donation from wood treating company; B – Home improvement Store; C – Playground demolition, weathered for 10 years at time of demolition; D - Concrete recycling center; E - Recycling facility; F - Pet warehouse; G - West Palm Beach Solid Waste Authority.

[b] SYP – Southern Yellow Pine.

[c] MSW lysimeters may have contained more than the added 2% wood fraction since RDF may include wood waste.