

# Quantification and Speciation of Arsenic Leaching From An In-Service CCA-Treated Wood Deck and Disposed CCA-Treated Wood to Lysimeters Simulating Different Landfill Conditions

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ABSTRACT

Arsenic toxicity is best expressed in terms of speciation rather than the total concentration. Inorganic As(III) and As(V) and the organoarsenic species, MMAA and DMAA are the predominant forms of arsenic found in environmental samples; with the trivalent species being more toxic than the pentavalent species and inorganic forms more toxic than organic forms. To study the forms and transformation of arsenic in new and weathered CCA-treated wood, leachate from a constructed in-service CCA-treated wood deck and lysimeters containing disposed CCA-treated wood designed to simulate different landfill conditions were collected and analyzed for arsenic using HPLC-ICP-MS. The landfill conditions tested were wood monofill, construction and demolition (C&D), and municipal solid waste (MSW). Results showed that the arsenic concentration in the rainwater runoff impacting the CCA-treated deck after 1 year averaged 0.73 mg/L with both inorganic As(III) and As(V) detected; although the form of arsenic in the chemical CCA is inorganic As(V). Arsenic concentrations in the rainwater infiltrating the soil beneath the CCA-treated deck rose from 2 to 18 µg/L in one year. The ratio of inorganic As(III) to As(V) in the infiltrated rainwater was much higher than that observed in the rainwater runoff, suggesting biological/chemical transformation of inorganic As(V) to the more toxic inorganic As(III) or preferential sorption of inorganic As(V) by the soil. When weathered CCA-treated wood was disposed to wood monofill and C&D lysimeters, the predominant arsenic species observed in the leachate was inorganic As(V), whereas, for the MSW lysimeter it was inorganic As(III). Unlike the C&D and MSW lysimeters, there was no organoarsenic species detected in the wood monofill lysimeter suggesting that inorganic arsenic concentrations were too toxic for microorganism survival, which is necessary for the conversion of inorganic to organic arsenic species (a possible detoxification mechanism). In one year, the mass of arsenic leached from the wood monofill, C&D, and MSW lysimeters was 1,400, 120, and 85 mg, respectively. DMAA was the predominant arsenic species detected in the leachate from the three control lysimeters. The rate of arsenic leaching was greater from the CCA-treated wood deck (7%) when compared to wood monofill (0.8%), C&D (0.7%), and MSW (1.8%) lysimeters and both leached enough arsenic to qualify CCA-treated wood as a hazardous waste.

The primary species of arsenic within the CCA chemical is As(V). Over time the speciation of CCA within wood may change during in-service use of the wood and during its disposal, resulting in arsenic releases possibly as As(V) or in some other form. Given that the concentration of arsenic in the wood product is high, the release of a small fraction of the CCA chemical from the wood product can be environmentally significant. The significance of these releases are dependent upon the amount released and the form of the arsenic. The primary focus of this study was to measure the quantity and speciation of arsenic leaching from in-service and disposed CCA-treated wood. These objectives were addressed through two field-scaled studies, a deck and lysimeter (column) study.

OBJECTIVES

**Deck Design.** Two 6-ft x 6-ft wood decks were constructed and placed in the open environment. The surface deck boards of one deck was made from CCA-treated wood and the other from untreated wood. Each deck was placed in an 8-ft x 8-ft x 3-ft untreated resin-coated wooden box built on a 5-degree incline aluminum base. These wooden boxes were lined inside with plexiglass and were underlaid by a leachate collection system consisting of gravel, a perforated drainfield pipe, and an impervious liner. About 1.5 ft of native Florida sand was poured above the geo-textile liner and the deck placed on top of the sand (Figure 1). Rainwater impacting the deck and infiltrating the sand were collected and analyzed for arsenic species.

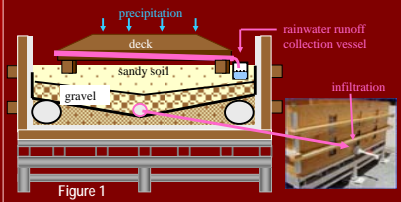


Figure 1

**Lysimeter Design.** Six 20-ft high lysimeters (Figure 2), made of 1-ft diameter PVC columns, were erected outdoors to simulate three different landfill conditions, wood monofill, C&D, and MSW landfills.

**Analysis.** Rainwater runoff, infiltrated water percolating through soil beneath the decks, and leachate from the six lysimeters were collected periodically and analyzed for the arsenic species, As(III), As(V), MMAA and DMAA by HPLC-ICP-MS. The study was conducted for 1 year.

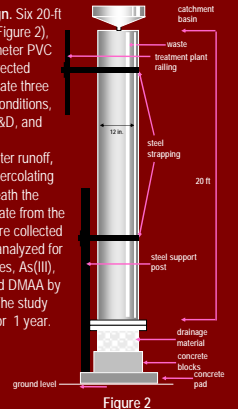


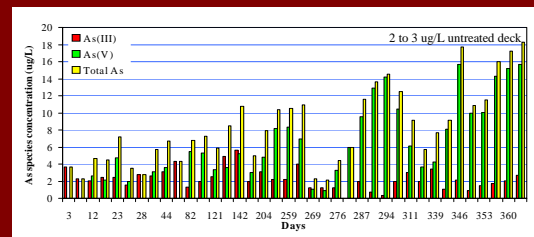
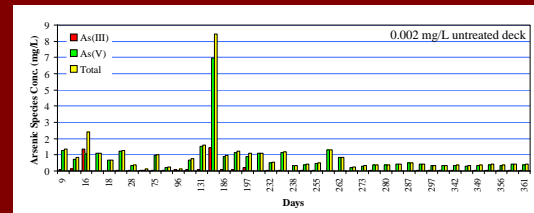
Figure 2



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METHODS

RESULT



RESULT

