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# Release of Arsenic to the Environment from CCA-Treated Wood. 1. Leaching and Speciation during Service

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Insufficient information exists about the speciation of arsenic leaching from in-service chromated copper arsenate (CCA)-treated products and the overall impact to soils and groundwater. To address this issue, two decks were constructed, one from CCA-treated wood and the other from untreated wood. Both decks were placed in the open environment where they were impacted by rainfall. Over a one-year period, rainwater runoff from the decks and rainwater infiltrating through 0.7 m of sand below the decks was collected and analyzed for arsenic species by HPLC−ICP-MS. The average arsenic concentration in the runoff of the untreated deck was 2−3 $\mu$g/L, whereas from the CCA-treated deck it was 600 $\mu$g/L. Both inorganic As(III) and As(V) were detected in the runoff from both decks, with inorganic As(V) predominating. No detectable levels of organoarsenic species were observed. The total arsenic concentration in the infiltrated water of the treated deck had risen from a background concentration of 3 $\mu$g/L to a concentration of 18 $\mu$g/L at the end of the study. Data from the deck study were combined with annual CCA-treated wood production statistics to develop a mass balance model to estimate the extent of arsenic leaching from in-service CCA-treated wood structures to Florida soils. Results showed that during the year 2000, of the 28 000 t of arsenic imported into the state and utilized for in-service CCA-treated wood products, approximately 4600 t had already leached. Future projections suggest that an additional 11 000 t of arsenic will leach during in-service use within the next 40 years.

## Introduction

Chromated copper arsenate (CCA) is a chemical preservative added to wood to protect the wood from biological deterioration. The amount of chemical added to the wood, or retention level, is typically expressed in units of kilograms of CCA chemical per cubic meter of wood. Lower retention wood is used for above ground applications (4 kg/m$^3$), while higher retention wood is used for utility poles (9.6 kg/m$^3$) and poles used in marine environments (40 kg/m$^3$) (*1*). This study focused on evaluating the arsenic component only, although CCA also contains chromium which can be highly toxic in the hexavalent state and net impacts of arsenic releases from the wood can be potentially enhanced by the chromium and copper components of the CCA chemical. Arsenic is added to the wood in its pentavalent oxidation state. Arsenic accounts for 22% of the CCA chemical by weight and the concentration in the treated wood can range from 1900 to 19 000 mg/kg. Given the high concentrations, arsenic leaching from CCA-treated wood structures to surrounding soils poses a possible threat to groundwater supplies. Studies have shown that soils (*2*−*8*) and groundwater (*9*) in close proximity to in-service CCA-treated wood products measured at levels well above natural background concentrations and risk-based regulatory levels. Recent surveys show the "actual" in-service life of low retention CCA-treated wood products such as decks to vary from 9 to 13 years (*10*, *11*) instead of the design life of 20 to 25 (*12*) years. This early retirement of the wood is attributed to aesthetics due to the effects of natural weathering. For higher retention treated wood, the "actual" in-service life is approximately 40 years (*13*) or more (*12*).

While a significant fraction of the arsenic remains fixed into the wood after prolonged environmental exposure, small losses may be of environmental significance due to the large concentrations in the wood and the toxicity of the components (*14*). Arsenic toxicity varies with speciation, with the inorganic species (As(III) and As(V)) considered to be more toxic than the organic species, monomethylarsonic acid (MMAA$^V$) and dimethylarsinic acid (DMAA$^V$) (*14*). Although recent studies have found that trivalent forms of the organic species can be more toxic than the inorganic species (*15*) these forms are believed to be relatively short-lived in the environment and thus measurements of organic forms of arsenic focused on the pentavalent species.

At the end of 2003, arsenic-treated wood was phased out in favor of new alternative wood preservatives for the U.S. residential market and for publicly used facilities (*16*). This transition affected CCA-treated wood structures used for playgrounds, decks, picnic tables, landscaping timber, residential fencing, patios, walkways, and boardwalks. While the phase-out provides a decrease in production rates, the mass of arsenic already released to the soil from preexisting and present-day leaching of CCA-treated wood products is of concern.

Past laboratory leaching studies provide useful insight into preservative leaching from CCA-treated wood products (*17*−*20*), however, very few of these studies measure arsenic species (*21*−*23*) and few evaluate leaching under field conditions (*24*, *25*). None have measured arsenic species released under field conditions. The objective of the current study was to evaluate the overall quantities and species of arsenic leached from in-service CCA-treated wood subjected to natural rainfall conditions. Two decks were constructed and placed outdoors as part of the current study, one made from CCA-treated wood and the other made from untreated wood. Rainwater runoff from the decks and infiltrated water percolating through soil beneath the decks were collected periodically and analyzed for arsenic species (As(III), As(V), MMAA, and DMAA). Results obtained from the decks were

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