

Landfill Disposal of CCA-Treated Wood with Construction and Demolition (C&D) Debris: Arsenic, Chromium, and Copper Concentrations in Leachate

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Although phased out of many residential uses in the United States, the disposal of CCA-treated wood remains a concern because significant quantities have yet to be taken out of service, and it is commonly disposed in landfills. Catastrophic events have also led to the concentrated disposal of CCA-treated wood, often in unlined landfills. The goal of this research was to simulate the complex chemical and biological activity of a construction and demolition (C&D) debris landfill containing a realistic quantity of CCA-treated wood (10% by mass), produce leachate, and then evaluate the arsenic, copper, and chromium concentrations in the leachate as an indication of what may occur in a landfill setting. Copper concentrations were not significantly elevated in the control or experimental simulated landfill setting ($\alpha = 0.05$). However, the concentrations of arsenic and chromium were significantly higher in the experimental simulated landfill leachate compared to the control simulated landfill leachate ($\alpha = 0.05$, $p < 0.001$). This indicates that disposal of CCA-treated wood with C&D debris can impact leachate quality which, in turn could affect leachate management practices or aquifers below unlined landfills.

Introduction

Chromated copper arsenate (CCA)-treated wood was a common residential construction material. While CCA-treated wood is no longer manufactured for residential uses in the United States, projections forecast annual CCA-treated wood disposal quantities to vary between 6 and 10 million m³ in the U.S. through 2030 (1). Even though the CCA-treated wood may be structurally sound for 25 years, research has shown that aesthetic reasons play a large role in when CCA-treated wood structures are removed from service and disposed of (2, 3). CCA-treated wood is contained in

construction and demolition (C&D) debris, which is primarily disposed of in landfills in the U.S. C&D debris may also be targeted for recycling, which typically excludes CCA-treated wood. CCA-treated wood is sometimes inadvertently mixed with C&D debris and contaminates recycled wood mulch (4, 5). On a life-cycle basis, combustion of CCA-treated wood with energy recovery is favorable with proper air pollution controls (1); however, the ash contains high metal concentrations (6, 7). Although research has progressed on new and effective air pollution controls and ash stabilization technologies (8), public and regulatory acceptance of any treated wood combustion remains low worldwide. Significant events creating disaster debris, such as hurricanes (e.g., Katrina), concentrate landfill disposal of CCA-treated wood in one location with unknown future impacts, especially if the landfills are unlined (9).

Historically, C&D debris was considered inert, without putrescible materials like those found in municipal solid waste (MSW) (e.g., food waste). However, research has shown that C&D debris goes through active processes of biological activity that affect both leachate and gas concentrations (10). These active processes can impact the timing and quantity of metals released from any metal-containing treated wood. Twenty-seven states in the United States do not require C&D debris landfills to have bottom liners (11). When CCA-treated wood is managed in the C&D debris waste stream and is disposed in unlined C&D debris landfills, there is concern for the quantity of arsenic, chromium, and copper that may be released in leachate, which could subsequently impact groundwater.

Previous research on CCA-treated wood metal leachability has focused on terrestrial environments and in-service use (12–17) and batch leaching studies (18–20). Studies targeting C&D debris leachate in general have included CCA-treated wood, and the applicable groundwater limit for arsenic (prior to 2006 was 50 $\mu\text{g/L}$) was exceeded by C&D debris with only 0.5% of CCA-treated wood by mass (10, 21). CCA-treated wood has also been leached in a simulated monofill disposal setting, illustrating that arsenic, chromium, and copper leach differently in a simulated landfill setting than batch leaching studies (22).

In a companion paper, Khan et al. (17) included some characterization of the leachate collected as part of the study presented here. However, the Khan et al. work focused specifically on the *speciation* of arsenic released from CCA-treated wood, as well as prediction of arsenic releases from various landfill scenarios in Florida. Chromium and copper results were not evaluated, and Khan et al. did not emphasize other physicochemical measurements that affect metal leachability and solubility in disposal environments. The experiment presented here differs from prior work in that an emphasis is placed on evaluation of the major ion chemistry, including the role of sulfate/sulfides, in influencing the releases of arsenic, chromium, and copper. Specifically, the objective of this research was to simulate the complex chemical and biological activity of a C&D debris landfill containing a realistic quantity of CCA-treated wood (10% by mass), produce leachate, and then evaluate the arsenic, copper, and chromium concentrations in the leachate as an indication of what may occur in a landfill setting.

Materials and Methods

The experiment consisted of the design and construction of simulated landfill environments (leaching columns) followed by the operation of these columns. Both leachate and gas

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