

## Quantities of Arsenic-Treated Wood in Demolition Debris Generated by Hurricane Katrina

BRAJESH DUBEY,<sup>†</sup>  
 HELENA M. SOLO-GABRIELE,<sup>\*,‡</sup> AND  
 TIMOTHY G. TOWNSEND<sup>†</sup>

*Department of Environmental Engineering Sciences,  
 University of Florida, PO Box 116450, Gainesville, Florida  
 32611-6450, and Department of Civil, Architectural and  
 Environmental Engineering, University of Miami,  
 Coral Gables, Florida 33124-0630*

The disaster debris from Hurricane Katrina is one of the largest in terms of volume and economic loss in American history. One of the major components of the demolition debris is wood waste of which a significant proportion is treated with preservatives, including preservatives containing arsenic. As a result of the large scale destruction of treated wood structures such as electrical poles, fences, decks, and homes a considerable amount of treated wood and consequently arsenic will be disposed as disaster debris. In this study an effort was made to estimate the quantity of arsenic disposed through demolition debris generated in the Louisiana and Mississippi area through Hurricane Katrina. Of the 72 million cubic meters of disaster debris generated, roughly 12 million cubic meters were in the form of construction and demolition wood resulting in an estimated 1740 metric tons of arsenic disposed. Management of disaster debris should consider the relatively large quantities of arsenic associated with pressure-treated wood.

### Introduction

The total disaster debris produced from Hurricane Katrina in the two hardest hit states, Mississippi and Louisiana, was estimated at 72 million cubic meters (1, 2). Disaster debris is composed primarily of construction and demolition (C&D) debris (50%) and vegetative wood waste (30%) (3). C&D debris consists of materials used in construction including concrete, roofing materials, drywall, and wood. Vegetative wood waste consists primarily of shrubs, tree branches, and tree trunks. Because of its nature, vegetative waste does not contain wood preservatives. However, wood used for construction is frequently treated to protect the wood from fungi and termite attack. The most common wood treatment preservative manufactured in the United States through 2003 is chromated copper arsenate (CCA) (4). Since 2003, non-arsenical copper-based wood preservatives, such as alkaline copper quat (ACQ) and copper boron azole (CBA), have been primarily used for the residential market. The typical concentrations of arsenic, chromium, and copper in CCA-treated wood used for

residential applications are 1800–2800 mg/kg, 1900–3100 mg/kg, and 1200–1800 mg/kg, respectively (5). Typical concentrations of copper in ACQ and CBA treated wood are 3500–4500 mg/kg and 2500–3500 mg/kg, respectively (5). As a result of these high levels of metals, the C&D portion of disaster debris can be potentially contaminated with metals. Among the metals contained in wood preservatives, arsenic is of primary concern because of its high human toxicity (6).

CCA-treated wood has been commonly observed in C&D waste, as documented through studies conducted in Florida (7–9). Within the wood waste component of C&D, the fraction of CCA-treated wood has been observed to vary from 8 to 22%. Research evaluating technologies for separating treated wood (particularly CCA) from other wood products has been conducted in an effort to remove arsenic contamination due to inadvertent inclusion of CCA-treated wood within mixed C&D debris at recycling facilities. Technologies available for rapid identification and quantification include near-infrared (NIR) spectroscopy, laser-induced breakdown spectroscopy (LIBS), and X-ray fluorescence spectroscopy (XRF) (8, 10, 11). Recently, handheld XRF units have been used for research to document their utility to further augment sorting and quantification of metals within treated wood (9). Such technology, because of portability and provision of rapid results, is ideal for evaluating the potential contamination of disaster debris with wood based preservatives.

The objectives of the present study were to evaluate wood waste generated by hurricane debris for the presence of arsenical-based preservatives (i.e., CCA) and to use these results to estimate the potential extent of arsenic associated with disaster debris. Handheld XRF units were used for this evaluation. Results from the study are useful for establishing policy concerning the management of wood waste after major disasters.

### Methods and Materials

**Site Selection for Study.** Measurements were taken during March 2006 within disaster debris from the New Orleans area. The wood waste portion of the disaster debris was evaluated at seven different sites (Figure 1). Sites included areas with extreme damage characterized by complete collapses of homes and areas where the damage was primarily due to flooding. Among the area with major damage, four sites were selected: two each at Upper Ninth Ward (Sites W1 and W2) and Lower Ninth Ward (Sites W3 and W4). The other three sites (Sites W5 through W7) were located in the inner area of the city where damage was mostly due to flooding.

**Measurement of Chemical Treatment within Wood Waste.** A total of 225 dimensional lumbers were evaluated using an XRF-analyzer (Innov-X model  $\alpha$ -2000S) with at least 24 dimensional lumbers evaluated at each site. The number of lumbers included in the study from a particular site was based upon the apparent volume of wood pile at that particular location, with larger piles resulting in a greater number of analyses. The selection of dimensional lumber for analysis was conducted in a uniform manner with wood pieces tested from different parts of the wood waste pile. Conversion of the XRF readings to As concentrations was based upon a calibration curve between the XRF results and As measurements using traditional atomic absorption analysis for the particular instrument used in this study (12; see Supporting Information for more details.)

\* Corresponding author phone: +1-305-284-2908; fax: +1-305-284-3492; e-mail: hmsolo@miami.edu.

<sup>†</sup> University of Florida.

<sup>‡</sup> University of Miami.