CHAPTER I

INTRODUCTION

Chromated copper arsenate (CCA) is a preservative chemical that is added to wood to prolong its useful service life by 20 to 40 years. The major reason for its use is economic; it is cheaper than other wood treatments. CCA, a waterborne preservative, is applied in a liquid form and forced into the wood under high pressures. CCA-treated wood is usually used for the parts of a structure that come in contact with the ground or outside elements. Wood products treated with CCA include lumber, timber, posts, and plywood. CCA contains copper, which serves as a fungicide; arsenic, which serves as an insecticide; and hexavalent chromium, Cr(VI), that converts to trivalent chromium, Cr(III), which drives the fixation of the copper and arsenic into the wood fibers (Solo-Gabriele and Townsend, 2004.). Two of these metals, arsenic and chromium, are capable of transformations under ambient conditions. These transformations impact the toxicity of the metal, which can have a direct effect on the health of humans and particularly children. Although copper is characterized as having a low human toxicity, it is known to have a high aquatic toxicity. Exposure routes of concern include direct human contact with the treated wood, human exposure to media impacted by the preservatives migrating from the treated wood, and organism exposure to preservative compounds in the environment. Pathways of concern resulting in direct human contact with wood products include those resulting from touching the wood (e.g., dermal sorption and the ingestion of dislodged chemicals from hand-to-mouth contact) and inhaling wood particles during construction and maintenance activities. The wood preservation industry worldwide presently treats approximately 30 million cubic meters of wood each year using 500,000 tones of preservative chemicals. Approximately two-thirds of this volume of wood is treated with CCA (Humphrey, 2002). When looking at the disposal-end management options for CCA-treated wood waste, there are many technological waste management options, but all have their limitations and problems. In Florida, for example, construction and demolition (C&D) wood can contain up to 30 wt% CCA-treated wood (Solo-Gabrile et al., 2003). The preservative chemicals, however, can still leach from CCA wood (from both its unburned and ash forms) in quantities that exceed the regulatory thresholds for landfill disposal. In comparison to C&D debris landfills and MSW landfills, monofills produce the highest leachate metal concentrations (Helsen and Bulck, 2004).

Concern has been raised in the US and Europe about the possibility of arsenic migration to groundwater from the disposal of CCA-treated wood. The US EPA has worked with pesticide manufacturers to voluntarily phase out CCA use in wood products for homes and children's play areas. From December 31, 2003 onwards, no US wood treater or manufacturer has been allowed to treat wood with CCA for residential uses, with certain exceptions (EPA, 2007). The European Union is also considering banning arsenic-treated wood after concluding that "the risks to human health might be greater than previously thought." If a ban is imposed, arsenic-treated wood could be used in Europe only for railroad ties, electric cooling towers, and utility poles. It would not be sold to the public (The Royal Society of Chemistry, 2000).

CCA has been used in Thailand for more than 20 years (Department of Science Service, 1987), so the quantities of discarded CCA treated-wood will increase significantly in the future. At present, there is no regulation regarding CCA-treated wood disposal in Thailand. CCA-treated wood is currently disposed in construction and demolition (C&D) debris dumping sites or in municipal solid waste (MSW) landfill sites, used as a fuel, or stored for future reuse. A rise in concern for the potential hazards of this waste and lack of inside knowledge of the ultimate fate of CCA-treated wood led to this investigation. The TCLP and WET were utilized to analyze the leachate from the burned and unburned CCA-treated wood, and the results were compared with the regulatory standards. In addition, a lysimeter test was implemented to evaluate the leachates of CCA-treated wood in monofills, C&D debris landfills, and MSW landfills.

1.1 Objectives of the study

The objectives of this study are as follows:

1. To conduct batch leaching tests with CCA-treated wood and ash from CCA-treated wood using the TCLP and WET.

2. To determine the levels of arsenic, chromium, and copper in the leachates generated from CCA-treated wood using lysimeter tests.

1.2 Hypotheses

The disposal of CCA-treated wood in landfills for construction and demolition wastes or municipal waste might significantly increase the arsenic, chromium, and copper values in the landfill leachate.

1.3 Scope of the study

Two types of experiments were employed in this study: batch leaching and lysimeter tests. The Toxicity Characteristic Leaching Procedure (TCLP) and the Waste Extraction Test (WET) were the methods used in the batch leaching tests. New CCA-treated soft and hard woods, weathered CCA-treated wood, and ash from the burning of CCA-treated wood were used as samples for the leaching test. The lysimeter tests were conducted in 6 lysimeters. Each lysimeter was filled with different conditions of CCA-treated wood, and the lysimeters simulated the conditions in wood monofills, C&D debris landfills, and MSW landfills. The overview of the study is presented in Figure 1.1.

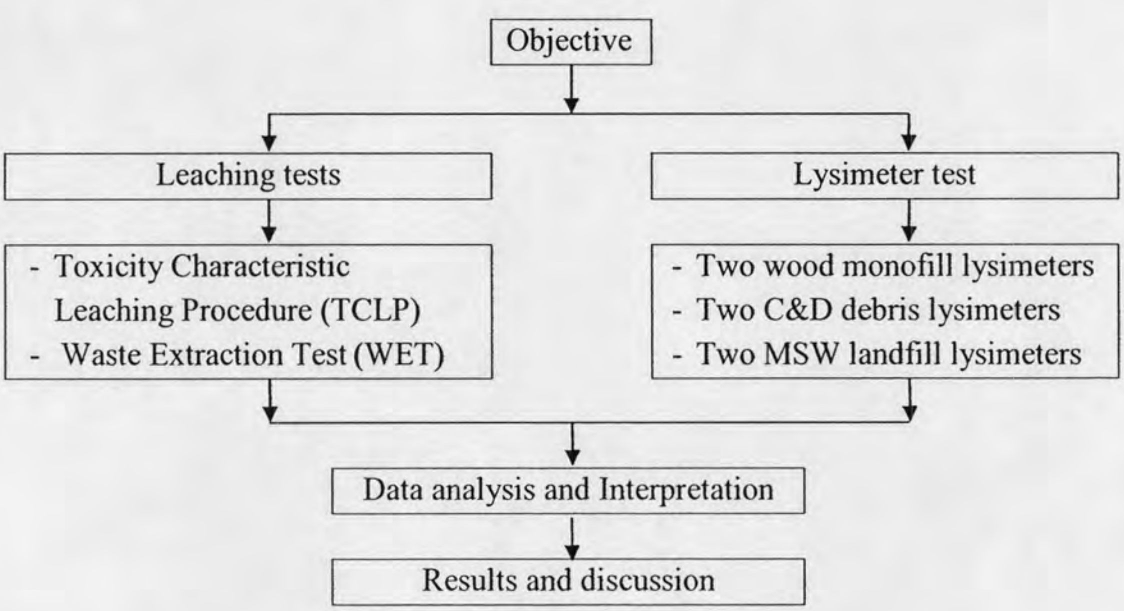

Figure 1.1 Overview of a study