Waste Management 24 (2004) 413–424

waste management

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Evaluation of XRF and LIBS technologies for on-line sorting of CCA-treated wood waste

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Accepted 29 September 2003

Abstract

Contamination of wood waste with chromated copper arsenate greatly limits recycling opportunities for the wood waste as a whole. Separation of CCA-treated wood from other wood types is one means by which such contamination can be removed. The purpose of the current study was to evaluate two detector technologies for sorting CCA-treated wood from other wood types. The detector technologies evaluated included X-ray fluorescence spectroscopy (XRF) and laser induced breakdown spectroscopy (LIBS). The XRF detector system utilized in this study was capable of rapidly detecting the presence of CCA in painted wood, wet wood, heartwood, sapwood, and at portions of the wood containing knots. Furthermore, the XRF system was capable of distinguishing between CCA-treated wood and wood treated with alternative wood treatment preservatives, but was limited by the fact that it was not designed for on-line operation so tests were conducted in a batch mode on a conveyor. The analysis time used in this study (3 s) can be decreased significantly for an XRF system designed specifically for on-line operation. The LIBS system developed for this study was found to effectively identify CCA-treated wood for pieces ranging in thickness from 1 to 8 cm. High sorting efficiencies were noted when 10 laser shots were taken on a piece of wood. Furthermore, the LIBS system was found to be effective for identifying wood that has been coated with stains and paints in addition to identifying wood that has been CCA treated. The major drawback with the LIBS system developed in this study was the limited laser pulse energy. With an increase in laser pulse energy it is anticipated that the working focal length of the LIBS system can be increased to enable the monitoring of wood samples of more variable thicknesses. Limitations associated with analysis of very rotted pieces of wood and wet wood can also be overcome by using a higher pulse energy laser. Overall, both technologies show incredible promise for sorting CCA-treated wood from other wood types. The next recommended step would be to run an improved full-scale operation at one facility to document sorting efficiencies and fine-tune the improvements proposed in the current study. Such a study could potentially open-the-door for more widespread sorting of wood waste.

1. Introduction

Wood waste represents a large component of the construction and demolition (C&D) waste stream, and as such represents a significant opportunity for recycling purposes (Falk, 1997; Alderman and Smith, 2000). Wood can be burned, for example, for cogeneration purposes or it can be used as landscaping mulch. Both of these potential recycling pathways, however, require that the wood be primarily free from contaminants such as wood treatment preservatives, in particular, chromated copper arsenate (CCA) the most widely used preservative in the US (AWPI, 1999). CCA-treated wood contains very high levels of chromium, copper, and arsenic. The amount of chemical added depends upon the intended use of the wood and typically varies from 4 to 40 kg/m^3 (AWPA, 1999). The chromium, copper, and arsenic concentrations as a result of this chemical addition can vary from the thousands to the tens-of-thousands of mg/kg, by weight. Untreated wood generally has less than 20 mg/kg of each metal. As a consequence, CCA-treated wood contaminates untreated waste wood (Townsend and Solo-Gabriele 2001).

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doi:10.1016/j.wasman.2003.09.006