

**Florida Department of Environmental Protection
FY 2006-07 INNOVATIVE GRANT APPLICATION FORM**

Draft Date: October 28, 2005

On-Line Sorting of Recovered Wood Waste Using Automated X-ray Technology

PROJECT ABSTRACT

(No more than 20 lines. Every word over 20 lines will constitute a one point deduction.)
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Dimensional waste wood is frequently contaminated with wood treatment preservatives including chromated copper arsenate (CCA). Because of difficulties in visually identifying treated wood especially after the wood has been weathered, wood treatment preservatives frequently contaminate dimensional waste wood, thereby limiting recycling options for Construction and Demolition (C&D) wood waste. The purpose of the proposed project is to evaluate the use of automated X-ray fluorescence (XRF) systems for identifying and removing CCA-treated wood within recovered C&D wood waste. The study will be conducted at a mid-sized wood waste recycling facility (Florida Wood Recycling) located within the Town of Medley, Florida. The picking line at this facility will be fitted with a slideway and XRF detector which will be designed to inspect each piece of wood in an automated fashion. The accuracy of the system will be documented and the results of the project will include a cost analysis. An earlier Innovative Recycling Grant awarded to the Town of Medley earlier showed that the only accurate means for sorting commingled C&D wood from a picking line is through XRF analysis. However, labor costs were very high (about \$80/ton) when using the hand-held units. This earlier study emphasized the need for automated systems which will decrease labor costs. The cost for an automated system is estimated at about \$40 per ton of wood. The proposed pilot system that is presented in this proposal is new and innovative and has not been implemented within other wood waste recovery facilities in Florida. A total of \$200,000 is requested for this project. Results from this project will be disseminated through seminar presentations, through the internet, and through an outreach program established for local grade school students. The equipment specification and design implemented at the host facility will be available to those interested in implementing automated methods for sorting C&D wood.

PROJECT DESCRIPTION

(1 page)

Motivation: Numerous studies have shown that recovered wood waste, in particular C&D wood waste (a.k.a. dimensional wood), in many instances is contaminated with wood treatment preservatives, the most notorious of which is chromated copper arsenate (CCA). This contamination is observed even when recycling facilities sort based upon the green-hue associated with CCA-treated wood. Even though visual sorting based upon the green-hue does remove some of the CCA, this method is not good enough, in particular if the recovered wood is to be used for mulch or wood cogeneration. Thus there is a strong need to develop methods to improve sorting of treated wood within recovered C&D wood waste

Background: Two earlier Innovative Recycling Grants (IRGs) have shown that x-ray fluorescence (XRF) technology is an effective means for identifying treated wood. Sarasota County during 2000 and 2001 received an IRG for evaluating XRF and laser technologies for sorting CCA-treated wood during a pilot-scale on-line operation. During this Sarasota study XRF technology was found have certain advantages over the laser system, in particular with respect to its capability to detect CCA in wet and painted wood. (Go to http://www.eng.miami.edu/~hmsolo/sarasota/index_sara.htm for more details). The x-ray instrument used in the Sarasota County study was large, bulky (25 pounds), and was not designed to operate in an on-line configuration. Since the work in Sarasota County, smaller more portable hand-held units (3 pounds) were commercially available. An IRG was awarded to the Town of Medley for 2004 to 2005 to evaluate methods to augment visual sorting for treated wood with either PAN Indicator stain or hand-held XRF units. Results of this grant indicated that visual methods plus PAN indicator stain were effective for sorting source-separated C&D wood. However, for commingled wood sorted on a picking line, these methods were not accurate due to the gray color imparted to the wood during the picking line process. The gray dust/dirt on the wood masked the green hue associated with treated wood and interfered with the performance of the stain. The only effective method for sorting commingled wood after removal from a picking line was through the use of XRF technology. The hand-held units utilized in the earlier Town of Medley project were found to be very accurate in identifying CCA-treated wood, from copper-only treated wood, and from untreated wood. However, the drawback of the technology was associated with labor costs as the hand-held units required that the wood be moved through the facility manually. The overall labor needed to manually move the wood along with the 6 second XRF analysis time was estimated at about \$80/ton.

Objectives and Methods: The objective of the current IRG proposal is evaluate an on-line XRF system for automated sorting of treated wood. Specifically, the picking line at the host facility (Florida Wood Recycling) will be fitted with a slideway and an XRF detector designed for on-line sorting. Phase I of the study focuses on the permitting and construction of the system. Phase II focuses on evaluating the performance of the system with respect to the accuracy and ability of the slideway to handle different types of wood observed in the waste stream. The hand-held XRF units purchased through the earlier Town of Medley grant will be used to check the performance of the automated system. Phase III will focus on information dissemination. In order to complete this project, the Town of Medley will collaborate with Dr. Helena Solo-Gabriele of the University of Miami, Dr. Timothy Townsend of the University of Florida, and Mr. Harvey Schneider of Florida Wood Recycling. Drs. Solo-Gabriele and Townsend were the lead investigators in the Sarasota County project and the earlier project awarded to the Town of Medley. They are experts in CCA disposal issues with numerous publications and presentations on the subject (Go to www.ccaresearch.org for a listing of their publications). Mr. Harvey Schneider has over 30 years of experience in the wood waste recycling business and is very pro-active in his desire to test new sorting methods. His facility served as the host facility during the earlier Town of Medley project. His facility is located within the Town of Medley and is in relatively close proximity (about a 20 minute drive) from the University of Miami. Florida Wood Recycling does not accept CCA-treated wood waste. Incoming loads that may contain incidental amounts of CCA wood are sorted and the CCA is disposed of at permitted facilities.

Criteria 1: TECHNOLOGIES

(1 page)

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(35 points) 0-15 points for meeting one of the following sub-criteria, up to 10 more points for meeting two, and up to 10 more points for meeting all three. Note: applicant may adjust space used to address each sub-criteria.

Sub-criteria 1 – Not in common use in Florida

The proposed technologies for sorting CCA-treated wood from the remainder of C&D wood waste is not used in Florida. The use of hand-held XRF units for identifying treated wood is starting within the U.S. Florida Wood Recycling uses hand-held XRF units to check its wood waste. The Mulch and Soil Council in Washington D.C. has purchased an XRF unit for developing inspection programs for mulch facilities. No facilities use automated XRF systems for sorting C&D wood waste.

Sub-criteria 2: Novel application of an existing technology or process.

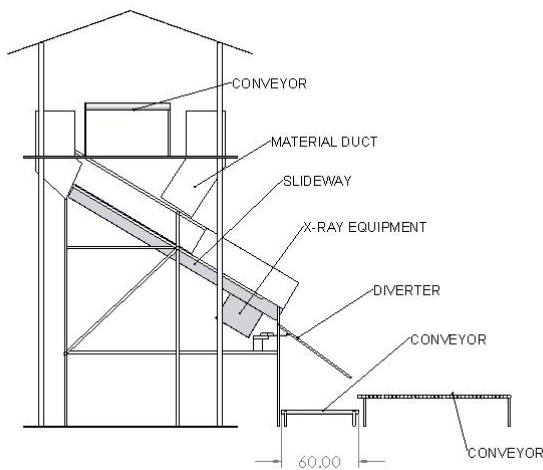


Figure 1: Configuration of the automated XRF system on a slideway located below a C&D picking line. (Diagram provided by Austin AI)

XRF is just starting to take hold in the U.S. for sorting wood waste. XRF is used for hazardous waste identification, identifying soil contamination, and for sorting metals at recycling facilities. However, its application for sorting wood is generally limited. Current known wood sorting efforts with XRF focuses on the use of hand-held units and such sorting is generally limited to spot-checking as the labor costs for manually moving wood are generally high. The automated system (See Figure 1) proposed through this study has not been implemented in Florida or anywhere else in the U.S. for sorting wood waste and is thus a novel application of an existing technology. The purpose of this study is to test this novel application in an effort to document the accuracy and cost-effectiveness of the system.

Sub-criteria 3: Overcoming obstacles to recycling/waste reduction in new or innovative ways. The presence of wood treatment preservatives (arsenic, chromium, and/or copper) represents a major obstacle for recycling C&D waste wood. Many wood recovery facilities in Florida do not accept dimensional wood and, if they do, all the dimensional wood (both treated and untreated) is sent to a landfill. *The implementation of this technology will likely result in the expansion of dimensional wood recycling.* Furthermore, augmented sorting based upon the use of on-line XRF systems will improve the quality of recycled wood from current recycling operations. Contamination of wood from C&D recycling facilities has been well documented through the work of Drs. Townsend and Solo-Gabriele. Their work has shown that C&D wood mulches are frequently contaminated with CCA (See targets section). Although C&D wood recyclers do their best at removing CCA, they are hampered by the difficulty in identifying treated wood, in particular among wood products that are both treated and untreated (2 by 4s, plywood, 4 by 4s, etc). As a result, some mulches sold within the State are contaminated with CCA (See targets section) thereby limiting the expansion of these markets. *Implementation of the proposed technologies represents one step towards assuring that dimensional wood-waste processing facilities provide mulch and wood fuel of high quality, essentially free from metal-bearing wood treatment preservatives, thereby maintaining the viability of existing wood recycling markets.*

Criteria 2: TARGETS

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(10 Points) Demonstrate innovative processes to collect and recycle or reduce these targeted materials/sectors: Construction and Demolition Materials, Commercial/Institutional Sectors, Waste Tires. Note: if the proposed project also includes materials/sectors other than those targeted by this criteria, the project will receive less than the maximum 10 points allocated for the criteria.

Target: The target for this proposal application is Construction and Demolition (C&D waste) which is considered to be a subset of Municipal Solid Waste. Wood waste represents approximately 25% of Florida's C&D waste stream by weight and because of its relatively small bulk density, it comprises an even larger fraction of the C&D waste stream by volume. Contamination of C&D waste wood with CCA has been well documented in Florida. During 1996, wood piles from 12 C&D facilities evaluated contained measurable amounts of CCA-treated wood with an average of 6% CCA-treated wood by weight. Studies at 3 facilities during 1999 confirmed the presence of CCA-treated wood within C&D wood waste with CCA-treated wood representing between 9 and 30% of the wood waste. The wood waste from 1 C&D recycling facility evaluated extensively during 2001 had an average of 22% CCA-treated wood (or 380 mg/kg of As). Thus contamination of the target material addressed in this proposal (C&D wood waste) has been well documented within the State.

Markets for Target: Primary markets for recycled C&D wood waste include wood cogeneration and wood mulch. These markets already exist but contamination of wood sold within these markets has limited the growth of this recycling market. During 1995, data showed that ash from wood cogeneration facilities was contaminated with CCA. A recently completed study initiated to analyze mulch samples from retail stores has shown that about ½ of the red mulch sold in South Florida during the 2002 and 2003 were contaminated with CCA (60 to 220 mg/kg As). Most of the contaminated mulch samples contained plywood indicating that the source of the wood was recycled C&D wood waste. Such results emphasize that sorting methods must be improved if mulch production and wood cogeneration are to remain viable options for recycling C&D wood waste. Furthermore, it is emphasized that many facilities do not attempt to recover the untreated wood portion from untreated wood, thereby sending the wood to landfills. This indicates that there is also opportunity to expand the existing mulch/cogeneration markets for recycled wood waste. The automated sorting method proposed through this study will help in expanding the wood waste recycling market since it can be used to assure a high quality recycled product.

Sectors Targeted: The wood waste recycling sector is the primary sector targeted, in particular for facilities that recycle dimensional C&D wood. Given the capital cost associated with the purchase of automated XRF units (\$90K plus), it is anticipated that this technology would be most useful for medium to large-scale wood waste recycling facilities (facilities that process more than 1200 tons of dimensional wood waste per year). This study will be carried-out at a medium-sized wood waste recycling facility. Once this technology is demonstrated at the medium-scale, it can be scaled-up for processing materials at larger facilities. The team assimilated for this project has been contacted by C&D recyclers including Philip Medico of Southern Waste Systems (previously with Delta Recycling), Tom Roberts of JR Capital Corp (previously with Atlas Recycling), and Bill Turley of the Construction Materials Recycling Association all of whom are interested in possibly incorporating the technology at their large mega-scale C&D recycling facilities. Lee Casey Chief of Environmental Compliance of Miami-Dade County has also exhibited an interest in the technology for screening waste at the 1.2 million ton/yr Montenay Waste-to-Energy facility. The team assimilated for this proposal believes that demonstration of this technology through this proposal will open-the-door for scale-up of the technology for incorporation at these mega-scale facilities, through the use of on-line x-ray sorting systems.

Criteria 3: BENEFITS

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(35 points) Demonstrate the potential economic, environmental, and cost-effectiveness of the program's approach.

Note: applicant may adjust space used to address each sub-criteria.

Sub-criteria 1 - Environmental Benefits (15 points) The implementation of the technology will have two direct environmental benefits: first, it will improve the quality of wood waste produced from C&D recycling facilities and second, it will divert preservative treated wood from unlined C&D landfills.

Methodology: The environmental benefits of this proposed project will be observed through both resource conservation and recycling efforts. The wood recovered through enhanced sorting can be used as a fuel or high quality mulch, thereby reducing our reliance of fossil fuels or reducing our need for using vegetative wood for producing mulch. The sorting technology improves the quality of the recycled product. Currently it is estimated that of the 11 million tons of CCA-treated wood have been sold within Florida and that 4.5 million tons have been disposed to date. The balance (6.5 million tons) will ultimately be disposed. As a consequence, focusing on the recycling-end for this particular product can have major environmental benefits.

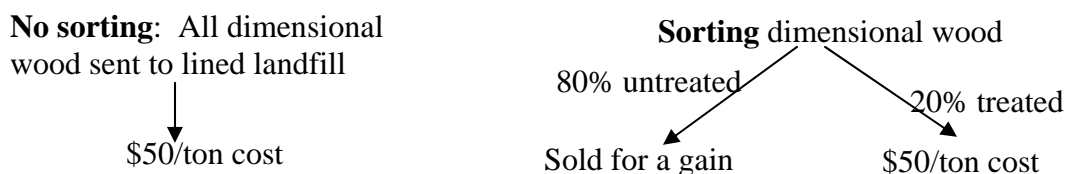
Toxicity: The metals contained in CCA-treated wood are very toxic. Arsenic is the most toxic to humans. Data collected to date indicates that ½ of the red mulches sold at retail stores in South Florida are contaminated with unacceptable levels of arsenic from CCA (60 to 220 mg/kg As). These levels are a factor of 100 times greater than Florida's residential Soil Clean-up Target Levels for arsenic. Removal of CCA-treated wood from recycled C&D wood waste will assure that mulches sold to Florida's consumers will be free of this highly toxic metal, resulting in a direct environmental and health benefits to Florida's consumers.

Sub-criteria 2 – Economic Benefits (10 Points)

The implementation of this technology will serve to expand markets for C&D wood waste. Currently, about 5 million tons of C&D wood waste is generated per year in Florida. Average disposal costs for C&D wood is about \$45 per ton. Recovery of this waste stream thus represents a possible yearly savings of \$23 million in disposal costs which can thus be focused towards recycling efforts. The availability of technologies for assuring high quality wood product will expand existing mulch and wood cogeneration markets for C&D wood. This will have direct economic benefits by increasing jobs within the wood waste recycling industry.

Sub-criteria 3 – Cost Effectiveness (10 Points) Includes, but not limited to cost reduction, payback period, sustainability, and cost-effectiveness.

The proposed technology is cost effective. If CCA-treated wood is not removed from mixed dimensional wood, the most environmentally responsible action would be to dispose the dimensional wood within a lined landfill at an estimated cost of \$50/ton for South Florida landfills. By separating CCA-treated wood from the untreated dimensional wood, the CCA-treated wood portion (estimated at 20% of the wood waste stream) would go to a lined landfill whereas the untreated portion can be recycled and sold (rather than paying \$50/ton for disposal), resulting in a considerable savings. The cost for sorting includes the cost of the slideway and XRF instrument (\$90K) plus labor associated with the sort. It is anticipated that these costs will be small relative to the \$50/ton tipping fee for disposing unsorted dimensional wood. One of the outcomes of the current study is to document the actual costs of automated XRF sorting on a per ton basis.



Criteria 4: TRANSFERABILITY

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(10 Points) Demonstrate transferability of technology and processes and specify how the project will promote transferability. Note: applicant may adjust space used to address each sub-criteria.

Sub-criteria 1 – Transferability of technology and processes (5 points)

The technology will be transferable at two levels. This technology will be directly transferable to wood recycling facilities, in particular facilities that process C&D wood waste. It will also likely encourage C&D processing facilities that landfill C&D wood waste to begin sorting, given that a high quality untreated product can be assured. The research team estimates that this technology will be economically feasible for facilities that process more than 1200 tons of wood waste per year. There are currently about 80 C&D facilities within the State, the majority of which process more than 1200 tons of wood per year. The second level of transferability includes the fact that the technology may be amenable to sorting other types of waste, other than wood. The technology is already used to sort different types of metals in metal processing facilities and different types of plastics. With further development, it is possible that the technology can be expanded to sort more components of C&D waste.

Sub-criteria 2 – How project will promote transferability (5 points)

The sorting method established through this project will serve as a prototype for implementation at other recycling facilities. Standard Operating Procedures will be generated and will be available to facilities that are interested in implementing wood waste sorting. A web page will be set up for the project which will document minutes of group project meetings, interim results, and a copy of the final report for the project. Drs. Solo-Gabriele and Townsend will present the outcome of the project at a minimum of 2 solid waste conferences. Drs. Solo-Gabriele and Townsend have been already approached by 3 C&D recycling facilities, in addition to Florida Wood Recycling, indicating a strong interest in learning about the outcome of such a study. Operational feasibility determined through this study will be made available to other recycling facilities. Articles will be written about the outcome of this project for inclusion within both scientific and lay journals. Lay journals currently considered include *Waste Age* and *C&D Recycler*.

A minimum of 3 project group meetings and 1 Technical Advisory Group meeting will be held throughout the duration of this project. The Technical Advisory Group meeting will be open to the general public and will be extensively advertised through web postings, email to C&D recyclers within the State, and through Dr. Solo-Gabriele's list of 400 email addresses of people that have contacted her concerning CCA research.

Furthermore, the X-ray manufacturers have also initiated strong marketing efforts for implementing the technology within the State. They have already visited several wood recyclers within the State promoting the technology. Implementation of the technology through the proposed effort will greatly improve the credibility of using the technology for sorting wood waste and will greatly enhance the marketing efforts of the X-ray instrument manufacturers.

Finally, an outreach program will be established for local grade school students to visit this particular facility. The Town of Medley has an inherent interest in providing educational experiences for local youth. The University research team will visit local grade school students to discuss recycling issues and the outcome of this study. The Town of Medley Mayor, members of the Town Council, and members of the Town's professional staff have contacts within the local grade schools who can help facilitate outreach to the local grade schools.

