

2004-05 INNOVATIVE GRANT APPLICATION FORM

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Project Information (on applicant letterhead)

- 1) **Applicant Name:** Town of Medley
- 2) **Primary contact person:** Roy Danziger, Town Finance Director
- 3) **Complete Address:** 7331 N.W. 74 Street,
Medley, FL 33166
- 4) **Telephone Number(s) (including SunCom number):** (305)887-9541 x109
(no SunCom Number)
- 5) **E-mail address:** rdanziger@townofmedley.com
- 6) **Project Title:** Augmented Sorting of Recovered Wood Waste Using
Stain and X-ray Technologies
- 7) **Grant Request Amount:** \$150,000
- 8) **Length of project (months):** 12 months

Jack Morrow

Mayor, Town of Medley

PROJECT ABSTRACT

(no more than 20 lines)

Dimensional waste wood is frequently contaminated with wood treatment preservatives including chromated copper arsenate (CCA). In many instances visual identification of CCA-treated wood is difficult, in particular when the wood is soiled or weathered. As a consequence, 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 two innovative technologies for identifying and removing CCA-treated wood within recovered 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 technologies used to augment identification of CCA will include: a) a chemical stain (PAN indicator solution) and b) hand-held x-ray units. The entire waste stream in question (i.e. dimensional wood) from this facility will be sorted for a period of 3 to 4 months using these “augmentation” technologies to document the practicality of implementing these technologies in day-to-day sorting operations. Results from this study will likely encourage the use of these “augmentation” technologies at other wood waste recovery and C&D facilities throughout the State. The proposed technologies, and in particular the x-ray method, are new and innovative and have not been implemented within other wood waste recovery facilities in Florida.

A total of \$150,000 is requested for this project. The bulk of the funds will be used to purchase the hand-held x-ray units and for labor costs, which include researchers from U.Miami and U.Florida and hourly laborers. Results from this project will be disseminated through seminar presentations, through the internet, and through an outreach program established for local grade school students. A set of Standard Operating Procedures will be available to those interested in implementing these “augmentation” technologies at wood waste recovery and C&D recycling facilities.

PROJECT DESCRIPTION

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 recovery 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 CCA-treated wood within recovered wood waste

Background: Earlier research has shown that a chemical stain (PAN Indicator) is a useful tool for identifying CCA-treated wood within C&D wood waste. In these earlier studies the stain was used during a manual sort (no conveyors). The performance of the stain on a traditional picking-line has not yet been documented. An Innovative Recycling Grant was awarded earlier to Sarasota County during 2000 and 2001 for evaluating two technologies (x-ray and laser technologies) for sorting CCA-treated wood during a pilot-scale on-line operation. During this Sarasota study the x-ray 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 (ASOMA Model 400) was large and bulky weighing about 25 pounds. Since the work in Sarasota County, smaller more portable hand-held units (2 pounds) are available which can rapidly identify metals. The particular units currently under consideration are capable of identifying up to 15 metals including arsenic, chromium, copper, lead, and mercury. The analysis time for arsenic within new CCA-treated wood is less than 1 second, making it practical as a tool to augment current wood sorting practices. The performance of the new more portable hand-held x-ray units for sorting wood waste has not yet been documented during either manual sorting or sorting through the traditional picking-line process.

Objectives and Methods: The objective of this innovative recycling grant (IRG) proposal is to document the performance of two “augmentation” technologies for sorting recovered wood waste. Specifically, the performance of these technologies will be evaluated through manual sorting without the use of conveyors (Phase I) and using a traditional picking line (Phase II), since these are the methods most commonly utilized at C&D recycling facilities within the State. The “augmentation” technologies to be evaluated include: a) a chemical stain (PAN Indicator), and b) a hand-held x-ray unit. During phase I, a minimum of 10 tons of dimensional wood will be sorted using the chemical stain and the hand-held x-ray unit to document the speed, costs, and consistency between the analysis methods. Sorting during phase II will take place during a period of 3 to 4 months, with 3 different conditions evaluated during the picking line sort: no augmentation, augmentation with use of the chemical stain, and augmentation with use of the hand-held x-ray unit. Wood waste throughput, labor, and sorting efficiency will be documented during each of these conditions. Sorting efficiency will be checked at the end of each run, by using the x-ray system with longer analysis times to check whether CCA-treated wood was correctly separated from other wood types.

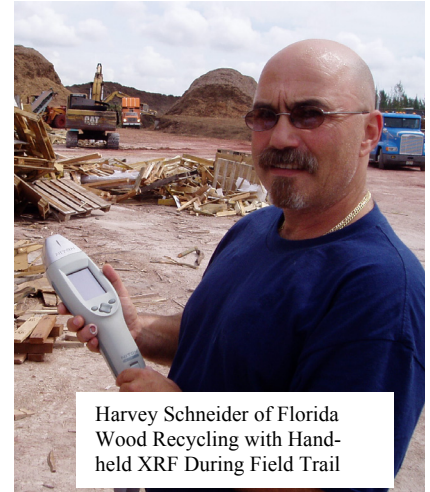
In order to complete this project, the Town of Medley will collaborate with Dr. Helena Solo-Gabriele of the University of Miami, Dr. Timothy Townsend of the University of Florida, and Mr. Harvey Schneider of Florida Wood Recycling. Drs. Solo-Gabriele and Townsend were the lead investigators in the Sarasota County project and 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 is permitted to process 99 tons of wood waste per day. About 50% of the wood processed is vegetative waste and the remaining 50% is dimensional wood. 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. The addition of a new picking line along with augmented sorting is intended to further automate the existing sorting method and to improve the quality of the final product at this particular facility.

Criteria 1: TECHNOLOGIES

Sub-criteria 1: Not in common use in Florida.

The proposed technologies for sorting CCA-treated wood from the remainder of dimensional wood is not used in Florida. During July-August 2003, Drs. Solo-Gabriele and Townsend sent out over 300 surveys to C&D, wood cogeneration, yard waste, and other wood processing facilities throughout Florida. To date 30 surveys have been returned with useable information. Of these 30, none of the facilities reported using either the stain or x-ray technologies for separating CCA-treated wood from other wood types with the exception of one facility that indicated recent trials with the PAN Indicator stain (See table below). Facilities that process dimensional wood for recycling purposes, predominantly sort treated wood by hand. Also of interest from the survey are the large number of facilities that do not process dimensional wood and dispose of the material (both treated and untreated) within a landfill.

No.	Description
10	No sorting of dimensional wood. Process only land clearing debris
2	Accept only pallets in addition to land clearing debris
11	No sorting of treated wood. All dimensional wood goes to a landfill or for wet weather roads on landfills. Most landfills used are Class I, except for one Class III and one C&D landfill.
5	All sorting for treated wood done by hand and/or by spotters who check loads, with the exception of 1 facility that has begun using PAN stain. Recovered dimensional wood used primarily for mulch or cogeneration.
1	Wood re-used through a re-use and exchange center.
1	No sorting. Incidental wood disposed via mass burn incinerator.



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

XRF has not been used for sorting wood waste within Florida, nor within the rest of the country. Few companies make hand-held XRF units. These units are currently marketed by these companies for lead paint screening, metal coating analysis, and in-situ soil analysis. The companies contacted are very interested in expanding the markets for their hand-held XRF units. Niton Instruments, given its interest in expanding markets, provided a hand-held XRF unit for a period of a few days to the research team (free of charge) for preliminary testing at Florida Wood Recycling (See picture above). The results of these tests were outstanding indicating that the instrument can easily indicate the presence of CCA-treated wood within recycled wood waste with analysis times of less than 1 second.

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. As seen from the table above, many wood recovery facilities 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” 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 repeatedly that C&D wood mulches are 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

Target: The target for this proposal application is Construction and Demolition (C&D 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 recent study initiated to analyze mulch samples from retail stores has shown that 6 of the 13 red colored mulches purchased in South Florida during 2003 were contaminated with CCA (60 to 220 mg/kg As). All of the contaminated mulch samples contained plywood indicating that the source 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 from the table shown on the previous page 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 augmented sorting tools evaluated 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-engineered wood. Other sectors include the regulatory agencies since the proposed "augmentation" technologies can be used to spot-check recycled wood waste for enforcement purposes. Given the capital cost associated with the purchase of a hand-held x-ray unit (\$15K to 48K per unit), 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, possibly through the use of on-line x-ray sorting systems.

Additional Targets: Since x-ray technology can identify metals within waste materials, the technology utilized within this study could potentially be used to sort all components of C&D waste. It can easily distinguish between iron versus aluminum containing products. It can easily identify products containing lead and mercury as well. Although the focus of this proposal is on the wood within C&D waste, it is anticipated that the demonstrated success of this technology for wood may open-the-door for sorting other components of C&D waste using x-ray methods.

Criteria 3: BENEFITS

Subcriteria 1 – Environmental Benefits: 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. The contamination of C&D wood waste with CCA has been well documented (see targets section) and it is likely that contamination of C&D wood waste with the chromium, copper, and arsenic from CCA will continue long into the future due to existing CCA-treated structures that will ultimately come out of service. This project will improve the quality of C&D wood waste by removing wood preserved with high concentrations of metals. The direct environmental benefits will include a decrease in arsenic concentrations in wood ash from wood cogeneration and reduction of metals concentrations within mulches provided to Florida's consumers. It is further emphasized that some contaminated C&D wood is disposed within unlined C&D landfills. Sorting of the wood will help to segregate and divert the treated portion towards lined landfills within the State, thereby protecting groundwater resources from contamination.

Methodology: The environmental benefits of this proposed project will be observed through a technology that improves the quality of recycled wood. Source reduction of CCA-treated wood will take effect in the year 2003 through a national industry initiated phase-down for residential uses. However, given the long service life of CCA-treated wood (10 to 40 years on average depending upon where it is used), CCA-treated wood will be observed within the disposal stream for many years to come. 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 Soil Clean-up Target Levels for arsenic which are 0.8 mg/kg for residential areas and 3.7 mg/kg for industrial areas. Removal of CCA-treated wood from recycled C&D wood waste will assure that mulches sold directly to Florida's consumers will be free of this highly toxic metal, resulting in a direct environmental and health benefits to Florida's consumers.

Subcriteria 2 - Economic Benefits: The implementation of this technology will serve to expand markets for C&D wood waste. Currently, due to concerns of contamination, markets for C&D wood waste have been limited with much of it being disposed in landfills. Use of the proposed technology will serve to assure that C&D wood is essentially free of CCA thereby expanding the mulch and wood cogeneration markets for C&D wood. This will have direct economic benefits by increasing jobs within the wood waste recycling industry. This project alone is expected to increase the number of jobs by 6 due to the new picking line and augmented sorting operations to be implemented at the host study facility (Florida Wood Recycling).

Subcriteria 3-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 XRF instrument (\$20K) 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 augmented sorting on a per ton and per cubic yard basis.

No sorting: All dimensional wood sent to lined landfill

↓
\$50/ton cost

Sorting dimensional wood

80% untreated → Sold for a gain
20% treated → \$50/ton cost

Criteria 4: TRANSFERABILITY

Sub-criteria 1 – Transferability of technology and processes

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

The “augmented” sorting methods 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 “augmented” 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 3 Florida solid waste conferences, such as Recycle Florida Today, Florida SWANA conferences, and Florida SWIX 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. A field trip will be established for local grade school students who will be shown the augmented recycling operation at Florida Wood Recycling and who will be taken to the Medley landfill (just down the street) to learn about recycling and disposal of solid waste within their community. The Town of Medley Major Jack Morrow, members of the Town Council, and members of the Town’s professional staff have contacts within the local grade schools who can help facilitate the participation of the students.

Criteria 5: LOCAL SUPPORT

A summary of local support for this proposed project is provided in the table below. The Town of Medley will provide an in-kind contribution in the form of administrative support. The costs for preparing and executing the contract for this project are estimated at about \$5,000. The University of Miami will provide an in-kind contribution in the amount of \$15,225 by waiving 75% of the tuition for the student supported on this project. The University of Florida will provide an in-kind contribution in the amount of \$6,250 by waiving 48% of the tuition for the student supported on the project.

A picking line will be constructed for this project. The picking line will consist of an infeed hopper and line conveyor capable of handling up to 16 pickers. Inflow will be loaded via an excavator equipped with a grapple. The cost of the line, the front-end loader and an excavator is estimated at \$350,000. The costs associated with the design, permitting, and construction of this line will be incurred by Florida Wood Recycling, the host facility for this study.

Niton Instruments has committed to provide two hand-held XRF instruments at greatly reduced costs. Two instruments will be purchased for this project (one with an ¹⁰⁹Cd source and another with an ²⁴¹Am source). Each of these sources has its advantages (see budget justification on next page). The list price of the instrument with the ¹⁰⁹Cd source is \$29,000 and the list price of the instrument with the ²⁴¹Am source is \$38,000. These instruments will be provided by Niton Instruments for this particular project at a cost of \$17,500 and \$20,000 respectively, resulting in an in-kind contribution of \$29,500 (\$29K + \$38K - \$17.5K - \$20K). Depending upon the success of this project and the demand, Niton Instruments has indicated that they can design and market a wood-specific unit for the wood recycling sector. The current units have many accessories that are not needed for wood sorting purposes including a bar code reader for logging samples, soil preparation kit including a grinder, computer memory chip for 3000 samples, and computer interface. Furthermore, there are many different metals that can be analyzed with the existing units. If the number of metals of interest can be reduced (say to arsenic and copper only) and the unnecessary accessories associated the units can be reduced then the cost of the instrument supplied to the wood recycling sector can also be reduced. Niton estimates that the reduced costs of the wood-industry specific unit would be about \$17,500 and \$20,000 for the ¹⁰⁹Cd and the ²⁴¹Am units respectively, which is the price at which they will supply the study with their current off-the-shelf XRF units.

Agency	Description of Cost Match	Amount
Town of Medley	Administrative Costs	\$5,000
University of Miami	75% of tuition for student supported on project	\$15,225
University of Florida	48% of tuition for student supported on project	\$6,250
Florida Wood Recycling	Cost of picking line including all permitting and construction fees	\$350,000
Niton Instruments, Inc.	Reduced Cost for 2 Hand-Held Units	\$29,500
TOTAL		\$405,975
Percentage Match = 100%* 409,950/150,000		270%

Applicant: Town of Medley	Project Title: Augmented Sorting of Recovered Wood Waste Using Stain and X-ray Tech.
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Budget

(1) Tasks	Categories								Local Match		(12) Total Grant Request
	(2) Personnel	(3) Travel	(4) Equip- ment	(5) Supplie s	(6) Contract- ual	(7) Constructio n	(8) Other	(9)* Total Budget	(10) In-Kind Match	(11) Cash Match	
Start Up , including equipment purchases, finalizing experimental plan, initiating web page, and hosting project team meetings. (5 months)	\$13,691	\$500	\$432,738	\$6,500			\$9,473	\$462,902	\$395,238		\$67,664
Phase I: Sort 10 tons by hand using stains and hand-held XRF, (1 month)	\$22,927	\$1,000		\$574			\$500	\$25,001	\$10,738		\$14,263
Phase II: Sort using a picking line. Sorting will be done using both stain and hand-held XRF, (4 months). Please note that permit for picking line has approved.	\$43,401	\$2,000		\$2,000			\$4,475	\$51,876			\$51,876
Information Dissemination: Prepare SOP, prepare final report, presentations at meetings, information dissemination, (2 months)	\$14,197	\$2,000						\$16,197			\$16,197
TOTALS	\$94,215	\$5,500	\$432,738	\$9,074	\$0	\$0	\$14,448	\$555,975	\$405,975	\$0	\$150,000

Percentage Match = 270% approx

Budget Explanation/Justification

Personnel: Funds are provided for an equivalent of 1 month of Dr. H. Solo-Gabriele's salary and for 0.5 month of Dr. T. Townsend's salary. Funds are also provided for a UM graduate student (9 mo. at \$1500/month plus 25% tuition costs) & for a UF graduate student (6 mo. at \$1500/month plus 52% tuition). Funds are provided for 5 hourly laborers for a period of 4 months at a cost of \$9.10 per hour which includes the base wage plus insurance costs.

Travel: Funds are provided for the UF team to travel to Medley for research and for travel to seminars and conferences.

Supplies: Supply funds include the costs for a laptop computer used to collect data from the XRF units (\$1,200 estimated), a weighing scale (\$2,000 estimated) and for chemical stains (\$1,000 estimated). Misc. supplies are estimated at about \$4,874.

Equipment: Two hand-held XRF units will be purchased: one containing a ²⁴¹Am source at 14 mCi (Niton XLP712, \$20,000) and another containing a ¹⁰⁹Cd source at 40 mCi (Niton XLP702, \$17,500). The ²⁴¹Am source has a 1/2 life of 400 yrs which does not require replacement but the signal from this source is not as sensitive as the ¹⁰⁹Cd source. The 1/2 life of the ¹⁰⁹Cd source is 15 mo. so it would have to be replaced every 5 yrs or so. Both instruments will be tested to determine the effects of the sensitivity and the half-lives of each unit.

Other: Other costs include indirect costs associated with contracts to U.Miami and U.Florida (\$9,473), the costs for use of a front end loader to move wood (\$2,500), and the costs for the disposal of CCA-treated wood that has been sorted out (\$2,475).