Agenda for TAG Meeting
Monday, July 9, 2001, 10 am to 2 pm
Knights Trail Park, Nokomis (Sarasota County), Florida

<u>Introduction</u>

1.	Welcome	
2.	History of Florida CCA Research	Solo-G/Townsend

<u>Florida Center for Solid and Hazardous Waste Sponsored Research (FCSHWM)</u> with Florida Power and Light, matching funds

4.	Background Information Concerning FCSHWM	Schert
5.	Year 4 & Year 5	
	- Leaching of Alt. Chemical Treated Wood (Yr 4)	Stook/Townsend
	- Toxicity of Alt. Chemical Treated Wood (Yr 5)	Stook/Townsend
	- Arsenic Speciation at Landfill Facilities (Yr 4)	Khan
	- Complimentary Study on Cr Speciation	Townsend/Song
6.	Proposed Research Plan Submitted to the FCSHWM for 2001-2002	

<u>Sorting Study</u> (Sarasota County, Innovative Recycling Grant)

7.	On-Line Sorting Technologies for CCA-Treated Wood	
	- Shelter	Carlsen/Townsend
	- Conveyor	Hosein/Solo-Gabriele
	- Detector	Hahn/Moskal/Solo-G
	- Experimental Results	Hosein/Moskal/Carlsen
8.	Future Innovative Recycling Grant Proposal	Solo-Gabriele

9. Field Trip to Observe Sorting System in Operation
(The meeting will likely break at about 1:00 pm for the field trip)

Refreshments Will Be Available.

Minutes of the July 9, 2001 Meeting Held at Knights Trail Park Sarasota County (Nokomis), Florida

<u>Attendees</u>

Kevin Archer, Chemical Specialties Inc., Charlotte, NC
Gary Bennett, Sarasota County, Nokomis, FL
Bhaskar Bondada, University of Florida, Soil and Water Science, Gainesville, FL
Robert Brickner, Gershman, Bricker & Bratton, Inc., Fairfax, VA
Yong Cai, Florida International University, Dept. of Chemistry and Southeast Environmental Research Program University Park, Miami, FL
James Cooper, Florida Department of Agriculture and Consumer Services, Tallahassee, FL
David Dee, Landers & Parsons, Tallahassee, FL
Louis Divita, Delta Recycling Corporation, Pompano Beach, FL
Huck DeVenzio, Arch Wood Protection, Smyrna, GA
Alicin Drescher, Florida Power & Light, West Palm Beach, FL
Keith Drescher, Florida Power & Light, West Palm Beach, FL
Jim Gabbert, Meyer & Gabbert Excavation Contractors Recycling, Sarasota, FL
Bill Gay, Langdale Forest Products Co., Valdosta, GA
Myron Georgiadis, Florida International University, Miami, FL
David Hahn, University of Florida, Gainesville, FL
William Hinkley, Florida Department of Environmental Protection, Tallahassee, FL
Naila Hosein University of Miami, Coral Gables, FL
Gary Hurst, Robbins Manufacturing, Tampa, FL
Gary Jacobi, University of Miami, Coral Gables, FL
Jenna Jambeck, University of Florida, Gainesville, FL
Jodi John, Sarasota County Resource Conservation, Sarasota, FL
Russell Ketchem, Florida Power & Light, West Palm Beach, FL
Bernine Khan, University of Miami, Coral Gables, FL
William Krumbholz, Dept. of Env. Protection Solid Waste Division, Ft. Myers, FL
Marc Laurent, Metro-Dade County Dept. of Solid Wste. Mgt ., Miami, FL
Donna May Sakura Lemessy, University of Miami, Coral Gables, FL
Lena Ma, University of Florida, Soil and Water Science, Gainesville, FL
Dave Mason, Southern Forest Products Association, Kenner, LA
Jerry McMullan, Florida Power & Light, Riviera Beach, FL
Tom Moskal, University of Florida, Gainesville, FL
Mel Pine, American Wood Preservers Institude, Fairfax, VA
Nina Powers, Sarasota County Public Works, Sarasota, FL
Joe Prager, Author, Gainesville, FL
Jay Robbins, Robbins Manufacturing Corporation, Tampa, FL
John Schert, Florida Center for Solid & Haz. Waste Management, Gainesville, FL
Jim Seufert, Universal Forest Products, Grand Rapids, MI
Helena Solo-Gabriele, University of Miami, Coral Gables, FL
August (Gus) Staats, Osmose Wood Preserving Division, Griffin, GA
Cathy Staats, Osmose Wood Preserving Division, Griffin, GA
Donald Surrency, Koppers Industries, Inc., Gainesville, FL
Tim Townsend, University of Florida, Gainesville, FL
Matt Valentine, Kessler Consulting Inc., Tampa, FL
Ed Zillioux, Florida Power and Light Company, Juno Beach, FL

The meeting began at 10:00 am. The meeting adjourned for lunch between 12:00 and 12:30 noon. The group left for the field trip to view the CCA-treated wood sorting system at 1:15 pm. The field trip ended at 2:00 pm.

1. Welcome

Jodi John welcomed the audience on behalf of Sarasota County. Helena Solo-Gabriele thanked the meeting attendees for their participation. Each member of the audience introduced themselves by stating their name, affiliation, and their home city/state.

2. History

Helena Solo-Gabriele mentioned that funding for this project was received from the Florida Center for Solid and Hazardous Waste Management, Florida Power and Light, and Sarasota County. Faculty researchers on the project included herself from the University of Miami and Dr. Timothy Townsend of the University of Florida. Both she and Tim Townsend have been working on the research for the past 5 years. Dr. David Hahn, also from the University of Florida and an expert in laser technologies, began working with the research team roughly 1 and ½ years ago. Dr. Yong Cai from Florida International University recently joined the team a few months ago and provides expertise in arsenic speciation. A list of students working on the project was provided and included the names of students whose research was to be presented. Background information for CCA-treated wood was presented including information concerning retention levels, Florida's soil background concentrations for arsenic, and disposal guidelines for arsenic. This project was initiated 5 years ago as a result of an ash disposal problem. The focus of the research during the first year of the project (1996-1997) was to develop a mass balance for CCA-treated wood for the State of Florida. Results indicate that the quantities of CCA-treated wood are projected to increase significantly in the near future. It was found that the primary disposal routes for CCA-treated wood was through construction and demolition facilities where the wood is either disposed in an unlined landfill, used as wood fuel, or recycled into mulch. During year 2 (1997-1998) the focus of the research was to develop tools by which to better manage CCA-treated wood within the disposal stream. The research focused on evaluating the leaching characteristics of CCA-treated wood ash and on developing methods to separate CCA-treated wood from other wood types. The results of the leaching studies indicated that ash would be considered hazardous if CCA-treated wood represented only 5% of the wood burned. It was also found that solvents can be used to extract metals from the ash. Citric acid was found to be a promising solvent for arsenic removal. Methods to separate CCA-treated wood from other wood types included the use of chemical stains and x-ray methods. During the third year of the research (1998-1999) disposal-end management strategies were again evaluated. The focus of this year's study included field work with the chemical stains to separate CCA-treated wood from other wood types, a literature review of pyrolysis technologies, and development of a resource book for the wood disposal sector. Non-arsenical wood preservatives were also evaluated during the third year of study through an in-depth literature review. The four most promising alternative chemicals identified included ACQ, CBA, CC, and CDDC. During the summer of 1999, the research team was invited to Minnesota's proceedings where a ban on CCA-treated wood was discussed. Scientific data was lacking during these proceedings and the research team as a result requested supplemental funds from the Florida Center to address new lines of research which included a soil/deck study, evaluating use sectors for CCA-treated wood, leaching of CCA-treated wood and C&D debris wood mulch, and literature reviews for new analytical methods. Two types of soil samples, surface and depth, were collected during the soil/deck study. Results from the surface samples indicated that CCA-treated decks significantly increase the arsenic concentrations in the soils located below them. Arsenic concentrations in the soils consistently exceeded the Florida Department of Environmental Protection's Soil Clean-up Target Level for industrial areas. The results from the depth samples indicate that the arsenic impacts are observed down to a depth of 8 inches. Recognizing that roughly 39 square miles are covered by CCA-treated decks, the approximate amount of soil impacted by CCA-treated wood in the State of Florida is thus 60 million tons. Results from the use sectors of CCA-treated wood indicated that roughly 16% of the arsenic in CCA is found in marine docks, 5% in utility poles, and the remainder is associated with CCA-treated products for which alternative wood preservatives are available. Results from the updated disposal forecast indicate that roughly 1600 tons of arsenic per year are imported to the State of Florida associated with CCA-treated wood. The cumulative quantity of arsenic imported into the State associated with CCA is estimated at 29,000 tons, a quantity that can significantly impact the environment if not properly managed upon disposal. Leaching studies of CCA-treated wood indicate that particle size plays a significant role in the amount leached. CCA-treated sawdust will consistently exceed toxicity limits. Results from three EPA leaching tests, TCLP, SPLP, and EPTox, showed similar quantities of arsenic leached. Leaching was much higher when California's WET test was used. Mulch leaching tests showed that C&D debris wood mulch, yard waste mulch, and colored mulch will exceed the State's Groundwater Clean-up Target Levels for arsenic and on a few occasions for chromium. The current status of on-going research was summarized. This on-going research will be the focus of the presentations that follow.

<u>Questions</u>

Kevin Archer: A presentation refuting the results from the disposal forecast was presented at the last conference of the American Wood Preservers' Association. Scott Conklin was the author of the paper. Has the research team had the opportunity to review that paper?
Response: We have requested a copy of that paper directly from Scott Conklin, from George Parris the co-author of the work, and from the American Wood Preservers' Association. We have not received the paper yet and the research team has thus not been able to comment on it.

John Schert: Is the chemical stain specific to arsenic?
Response: The ones shown on the Powerpoint presentation were not specific to arsenic. We have obtained a formulation, through Kevin Archer and Lehong Jin, for a stain specific to arsenic. We have tested the chemical in the lab; however, the chemical is water based and does not soak into the wood easily. Some more work is needed to modify the formulation so it soaks easily into treated wood.

Nina Powers: Were the age of the decks evaluated and was there a correlation between the age of the deck and the arsenic concentration in the soil?
Response: The age of the decks were known. However, correlations between age and soil arsenic concentrations were not observed. Reasons for this are because of the relatively few decks evaluated and because some decks were replaced at the same site as new decks. For example, the lifeguard stand sampled in Miami-Dade County was replaced shortly after Hurricane Andrew at possibly the same site. Also, the bridge deck at Tom Brown Park in Tallahassee was replaced using the pilings from the previous deck. There were too many variables other than deck age that affect the quantity leached.

Dave Mason: Were decks sampled or were they walkways?
Response: It depends upon how you define a deck. The research team considers a deck to be any wood structure that is laid parallel to the ground. Walkways would therefore be considered decks. The decks sampled included a walkway to a bathroom facility, a ramp for a lifeguard stand, and a couple of bridge walkways.

Yong Cai: Chromium is present as Cr(VI) in the wood treating solution and then it converts to Cr(III). What causes this conversion?
Response: The conversion is called fixation by the wood treatment industry. It is dependent upon temperature and time.

John Schert: Are there other similar soil/deck studies?
Response: Yes, there is a list of soil/deck studies that have been compiled by the Environmental Working Group. One of the studies was conducted by Stillwell who evaluated decks in Connecticut. The results between the Florida study and the Stilwell study are comparable. Currently there are a lot new studies that have been initiated due to increased public awareness. Tampa and Orlando have compiled some additional data.

John Schert: I have heard that the U.S. Environmental Protection Agency plans to compile a list results from such studies.

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3. Background Information Concerning the FCSHWM

John Schert mentioned that the Florida Center was initiated in 1988. The Center funds 6 to 10 projects per year. The Center requires that two TAG meetings be held per year for each project. The CCA meetings tend to be more heavily attended than other meetings.

4. Year 4 & 5

Tim Townsend presented the results from the experiments conducted on alternative chemical treated wood. The work with alternative chemical treated wood was separated into two parts: leaching and aquatic toxicity. Dr. Townsend acknowledged his graduate student, Kristin Stook, who conducted the experiments and who recently graduated. The rationale for the project came from the perception that alternative wood preservatives had advantages over CCA with respect to disposal and human toxicity. Aquatic toxicity was also debated due to the higher concentrations of copper found in the alternatives. The objectives of this study were to conduct a side-by-side comparison of CCA-treated wood and alternative chemical treated wood with respect to chemical leaching and aquatic toxicity of leachates. This data can be used as part of an overall assessment of preserved wood types. Currently the leaching and aquatic toxicity analyses have been completed. The research team has not yet fully analyzed that data nor has developed recommendations addressing the results. The wood preservatives evaluated included CCA, ACQ, CBA, CC, and CDDC. All of the alternatives contain copper and an organic co-biocide. Eight 16 foot long untreated samples of Southern Yellow Pine were selected and cut into 2 foot sections. One two foot section from each original board was bundled and sent out for treatment. The 2 foot long samples were cut in half and one half was archived at the University of Miami and the other half was used for analysis by the University of Florida. The wood samples were cut and ground. A set of four leaching tests, which included SPLP, TCLP, dionized water, and synthetic seawater, was conducted on each sample. Inorganic analysis of the leachates was conducted on an ICP-AES. Various methods were utilized for the organics analyses. The results from the leaching tests showed that arsenic generally leached less in the seawater extract, whereas copper was readily extracted in seawater. TCLP was the most aggressive extractant for chromium. The leaching of the organic chemicals was generally independent of the type of leaching fluid. The most copper was extracted from copper citrate on a mg/L basis, followed by ACQ, CBA, CDDC, and CCA. The mass percent leached for copper proceeded in a similar sequence except that CBA had a slightly higher % leached than ACQ. If the percent leached of all the metals are considered, then the mass of metals leached from CCA (%) would be higher than the mass of metal leached from ACQ and CDDC (%). The mass percentage of the organic components that leach from alternative chemical treated wood is chemical specific. The remaining work for the leaching study includes boron analysis and the interpretation of the results.

Tim Townsend acknowledged the assistance received from Dr. Gabriel Bitton and his Ph.D. candidate Marnie Ward for the toxicity analysis portion of this study. The reason that aquatic toxicity studies were conducted was because chemical leaching data can not account for other factors that affect aquatic toxicity, such as complexation, binding, interaction, etc.. The toxicity tests conducted included MetPLATE, Microtox, an algal assay, and an invertebrate assay. MetPLATE was developed by Dr. Bitton. The test is a measure of the metal bioavailability. Microtox is a general toxicity assay that is based on the decrease in bioluminescence of the marine organism *Vibrio fisherii*. The algal assay is a chronic toxicity assay based upon the use of the algae, *Selanastrum capriconutum*. The invertebrate test was based upon measurements of *Ceriodaphnia dubia*. The units of toxicity include EC_{50}, LC_{50}, and IC_{50} which are provided in either mg/L or %. The % units is the % of the toxicant needed to cause 50% mortality. The lower the EC_{50}, LC_{50}, and IC_{50} the more toxic the leachate. A comparison of the toxicity tests were provided for the SPLP leachate produced from CDDC-treated wood. Results show that the invertebrate test and the algal assay were more sensitive to the CDDC leachate given their lower EC_{50} or IC_{50} values. Between chemical preservatives the alternative chemicals appear to be more toxic to *C. daphnia* than CCA. The results were variable between the two CCA samples for algal toxicity and thus it is difficult to interpret the relative toxicity of CCA versus that of the alternatives for this particular assay. Tim Townsend discussed the potential for using copper as a surrogate for evaluating toxicity. The next steps of the research are to conduct the hormonally active agent assay, determine the relative contribution of copper and co-biocides to aquatic toxicity, and make recommendations concerning how to use the data in the decision-making process.

<u>Questions</u>
Gary Hurst: What was the retention level of the wood samples evaluated?
Response: The target retention level was 0.25 pcf.

Bob Brickner: How many samples were evaluated?
Response: Each analysis was conducted in triplicate. For example, one sample was evaluated by TCLP in triplicate, SPLP in triplicate, etc..
Bob Brickner: Will the raw data be included in an appendix?
Response: Yes.

Bill Hinkley: I met with a representative from Arch Chemical who told me that copper azole did not contain boron. Is this true?
Huck DeVenzio: There IS boron in copper azole.
Bill Hinkley: Is there boron in ACQ?
Kevin Archer: Yes, it is used as a corrosion inhibitor.

Bob Brickner: Was the original retention level at 0.25 pcf?
Huck DeVenzio: Copper Azole has a different retention level.
Response: True, the wood samples were treated for above ground application so the CCA sample was treated to 0.25 pcf and copper azole was treated to the equivalent of 0.204 pcf.

Ed Zillioux: How many samples were run?
Response: For the algal test, the leachates were evaluated in triplicate and at the different dilutions as required by the test.

Bob Brickner: How many pieces of wood did you start with for the toxicity tests?
Response: There was one sample of untreated wood, two samples of CCA-treated wood, one sample of copper azole, etc… Each sample was a composite of 8 boards. Eight 16 foot untreated boards were purchased and cut into 2 foot long segments. One two foot piece from each board was grouped into a bundle and was then shipped to the wood treaters for treatment.

Bill Hinkley: Toxicity has been a huge issue for the Florida Department of Environmental Protection (FDEP), especially given the media attention given to the potential for dermal exposure. Copper releases are an additional concern. Permits have been denied for use of CCA-treated wood in marine applications. The concern with respect to copper stems from three issues. First the FDEP has developed threshold effect levels and probable effect levels for sediments. The threshold effect level is 19 mg/kg. Second, the use of alternatives to CCA is of concern for decks used over wetland areas. Third, the soil clean-up target level for copper is 105 mg/kg in residential areas and 12,000 mg/kg in industrial areas. These limits are set based upon possible gastro-intestinal effects rather than on potential carcinogenicity. The potential copper releases are a big issue.

Joe Prager: What samples will be analyzed for hormonally active agents (HAA)?
Response: The CCA-treated wood samples, the untreated wood sample, and the samples of alternative chemical treated wood.

Ed Zillioux: What endocrine disrupters are expected?

Response: The organic co-biocide in CDDC is suspected.
Bill Hinkley: Arsenic is considered an endocrine disrupter for humans.
Ed Zillioux: The research team should consider expanding the scope of the research to include tests on fish, both freshwater and saltwater. The distribution of resources should be considered.
Response: The tests chosen were those readily available through the University of Florida.
Bill Hinkley: The FDEP also focuses on benthic organisms and mollusks. Are there particular benthic organisms or test mollusks that can be considered?
Response: The FDEP does have benthic organisms. Currently there are no plans to conduct toxicity tests with such organisms. The research team is open to conducting such tests, however.

Joe Prager: Evaluation of endocrine disrupters is extremely vital, especially since the results can be used to evaluate potential impacts to humans.

Nina Powers: There are concerns about copper. Copper is a known algacide. The EPA is concerned about aggregate and cumulative effects of copper. There is not much data available concerning these effects. Also it is important to consider other chemicals, not only copper or arsenic, because of the potential for synergistic effects. There is a need to evaluate the real world, especially combinations of chemicals that can be found in the environment. Are there other chemicals available through the wood treatment industry?
Response: The toxicity tests currently conducted look at multiple effects. Copper was not evaluated independently of the other chemicals. It would be of interest to determine how much of the toxicity observed was due to the copper and how much was due to other chemicals.

John Schert: Please mention your other project evaluating endocrine disrupters in solid wastes.
Response: The HAA test came about because of that project.
David Dee: Why are you evaluating endocrine disrupters with respect to landfills?
Response: There are chemicals introduced into landfills that are suspect endocrine disrupters.

<u>Arsenic Speciation of Leachates and Groundwater at Landfill Facilities</u>

Bernine Khan defined speciation as the various species of an element which make up the total concentration of that element. Different species are characterized by different oxidation states. Some species are organic whereas others are inorganic. The reason speciation is of importance is because some species are more soluble than others and toxicity is a function of the arsenic species consumed. The most toxic arsenic species is a gas known as arsine. Arsenite [As(III)] is the most toxic form found in water followed by arsenate [As(V)]. The methylated forms of arsenic, MMA and DMA, are less toxic than As(V). AsB and AsC which are organic forms of arsenic typically found in shellfish are considered to be essentially non-toxic. The mobility of arsenic is strongly a function of the oxidizing conditions (Eh) and the acidity of the system (pH). Field sampling methods for the collection of groundwater and leachates samples were described. The samples are analyzed for total-total arsenic and for total-dissolved arsenic. Speciation analysis is accomplished using an HPLC-HG-AFS. Total arsenic concentrations are measured using an ICP-MS. Results of groundwater speciation analysis to date indicate that the concentration of As(III) and As(V) is much higher than the concentration of MMA and DMA. Leachate data indicate that the total dissolved arsenic concentration is significantly less than the total arsenic concentration as measured by ICP-MS. Such results indicate that a significant fraction of the arsenic is "non-labile" indicating that it is not readily converted to the hydride form needed for HPLC-HG-AFS analysis. Matrix interferences were found to have a negligible effect on the results. Current work focuses on quantification of arsenic species from C&D landfills. Future work will focus on evaluating the speciation of the leachates from CCA-treated wood and CCA-treated wood ash from TCLP and SPLP tests. Also, samples from lysimeters will be analyzed for various arsenic species.

<u>Questions</u>
Bob Brickner: There was no comparison between the total amount of arsenic found in construction and demolition landfill leachate versus that in municipal solid waste leachate.

Response: The purpose of the slide that provided the leachate values was to emphasize that the arsenic was present in the inorganic form rather than in the less toxic organic form. The totals are different but the number of samples available is limited.
David Dee: The total arsenic concentration in MSW leachate appears to be higher than the arsenic concentration in C&D leachate. It appears as though the threat of arsenic is C&D leachate may not be as significant.
Bill Hinkley: How were the samples collected at the C&D facility?
Response: With a bailer.
Bob Brickner: How representative was the sample collected? The integrity of the sample will have an impact on the quality of the results.
Bill Hinkley: Currently the arsenic data collected from C&D facilities is difficult to interpret. Monitoring at C&D facilities was required as of 3 years ago. The data collected by the individual C&D facilities may or may not be good. From the leachate side, there are a small number of lined C&D cells.
Bob Brickner: In a previous study, an old MSW landfill was torched and a C&D facility was constructed above it. A paper referenced this work as a C&D site and subsequent references led to more confusion. The research presented here is cutting-edge research. However, it will be important to properly report information that is relevant.

Joe Prager: The data indicate that there is not much bacterial breakdown.
Response: The data show that there are no measurable levels of the methylated forms of arsenic in the leachate or groundwater.

Question: Has the migration of arsenic been evaluated?
Response: It would be of interest to evaluate potential migration of arsenic; however, that was not evaluated in this study.

<u>Complimentary Study on Chromium Speciation</u>

Tim Townsend mentioned that funding for the chromium speciation study was provided through the Florida Department of Environmental Protection. He also acknowledged his graduate student, Jin-Kun Song, who performed most of the laboratory work. The most common oxidation states of chromium are 0, +3, and +6. This study focuses on Cr(III) and Cr(VI). Cr(VI) is much more toxic and mobile than Cr(III). This difference is reflected in solid waste regulations which state that, "a solid waste that is a characteristic or listed hazardous waste solely because of chromium is not hazardous if: a) the chromium in the waste is exclusively present at Cr(III), and b) the waste is generated from an industrial process which uses trivalent chromium and the process does not generate Cr(VI), and c) the waste is typically managed in non-oxidizing environments." The US EPA soil screening guidance levels for Cr(III) is 78,000 mg/kg and for Cr(VI) is 390 mg/kg. Cr(VI) is typically found in alkaline and strongly oxidizing environments. Cr(III) usually is found in moderately oxidizing and reduced environments. The speciation of chromium between Cr(III) and Cr(VI) is a function of both Eh and pH. The form of chromium in the CCA solution is as Cr(VI). Upon fixation in the wood, Cr(VI) is converted to Cr(III). Cr(VI) may be encountered if the wood is improperly fixed or when the wood is in contact with oxidizing chemicals such as deck brighteners. In the environment, chromium tends to exist as Cr(III). Oxidation of Cr(III) to Cr(VI) can occur in the presence of manganese (hydr)oxides. Cr(VI) can be analyzed using a colorimetric or using ion chrdomatography. Tasks for the current project include a literature review, assessment of pH and ORP as indicators of chromium speciation, evaluating the kinetics of conversion of Cr(VI) to Cr(III) in natural soils, and development of a guidance document. The kinetic study uses 3 different soil types including a clay soil, an organic soil, and a sandy soil. These soil samples have been spiked with CCA solution to add a known amount of Cr(VI). Cr(VI) and total chromium concentrations in the soil are being measured over time. Leachable Cr(VI) and Cr(III) are also being measured. Measurement of chromium in the soil requires an alkaline digestion of the samples. Cr(VI) is measured using a standardized test based upon the use of ion chromatography. Preliminary results indicate that Cr(VI) in the organic soil is more readily converted to Cr(III). Conversion is not as extensive in the sandy and clay soil. Similar observations were observed in the leachable fraction. Future work includes completing the kinetic study, measuring Cr(VI) in various environmental matrices, and preparation of the guidance document.

Questions
Bill Hinkley: Was Cr(VI) versus Cr(III) evaluated in the soil in the deck study?
Response: Chromium speciation was not evaluated in the original soil samples. It would be of interest to go back and collect fresh samples and evaluate those samples for chromium speciation. Cr(III) would be expected in the soil unless deck cleaners were used which could potentially oxidize Cr(III) to Cr(VI).

5. Proposed Research Plan Submitted to the FCSHWM for 2001 – 2002

Helena Solo-Gabriele mentioned that the objectives of the research that has been recently funded include: evaluating the impacts of CCA-treated wood within simulated landfill conditions, b) evaluating the impacts of CCA-treated wood ash, and c) identifying major arsenic inputs and reservoirs within the State. Phase I of the project focuses on arsenic speciation of leachates from simulated landfill conditions. The design of the lysimeters and the methods for analyzing the leachates was presented. Phase II focuses on ash leaching. The samples used will be those that have been archived from the 1998 study. Phase III will focus on evaluating various arsenic reservoirs in order to better evaluate the significance of arsenic in CCA relative to the arsenic from other potential sources. Reservoirs to be evaluated include an arsenical pesticide (MSMA), coal, aquifer media, phosphate mines, shellfish, and wastewater sludge. Inputs and outputs evaluated include rainwater, rivers, air emissions, and the quantity exported in fertilizer. The timeline for the project is from July 1, 2001 to September 30, 2002.

Questions
Jodi John: What type of waste will be used to fill the lysimeters?
Response: The composition of the C&D waste is based upon EPA's 1997 study and dissertation work conducted at the University of Florida. MSW was collected from West Palm Beach from the residues from well drilling.

6. On-Line Sorting Technologies for CCA-Treated Wood

Helena Solo-Gabriele mentioned that the objective of the study was to design and implement an automated system to effectively sort CCA-treated wood from other wood types at C&D facilities. Project tasks include constructing the shelter, constructing the conveyor, lab testing the detector, installing and field testing the conveyor and detector, and operating the sorting system to document performance. Jenna Jambeck described the agencies involved in the construction of the shelter and the timeline for its construction. The control room was built with recycled materials by Meyer and Gabbert. Helena Solo-Gabriele described the design and installation of the conveyor. Jenna Carlsen described the preliminary results from the wood sort which included a pallet study where 100 pallets were evaluated and 0 were found to be treated. Additional wood sorts included the evaluation of 3 construction piles and 1 demolition pile. The fraction of CCA-treated wood in the various waste piles was 9%, 65%, 17%, and 10%. The two detectors evaluated in this study were a laser detector (laser induced breakdown spectroscopy, LIBS) and x-ray detector (x-ray fluorescence spectroscopy, XRF).

The theory of LIBS was described by David Hahn. The tasks associated with the LIBS portion of the work included: acquiring the laser and spectrometer components, interfacing the spectrometer to the computer for data acquisition, designing the optics and detector package, constructing the prototype detector system, synchronizing the spectrometer data acquisition with the firing of the laser, interfacing the output trigger signal with the computer for firing the strobe light upon CCA detection, building the detector mount, and field testing the instrument. The detector configuration, data acquisition system, and instrument synchronization were described. The results from single laser shots on treated wood and untreated wood were shown with respect to the threshold value used to distinguish between CCA-treated wood and other wood types. Data show that single-shot analysis has a 92% accuracy for treated wood and a 95% accuracy for untreated wood. The 10-shot average was 100% accurate for treated wood and 99% accurate for untreated wood. The characteristics of the output signal, a set of strobe lights, were described. Results of the work to date indicate that LIBS is capable of detecting CCA-treated wood in the field and the strobe enables on-line sorting with accuracy approaching 100%. Future work will focus on assessing the accuracy of the LIBS-based detector and on formulating improvements.

Naila Hosein mentioned that XRF technology has proven to work well and has been used extensively by many wood treating plants to test retention levels. The technology has been standardized by the American Wood Preservers' Association. The instrument used for the current study is a Spectro-ASOMA model 400. The theory of XRF analysis was summarized. Results of the XRF analysis indicates that the instrument can easily distinguish between CCA-treated wood and untreated wood. This distinction is possible when the wood is wet or dry, and even when the wood is coated with various paints, stains, and water sealants. XRF analysis can also easily distinguish CCA-treated wood from wood treated with other non-arsenical wood preservatives. CCA-treated heartwood was found to provide a lower signal than CCA-treated sapwood, which is as expected given that heartwood does not retain the CCA chemical very well. Results from the distance study indicate that the presence of CCA within a sample can be detected up to a 2 inch distance from the wood sample. The main advantages of the XRF system are that the results are very consistent and that it can distinguish the level at which the wood sample is treated. The disadvantages of the system are that the equipment that the team has been using has not been customized for on-line use. The detector must be within a 1inch distance of the wood sample. Also, from a safety perspective a 6 inch radial distance must be maintained from the detector due to the emission of low level x-rays.

<u>Questions</u>
Lou DiVita: Can you explain why the particular samples evaluated were near the threshold?
Response: For that particular sample, one side would be detected as treated and the other side would be detected as untreated.
Lou DiVita: Does moisture impact the ability of the laser to detect treated wood?
Response: When the wood is wet the particular laser used in this study loses its ability to discriminate between treated and untreated wood. However, this can be overcome by using a more powerful laser. A more powerful laser can be purchased for a few extra $1,000. The more powerful laser should be able to discriminate between treated and untreated wood when the wood is wet.
John Schert: Can you explain why the sample detected treated wood on one side and untreated on the other?
Gus Staats: Probably one side consisted of heartwood and the other consisted of sapwood. Heartwood does not absorb the CCA chemical very well whereas the sapwood does.
Dave Hahn: Only a small percentage of the samples gave us this sort of trouble.
Lou DiVita: Were these samples analyzed using the chemical stains?
Response: Yes, the samples were analyzed using the chemical stains. They will be analyzed using the x-ray detector shortly.
Dave Dee: Can the system be scaled-up for a fully operational facility?
Response: The purpose of this study was to demonstrate the feasibility of the technology. The technology is very feasible. In order to scale-up the system, additional sensors will need to be added to identify the length of each piece of wood and some logic must be added to actuate the shear arm in a more automated fashion. There is definite potential to scale-up the system.
Bob Brickner: Has the research team heard about the electrostatic separator developed for aluminum cans?
Response: There has been a considerable amount of work developing the output signals for sorting purposes, such as glass sorters. There is a considerable amount of information available concerning control theory and processing.

7. <u>Future Innovative Recycling Grant Proposal</u>

Helena Solo-Gabriele mentioned that the Innovative Recycling Grants Program will not be continued next year and, unless other sources of funding are identified, the experimentation with the sorting system will likely end in August 2001.

8. <u>Field Trip to Observe the Sorting System in Operation</u>

The meeting adjourned at 1:15 pm after which most attendees at the meeting went to the sorting facility located at the Meyer and Gabbert C&D Recycling Facility. The field presentation included a demonstration of the operation of the chemical stains, XRF system, and the LIBS detector. The field trip ended at 2:00 pm.