Quarterly Report of

EVALUATION OF THERMAL PROCESSES FOR CCA WOOD DISPOSAL IN EXISTING FACILITIES

To
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Progress Report (December 2004 – February 2004)

In the previous quarterly report (Sep – Nov 2004), we had proposed to accomplish literature review for identification of potential sorbents for control of heavy metal emission during incineration of CCA wood and their leaching from ash and design a laboratory-scale incineration system for future experimental work. In this quarter, we have completed the identification of potential mineral sorbents based on literature review and have designed the system for the first phase of experiments. In addition, we have also conducted a few batches of experiments for the 1st phase and are currently analyzing the results.

An extended literature review reveals that many mineral sorbents can successfully prevent volatilization of CCA metals. However, in most of the 'heavy metal – sorbent' interactions, leaching of heavy metals from the product may be the limiting condition, and only limited leachability data is available. So the experiments are being conducted in two phases to obtain insights into the metal – sorbent interaction and to determine the optimal material and operating conditions for combustion of CCA treated wood.

Phase 1: The prime objective in the 1st phase of experiments is to screen sorbents based on their leachability characteristics. Fifteen potential sorbents were shortlisted based on past studies. Out of these, six were eliminated by comparison of their performance relative to each other. Emphasis was laid on selecting those sorbents which are readily available and inexpensive so that it is practical to use them in combustion facilities. Table 1 shows the list of sorbents being used in Phase 1.

Table 1: Properties of sorbents being used for metal capture in Phase 1 experiments

Name of Sorbent	**Chemical formula**
Calcium Hydroxide	$Ca(OH)_2$
Silica	SiO_2
Diatomaceous Earth*	$Si_{106}Al_{4.6}Ca_{0.3}Mg_{0.5}Fe_2O_{229.5}$
Alumina	Al_2O_3
Kaolin	$H_2Al_2Si_2O_8$-H_2O
Attapulgite Clay*	$Si_{16}Mg\ H_{3.6}O_{5.9}$
Bauxite*	$Si_{0.3}Al_{40}Ca_{0.2}Ti_{0.3}Fe_2V_{0.02}H_{120}O_{124.3}$
Cement*	$Si_9Al_3Ca_{29.3}S_{0.8}H_3Fe_1O_{57}$
Magnesium Hydroxide	$Mg(OH)_2$

*Approximate molecular formula based on % composition. Varies according to mineral composition

In the 1st phase, pure chemicals (containing CCA metals) are being used to obtain data regarding leachability and speciation of CCA metals on application of sorbents. While the wood composition may affect the 'sorbent–metal' interaction, the use of pure metal compounds will provide fundamental baseline to understanding the nature of interaction between sorbents and heavy metals. Table 2 column 4 shows the information about the metal compounds which are being used in the metal spike. While choosing the metal compounds, care has been taken to ensure that the anions don't interfere with the experiment. Twenty grams of sorbent was chosen based on their stoichiometric reaction ratio and also to have a mass based comparison between different sorbents. The reaction mixture consists of 50 ml of metal spike containing the three metal compounds and sorbent. It is placed in a 75 ml porcelain crucible and heated in an Isotemp programmable forced draft furnace at three different temperatures; 700^{o}C, 900^{o}C and 1100^{o}C.

The residue shall be analyzed by

- TCLP on residue
- Determination of mass of metal in residue using Acid Digestion and ICP
- XRD to determine the speciation of crystalline products in residue

Table 2: Experimental Calculations

CCA compounds	**% composition of CCA Type C (by weight)**	**Molar ratio of CCA metals**	**Metal Compounds used in Metal Spike**	**Mass ratio of metal compounds based on their molar ratio in CCA Type C wood (grams/50 ml)**
CuO	18.5	1	$Cu(NO_3)_2.2.5H_2O$	1.54
CrO3	47.5	2.05	$Cr(NO_3)_3.9H_2O$	5.62
As_2O_5	34	1.27	As_2O_5	1

Experiments have already been conducted on the sorbent-metal spike samples at 700^{o}C & 900^{o}C. The residue is currently being analyzed using the above mentioned methods and the results will be reported in the next quarterly report.

Phase 2

Sorbents shortlisted after Phase 1 will be combusted with CCA wood to evaluate their effectiveness in suppressing volatilization and leaching using a reactor simulating actual combustion conditions. The optimal operating conditions and materials will be determined in this phase of experiments.

Table 3: Timeline for completion of major milestones

Milestone		**2004**				**2005**							
		S	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**
TAG Meeting			•								•		
Task 1 – Inventory of Existing Wood-Fired Capable Facilities		•	•	•									
Task 2 – Evaluation of Potential Materials for Preventing Arsenic Leaching from Incineration Product	Phase 1			•	•	•	•	•	•				
	Phase 2								•	•	•	•	•
Task 3 – Survey of Available Pollution Control Technologies								•	•	•	•		
Evaluation of Data		•	•	•	•	•	•	•	•	•	•	•	•
Preparation & Peer Review of Final Report										•	•	•	
Submittal of Final Report													•

The green boxes represent the work done as against the total work as set in the timeline in the project proposal.

Website Development: To make the information related to this project accessible to general public, we have developed a website which contains basic information related to this project. The website can be accessed at http://combustcca.ees.ufl.edu . The website is updated periodically.

Work to be accomplished in the next quarter (Mar – May 2005)

- Completion of Phase 1 Experiments
- Design of laboratory-scale incineration system for Phase 2 Experiments
- Preliminary Experiments for Phase 2