Biochar Characterization Standard Meeting Minutes

Meeting Title:	Phase 2: Live review of characterization criteria and reporting levels
Date:	July 26-27, 2011
Location:	Frankfurt, Germany

Attendees:

Name	Organization
Keith Driver	Leading Carbon – CA
Alison Lennie	Leading Carbon – CA
Kelpie Wilson	IBI – US
Johannes Lehmann	WG1 – US
Marta Camps	WG2 – NZ
Stephen Joseph	WG2 – AU
Saran Sohi	WG2 – UK
Cordner Peacocke	CARE - UK
Michael Sesko	Encendia Biochar – US
Edward Someus	3R Agrocarbon – Hungary/Sweden

Agenda: -

26 July

1. Introductions
2. IBI Vision and Meeting Goals & Purpose
3. Past-History of Process
4. Review of document, and all supplementary material – including scope
5. Discussion of Scope: Initial discussion of materials, vision, document overview, how document fits with IBI vision, thematic changes…
6. Feedstock identity and Pyrolysis process (to what level should IBI limit/control these?)
7. Review of all document text prior to classification tables
8. First review of classification tables and test selections

27 July

1. Review of IBI Vision, Meeting Goals & Purpose
2. Continued discussion of classification tables and test selections
3. Continued discussion of classification tables and test selections Test levels and methodology selections, formal annotation, all decisions final!
4. Review of Appendix and reporting requirements
5. Review of entire document and final notation
6. Final review of entire document, identification of challenges & problems for classification

The following provides a summary of the issues discussed and the decisions made:

IBI Vision and Meeting Goals

The purpose of the Guidelines document is to provide guidelines and methods for characterizing a biochar material. The Guidelines will not address production methods or prescribe specific uses for specific materials.

Document Scope

Discussion:

Do the Guidelines provide the basis for characterizing a material or a product? How do we address biochar that is sold as part of a mixture? Who will be responsible if the user does not like the results? Who is the primary audience for the Guidelines and who will apply the label?

Decisions:

- The Guidelines apply to biochar as a material, including biochar as an ingredient in a blended product.
- A "Fit-For-Use" approach should be taken to addressing biochar properties.
- The producer bears the responsibility for the quality of the product and for making sure that the characterization is carried out according to the Guidelines and for providing the information on the label.
- IBI will not provide any instructions for using the material. That is up to the producer and/or the distributor of the product.
- The Guidelines are to help identify characteristics that contribute to the utility of the product and to identify characteristics that may represent potential risks to its use in soil. A higher class of biochar represents a more fully-characterized material, not one that performs better for any particular use.

Biochar Definition and Process Requirements

Discussion:

Not specifying processes, but need to require that producers comply with local regulations and follow good practices. Require biochar be tested for self-heating and flammability. Need to be process agnostic, but want to make sure that biochar has a minimum threshold of fused aromatic pyrolytic C. Could have C stabilization requirement in efficiency terms – percentage of original C that is stabilized. Would need to separate out C already stabilized - carbonates or bone. Need a measure of how stable. What about hydrochars? H:C ratio will distinguish hydrochars from biochars. Need to define carbonization.

Decisions:

- Biochar defined as solid material obtained from carbonization of biomass.
- Carbonization defined as reductive thermal processing.
- All references to process control dropped from General Biochar Process Requirements, but provided indication that process guidance could be found via IBI document (with link)
- Requirements to follow local regulations, best practice and material safety data are retained.

Feedstock Requirements and Testing Classes

Discussion:
Do the current feedstock classifications make sense? Is Virgin/Non-Virgin the best description of feedstocks? Are the current 7 categories based on Virgin/Non-Virgin and degree of testing the best approach? Need to address cost of testing and not require tests that are not needed. Which characteristics should be reported as declarations and which should be required to meet threshold values? Which characteristics should be assigned to which testing classes? How are diluents and contaminants to feedstocks handled? Are plastics and other fossil fuel-derived materials diluents or contaminants? Need to define these terms clearly.

Decisions:

- Change Virgin/Non-Virgin to Unprocessed/Processed feedstocks. Define Unprocessed as "biomass that has not gone through chemical or biological processing."
- Reduce classes to 3 testing levels with the basic level for Unprocessed Feedstocks and additive levels for Processed Feedstocks and Advanced Analysis and Enhancement Properties.
- Define diluents as inorganic material (such as dirt and sand) and contaminants as an "undesirable material that compromises the quality or usefulness of the biochar." No limit on diluents (some are added deliberately to make organo-mineral complexes), but limits on ash content will have the effect of limiting diluents.
- Limit contaminants to 2% by dry weight of total feedstock. (which are different from diluents by being potentially harmful – glass shards, plastics, metal pieces, etc.)

<u>Content of Testing Classes, Testing Methods and Thresholds – Level 1</u>
Discussion:
Moisture level changes over time – at what point will it be measured? Should there be a minimum level to protect against self-heating and dust? Need particle size information. Should measurements be based on dry weight or wet weight? Electrical conductivity is a measure of solubility of ash – should it be added to Test Level 1? Why have both liming and pH? Is liming a utility or a safety characteristic? Require total N or available N? Are biotoxicity tests reliable? What is the best way to determine C stability? What is the level for ash content? It is easier to determine total ash than to determine C_{org} (because of the challenge of measuring carbonates), so it makes more sense to put a limit on ash.

Decisions:

- Measure moisture at the same time as other values. No minimum level. Levels are up to producers who must provide safe material handling instructions. Drop the available water measurement.
- All measurements will be based on dry weight.
- ASTM method for progressive dry sieving chosen for particle size distribution.
- EC is moved to Level 2.
- Liming is needed as measure of buffering capacity. Need pH for acid materials.
- Available N is enhancement property for Level 2. (liming is a longer-lasting property than pH, which will change upon mixing of biochar with other materials.)
- Retain the biotoxicity tests as substitutes for measuring PAH directly.
- $H:C_{org}$ ratio is the best way to understand stable C. Use H:C:N analysis by dry combustion, determine C_{org} using HCl addition and construct $H:C_{org}$ ratio – this is directly related to O:C ratio from literature. Use 0.7 value as threshold after Spokas (2010).

- Measure ash using ASTM loss on ignition method. 50% threshold is about the right balance.

Content of Testing Classes, Testing Methods and Thresholds – Level 2
Discussion:
Should we add chlorine to this level? PCBs? What are the acceptable values for dioxin? It is naturally occurring in soils, but acceptable levels in amendments are extremely low. Will the biotoxicity tests address PAH? Is this the right test level for available N,P,K? Not useful to measure CEC – it changes too quickly. No need for measure of crystalline silica. EC is related to ash levels. Should we base declaration of boron, Cl, Na on EC level? Need test for mineral N as mineral N will likely be different from available N.

Decisions:
- Chlorine added as declaration.
- Move all metals to Level 2. Change from range of values to specific thresholds for some, declaration only for boron, sodium and chlorine.
- EC and available N,P,K are appropriate for Level 2 as basic enhancement properties.
- PCBs, dioxins and furans moved to Level 3.
- PAH moved to Level 3.
- CEC and crystalline silica will not be included in any levels.

Content of Testing Classes, Testing Methods and Thresholds – Level 3
Discussion:
What are best methods for measuring PAH, dioxins and furans? Literature shows that soils methods will work for biochar. Biochar has an affinity for PAH in soils – unless biochar is high and soil is low in PAH, then it can be a source. Should use EPA numbers for total PAH, not bioavailable. Surface area and porosity is in Level 3 – but which methods? BET, iodine or CO_2? Many things are being measured: pores, surface area and surface adsorption. There are 13 different tests for activated carbon depending on the use. Biochar science is not yet clear on the function of these properties in soil and SA does not always correlate with adsorptivity. But, even so, these measurements are useful for comparing biochars and for research. Iodine method is best for metals adsorption – useful when biochar used for soil remediation.

Decisions:
- Use US EPA methods and thresholds for PAH, PCB, dioxin, furan.
- Use ASTM iodine method for porosity and surface area.

Product Marking and Instructions
Discussion:
How will the Certification program work? Self-certification or certified labs? Role of authorities?

Decisions:
- This section will not define the Certification program but set out the reporting requirements for the program.
- The sample label will not include the IBI logo at this time.

- Reporting requirements will include information on feedstock material and diluents, country of origin for feedstock and manufacture, and test results. We will also require producers to provide instructions to the user on handling and storage of the material.

Conformity and Record Keeping

Discussion:

Testing frequency is the main issue due to cost. More frequent testing is better, unless you can justify less frequency based on consistent results. Batch processes more variable. Need to base on throughput or on time. Tonnage should be based on dry feedstock. Variations in process conditions of 10% are standard Quality Assurance approach.

Decisions:

- Testing frequency will be every 600 metric tonnes or every 6 months or after material change in feedstocks or process conditions
- Specify that labs must be accredited