Biochar Characterization Standard Meeting Minutes

Meeting Title:	WG1 and WG2 Third Conference Call
Date:	22 February, and 2 March 2011
Location:	Conference call

Attendees:

Name	Organization
Keith Driver	Leading Carbon – CA
Alison Lennie	Leading Carbon – CA
Ian Kuwahara	Leading Carbon – CA
Joseph Pignatello	WG1 – US
Johannes Lehmann	WG1 – US
Jason Aramburu	WG1 – US
Sunguo Wang	WG1 – CA
Jim Amonette	WG1 – US
René Pigeon	WG1 – CA
Marta Camps	WG2 – NZ
Stephen Joseph	WG2 – AU
Lukas Van Zwieten	WG2 – AU
Amran Salleh	WG2 – MY
Saran Sohi	WG2 – UK
Balwant Singh	WG2 – AU

Agenda: -

1. Brief Introduction of participants in attendance
2. Administrative notification of intent to schedule fourth call in mid-April. (may be a single global working group call)
3. Brief overview of strategy from previous call, and work done based off of working group "homework" submissions.
4. Outline of revised Draft Standard with a focus on the homework/classification document
5. Next Steps:
    a. Product Classification to undergo more directed discussion with working group, mediated via e-mail and/or web-based Survey Monkey to assess appropriate scale of property testing (e.g. allowable amounts of toxins).
    b. Revision of classification scheme and document to accommodate most appropriate labelling approach
    c. Revision/refinement of definitions (e.g. "virgin feedstock")
6. New draft of classification standard to be delivered in mid-April, prior to working group call.

The following provides a summary of the issues discussed on each of the working group calls.

WG1 – Meeting 22 February, 2011

Recommended to develop a volunteer list to help sort out testing meths for particular contaminants/qualities.

Flow Chart Review:

Class IV – why only labelled as heterogeneous?
Re-arrange to have Class IV in center, between Heterogeneous and Virgin. Or wide enough to encompass both of them.
Numbering 1-V, 2-V, 3-V vs I, II, III, IV is confusing. Figure out better nomenclature/numbering approach.
Top-down vs bottom-up orientation?
OR turn it sideways? L to R orientation would avoid confusion.

Classification Test Selections:

OECD tests (germination, worms), look at actual test methodology to understand the type of soil to be used, why it is used, and whether it is easily achieved by any lab anywhere in world. Is it a % soil % biochar blend that would be used, or what? Pure biochar doesn't make sense, but soil blends are very subjective.

Recommended that a supplementary reasoning document is produced to justify the use and selection of test methodologies within the biochar characterization testing. (e.g. why NSW EPA test?, why OECD, why ISO etc. etc. etc.)

Class I (basic heterogeneous)

Why using C-stability via ASTM methodology when O:C ratio is a better & more applicable test for fixed C? (b/c of difficulty and accessibility of test. Class I should be easy, class III/IV has the O:C test & allows for a higher classification if used).

Volatile C matter notation useful as a mention of nutrient value for microbes: 1 - fixed C – ash = volatile C (b/c the ash/fixed C/volatile are all proportions of total C through ASTM method) Proximate analysis

ASTM 1762 as char for fuel may not be best for sequestration assessment, but it is more readily accessible as a test.

Edinburgh chemical oxidation test is being developed, but is expensive. ISO method as well (ISO 562; ASTM 7582 via R. Pigeon)

Testing at 450 or 550 degrees allows for soil-level or less-than-immediate testing b/c of time needed to degrade materials. (vs full combustion at higher temps) accelerated vs normal soil, but not incineration.

Total Ash & EC both needed b/c ash = ph-ish, & EC addresses salinity (soluble salts)

Dust size definition is needed to address flammability/explosiveness & inhalation/lung injury risk How best to address particle distribution? Size & limitations needed. Moisture content helpful? OSHA flammability USA standard look up.

Class II

Liming: delete from class II (put it only in one spot; ensure consistency across all certification levels Heterogeneous and Virgin feedstocks)

PAH, PCB, Furan, Dioxin to be moved to Class III (may allow tests to be waived (dioxin, furan, PCB) with declaration of feedstocks, but how to prove & document?)

PAH move debated, but maintained in class III due to cost & accessibility of test Needed for addressing incomplete combustion (look up associated health risks…)

- PAH is hard to avoid, but usually at low levels, with 90% of chars (Sunguo/AITF tested) produced being under limits
- PAHs are a big concern for food, crops & health

PCBs: Move PCB to class III b/c of cost & test accessibility

- Not produced in combustion; only produced from contaminated feedstocks (Cl containing) (e.g. plastics, pulp & paper mill sludge/waste)
- Furan & dioxin small amounts found in contaminated & chlorinated feedstocks
- Need to assess diluents from fossil-fuel-derived compounds. If diluents removed, may not need to assess furans, pcbs and dioxins. (MSW, pulp & paper, municipal sludge… mixed, unidentifiable 'organic' waste materials)

Feedstock consistency is a challenge (across the board). Drastic changes in feedstock composition will require re-testing/certification. (e.g. moving from 1 source to a mixture, or from mixture to a single source (e.g. sawmill waste wood to sawmill waste + agricultural byproducts, or combined pulp & paper & sawmill waste to straight pulp & paper waste).

Crystalline silica must be included for health (due to particle size) should this be combined with dust? To keep in class III vs class I???
Ask initial suggestor of crystalline silica what the purpose/concern was, specifically (rice husks & graminoids). Would dust assessment address silica, or should a further test focus specifically on silica? What particle size should be used as the limitation? Would limitation require a

particular % restriction below x particle size, or absolute floor on particle size with no smaller particles allowed?
Look to bentonite production requirements/restrictions/tests for more details.
Would water (like with the dust test) be an effective mitigation? % moisture? What sorts of handling stipulations are necessary? SOPs for silica?
Would particle size via progressive sieving be adequate? What mesh size? nm as smallest particle to be allowed/prevented? Where's the threshold?
What sort of handling restrictions would be placed on v. dusty materials? Moisture @ time of measurement, @ time of handling?

Class IV Exemplary
Soil enhancement properties (N P K, etc.) move to class IV. Class II and III become toxins & safety – quality levels Class IV becomes positive quality level (which can be voluntarily reported earlier if producers want to describe the properties). Class IV becomes less about requirements and more a soil enhancement class that may be reported in part or in entirety. As materials properties tests improve, class IV will also improve, and become more concrete.

Surface Area test for char from mid-speed pyrolysis symmetry CO2 Surface area at 0deg Celsius CO2 diffusion (addresses porosity, interactivitity of surfaces…)
N test for surface area has serious limitations. Gas fuses into pore network, and can be slow (no threshold, no asymptote… just keeps absorbing N surface area addressed better via other tests than hot-gas.
Porosity = water holding capacity. Macro-scale porosity.

Activated Carbon tests BEI??? CO2 vs N2? Different equation CO2 P/Po = 0.3 or N P/Po = 1 at N boiling point (harder to do w/o specialized facilities) … works up to a certain pore size

NPK as available NPK, not total NPK, which would be false-advertising. P base-cations are available (??) N is the big "if" as total vs available are highly different values. Include an explanation with adequate wording to understand test choice.
Only have Liming value in classification scheme at one level.
Sorption Activity (Butane Test???) Address test identification. Look @ McShields Method. What is the simpler, more appropriate test?

Tests for all elements are different. K vs N vs C N&C can be done via autoanalyser, K and the rest need GC, spectroscopy, ICP or Atomic Absorption…

Further recommendations/ comments

Produce a companion document to explain test expectations and selections better. Explain WHY tests were chosen, and what the decision making process was along the way.

Need to come up with concrete test value numbers for each element/toxin. Via e-mail/assigned responsibility with working group members, not via telephone.

WG2 – Meeting 2 March, 2011

Flow Chart Review:

Risk of virgin feedstocks being contaminated by virtue of having grown on contaminated sites. Definition of "virgin" as feedstock from a single, known biomass source fails to address the risks of contaminated sites and soils feeding in to biomass.

Biochar quality tests NEED to screen out toxins, regardless of feedstock source OR the virgin feedstock source needs to screen out contaminated site origins.

Virgin feedstock provisions (definitions) must be very clear and prescriptive to avoid risk of contamination. Definition, and the characterization testis must not mislead people that "virgin" is safe or that the virgin feedstock-sourced biochar is good for any soil at any rate of application.

"Virgin" should be changed to a less presumptive term, particularly as reflects the risk of contamination.

Recommended that an MSDS be developed, or that there be a stated requirement/provision for producers to create MSDS on all products to address transportation, handling and use.
This should be a responsibility of the biochar producer, not the IBI, but the Characterization Standard should recognize and require producers to provide an MSDS for appropriate uses. (i.e. IBI should not need to police this, but producers will need to comply to participate in international trade etc.)
In all classes, manufacturers must provide an MSDS

Need strong indication of how often to review/retest biochar. Suggestion beyond need for annual retest, or retest with feedstock/process changes, to also include retesting when biochar properties have been observed to change (i.e. anecdotally changing) – properties include smell (benzopyrenes have a characteristic odour (?))

Emergency shut-downs, initial start-ups (and products thereof) should be automatically run through properties tests, re-pyrolised to ensure complete pyrolysis has been achieved, and/or disposed of in a safe, non-harmful way.

Product testing should occur once consistency of final biochar product has been achieved.

Classification review:

Class I Basic

Perhaps too detailed for the first (entry-level) class.

Local Jurisdiction Regulations should be required for the production origin and the end-destination of the biochar. (i.e. for international trade, the biochar produced would have to meet local jurisdiction regulations for the country of production AND for the country of product sales). Requirements to meet these standards/regulations lie with the producer of biochar, not the purchaser.

Particle size not necessary (progressive sieving is too ambitious), however maximum and minimum size limitations (large chunks and dust) should be included.
Particle size overlaps with suspended solids. Fine particles ARE an issue, but are also dependent upon how the biochar is applied. Should be addressed through MSDS (respirator requirements etc.).

PAH might be useful at an earlier class level than it currently is listed. PAH risks exist with all chars, and with dust. PAHs are the most likely organic contaminant in biochar (benzopyrenes being the most of-concern of the PAH group) – perhaps should belong in Class I or II instead. Although tests are expensive, the carcinogenic potential should set priority over affordability (PAH tests are still more affordable than furans/dioxins)

Standard will use best available methods at time of publication. Characterization will evolve with biochar science and will need to be revised.

ASTM D1762 – the most accessible methodology for fixed carbon testing at this time. Will be used until non-combustion assessments are developed specifically for biochar.

Fixed Carbon assessment methodologies depend on final temperature severity. The currently cited test methods (ASTM D1762) do not reflect soil processes, however revisions to the methods will require the development (and testing & proving) of entirely new standard methodologies. Fixed Carbon testing should be a reasonable, relative (relatable) measure.

Germination and Earthworm tests; costs & access… Need to specify type of soil, amount of biochar/soil mixture, and need to address geographic limitations of the test.
More test details are required.
Perhaps use Earthworm and Germination tests as back-up in case there is no local jurisdictional regulation

Liming (or pH) should be kept, as it is one of the easiest-to-assess and easiest-to-understand properties for the average user/buyer.

Class II

Concern over using NSW EPA guidelines for analyses, since this is a global document. Most generic guidelines should be used (as is the intent of this process)

Would contaminant limits be dependent upon jurisdiction? – Only at Class I level. Higher classes receive more stringent contaminant limitations, BUT if local jurisdictional limitations meet the higher classification restrictions, analysis only requires disclosure of values and adherence to the additional tests to be classified as Class II or III instead. (based on applicability, thoroughness etc. of the local jurisdictional requirements)

Do PCBs break down during pyrolysis? Is there a minimum temperature for that to occur?

NPK claims need to indicate whether reporting available or total nutrient levels. (which might be misleading for some users – especially N)

How much NPK will come out of biochar? Test parameters & additional areas of study for future classification scheme updates.

P – Recommended Total P via AOAC official method testing [which one? In Liming Materials? Water-soluble in Fertilizers? Total in Fertilizers? Available in Fertilizers? Citrate-Insoluble in Fertilizers? ???] Soils-testing or P-solubility depends upon soil type. Goal is to select most general (broadly applicable) test available.

Is Cyanide likely to occur, or will it most likely break down during pyrolysis? Assessment of combustibility necessary.

Requested that group continue assessing document & pass on comments and documents via e-mail.

Recommendations for new directions:

- MSDS requirement for all producers to address shipping, storage & handling issues
- Improved definitions
- Classification scheme re-organization to horizontal rather than vertical hierarchical structure
- More specific properties test methodologies and limits selections are needed (the next step of property standards and classification)
- Justification/explanation companion document should be drafted to help explain selection of test methodologies etc. (based off of working group history etc.)
- Entire group call to discuss classification scheme as it nears final stages