



Laboratory and Analysis Methods for Biochar

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Background

- M.S. and Ph.D. Biological & Agricultural Engineering, U.C. Davis
- Research Chemist, USDA-ARS
 - Involved in biochar research since 2001
 - Project: Biochar as a value-added tool to address agricultural wastes
 - Develop, characterize and analyze biochars for environmental remediation
 - Develop, characterize and analyze biochars for soil amendment applications
- Survey of existing laboratory facilities to determine biochar testing capabilities



Challenge

- Biochar is made from a wide spectrum of materials with a range of different properties
- There is a broad range of biochar end uses with different requirements for different purposes, different soils, and different applications
- Biochar characterization should aim matching it to its final application
- Good news: large number of applications, potential feedstocks, and pyrolysis conditions can mean large number of potential markets for biochars
- Bad news: large number of applications, potential feedstocks, and pyrolysis conditions can mean challenges in biochar characterization, testing, certification
- New uses and better testing mean that standards are expected to evolve



Biochar Standards

- Principle: Define, analyze and communicate the essential characteristics that define each and every biochar:
 - Identify chemical/physical properties to be tested
 - Determine what tests can measure chemical/physical properties
 - Define acceptable thresholds for some parameters
- Biochar Standards then become the common framework for biochar analysis/testing guidelines
- Biochar materials can be compared for the benefit of the biochar users, buyers, marketers, producers, researchers
- Tests should:
 - Accurately measure each property
 - Use standard and approved peer-reviewed methodology
 - Be affordable and accessible
- The biochar industry can ultimately benefit from a biochar certification process that is based on the established standards





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Chris Wiberg, Timber Products Inspection/Biomass Energy Lab



Timber Products Inspection

- ISO Accredited Certification Body, Inspection Body, and Testing Body
- Primarily service the wood products industry
- Approximately 70 inspectors within North America
- Three testing laboratories, Conyers GA
- Serve on 24 different rules writing, regulatory, and/or standards development initiatives
- Corporate Headquarters is in Peachtree City, GA

www.tpinspection.com



Timber Products Inspection / Biomass Energy Lab

- ISO 17025 accredited to ISO, CEN/EN, and ASTM solid biofuel test methods
- Primary products Include:
 - Wood Pellets (industrial/residential)
 - Woody and agricultural residues
 - Thermally treated materials: Torrefaction, Steam Explosion, Biochar, Biocarbon, & Biocoal
- Wood Pellet Certification Schemes – PFI and ENplus

www.biomassenergylab.com



Chris Wiberg, VP of Biomass Energy Lab

- Oversee Biomass Energy Lab and TP's domestic biomass laboratory services
- Over 25 years in the solid biofuels industry
- Nearly 20 years in standards development
- Chairman of the PFI Standards Committee
- Chairman of the US TAG to ISO TC 238, Solid Biofuels
 - Active in WG1, 2, 4, 5, and 6
 - Project leader WG4
 - Member of WG4 TG1 – Developing a road map for the inclusion of Biochar, Biocarbon, and Biocoal





Process Impacts on Biochar Properties

Catherine “Catie” Brewer
Chemical & Materials Engineering
New Mexico State University



Panelist Background

- B.S. Chemistry, Indiana U. of Pennsylvania
- Ph.D. Chemical Engineering and Biorenewable Resources & Technology, minor in Soil Science, Iowa State University
 - Thesis: “Biochar characterization and engineering”
 - Biochars from fast pyrolysis and gasification vs. biochars from slow pyrolysis
- Postdoc, Rice University
 - Measurement of biochar physical properties
- Faculty, Chemical & Materials Engineering, New Mexico State University
 - Biochars for arid agroecosystems
 - Development of value-added co-products



Biochar Engineering

“Is biochar good for _____?”

The engineering answer: “It depends.”

Application determines desired biochar properties.

Desired biochar properties determine property measurement requirements.

Property measurements and feedstock availability determine process design.

Process design determines co-products and economic feasibility.

Feedstock
Properties

Process
Decisions

Desired Biochar
Properties





Lalitha Gottumukkala, Celignis Analytical



Panelist and Celignis Background

- PhD in Biotechnology (Applied sciences)
- Postdoctoral studies in Process Engineering
- Claude-Leon and Marie-Curie Fellow
- Joined Celignis in 2018
- Celignis analytical- 10 years old
- >20,000 samples analysed
- >1000 clients globally
- >20 processes developed
- Irish Innovation awards winner



Biochar Analysis and Process Expertise

- Feedstock evaluation
- EBC and IBI testing for biochar
- Biochar upgrading and process integration
- Lab-scale biochar production testing
- Techno-economic analysis
- Research Collaborations

celignis.com/biochar

The screenshot displays the 'Our Biochar Services' page on the website. At the top, the URL 'celignis.com/biochar' is shown. Below it, the heading 'Our Biochar Services' is centered. The page features a grid of service icons: Feedstock Evaluation, Biochar Production, Biochar Analysis, Biochar Combustion Properties, Soil Amendment & Plant Growth Trials, and Analysis of PAHs in Biochar. A central banner image shows biochar with the word 'BIOCHAR' overlaid. Below the banner, a paragraph states: 'We can produce biochar samples from your feedstocks. We can formulate a Design of Experiments (DOE) to study the effects of varying process parameters on biochar yield and quality and can optimise these outputs according to your desired biochar market applications.' A green button labeled 'Further info...' is positioned below the text. The bottom row of icons includes: Surface Area and Porosity of Biochar, Thermogravimetric Analysis of Biochar, Biochar Upgrading and Bioprocess Development, Biochar for Carbon Sequestration, Technoeconomic Analyses of Biochar Projects, and Research Project Collaborations.



Panel Discussion

- Refine existing “standard” analytical methods for biochar, and the process of creating new standard analytical methods, if needed.
 - What analysis are required (minimum of “do no harm”)?
 - Different biochar uses call for different analysis
 - Grouping biochar analysis in terms of source of feedstock, pyrolysis conditions, etc?
 - Analysis to include biochar handling information (e.g. fine particulates, dust)
 - ISO TC 238 and the current initiative to develop a roadmap for creating a path/platform for biochar standardization
 - History of the standardization of solid biofuels and parallels to the current situation for biochar.
- What is the value of advanced analytical methods for biochar, beyond standard analysis methods.
- What is the process for the development of a laboratory certification for biochar?
 - Difficulty in getting laboratories to engage in biochar analysis
 - Creating a process to produce “standard biochars” that could be used in biochar laboratory certifications and QAQC procedures
- Develop a robust laboratory ecosystem for biochar analysis, and how USBI and others can get more laboratories to provide biochar analytical services.
 - What is the laboratory’s perspective on biochar analysis?
 - How have you overcome biochar testing challenges

