



Laboratory and Analysis Methods for Biochar

Catie Brewer

Chris Wiberg

Lalitha Gottumukkala

Isabel Lima







Isabel Lima, Research Chemist USDA-ARS-SRRC New Orleans, LA



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









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 coproducts 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

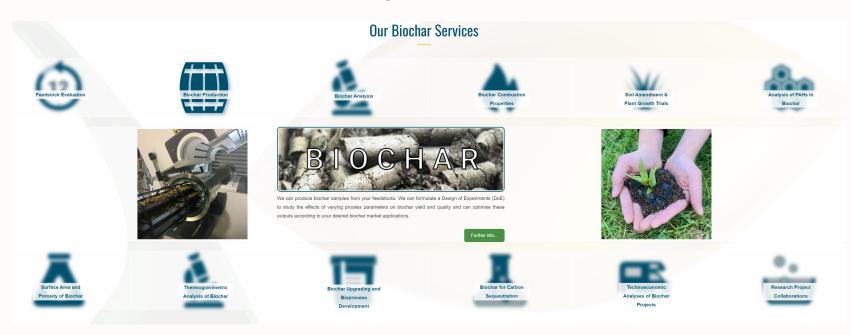


Biochar Analysis and Process Expertise

- 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





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

