



April 2013 News from the International Biochar Initiative

IBI Announces New Job Position

Title: Senior, Remunerated Director-Level Post, with Responsibilities in Strategy, Business Development and External Relations.

This science-based, non-government organization has staff based in the US but operates internationally under the direction of a multinational Board. IBI seeks to promote the further development and adoption of a cluster of biomass-based technologies that provide energy production, sustainable soil management and improved food security, with the potential to mitigate climate change. Our aim is to facilitate commercialization of the techniques, in developed and developing countries, across the range of business scales. We prefer candidates with strong backgrounds in market development, including knowledge of biomass-based technologies and/or agriculture and food supply. This is a part-time position that would suit candidates who wish to round-out careers in relevant industries by undertaking work with a societal impact.

We seek candidates with several of these qualifications:

- Experience in estimating needs for, and securing and deploying, financial resources.
- Extensive senior-level connections at senior level with major industrial, investment or philanthropic organizations, in any or all of the following sectors: environment, biomass and bioenergy, international development, sustainability, and food security.
- Strong, persuasive communication skills in writing and speaking and the ability to present the organization internationally in interactions with interested parties, from corporate and NGO leaders to technical researchers and policy makers.
- Experience in the early-stage commercialization of fledgling technologies with significant regulatory and business risks.
- Entrepreneurial orientation; comfortable running a small fast-paced organization.
- Alignment with values, strategy and style of the organization.
- Minimum 25 years professional work experience.
- Willingness and ability to travel internationally.

For more information and instructions on how to apply, please see: <http://www.biochar-international.org/node/4089>.

IBI Publishes Version 1.1 of the *IBI Biochar Standards*

On April 11, IBI published Version 1.1 of the *Standardized Product Definition and Product Testing Guidelines for Biochar That Is Used in Soil* also known as the *IBI Biochar Standards* at: http://www.biochar-international.org/sites/default/files/IBI_Biochar_Standards_V1.1.pdf) as part of its process to continually improve and update the document. The technical program changes

made to the *IBI Biochar Standards* include a new test method for organic carbon content, removal of the earthworm avoidance test, and inclusion of a new section on the revisions process, in addition to other minor editorial modifications.

As a next step in implementation of the *IBI Biochar Standards*, IBI will be launching the *IBI Biochar Certification Program* in the very near future. This program will enable manufacturers whose biochar materials have passed the *IBI Biochar Standards* to apply for certification through IBI, and to place an “IBI Certified Biochar” seal on their product.

The *IBI Biochar Standards* provide a framework for determining what biochar is—and what it is not—and for demonstrating the safety and efficacy of its use as a soil amendment through a series of tests that determine basic physicochemical properties and the presence of potential toxicants. Version 1.1 of the *IBI Biochar Standards* and a Technical Note explaining the changes in the test method for organic carbon content and the removal of the earthworm avoidance test, as well as FAQs and supporting documents, are all available in the Downloads section of the *IBI Biochar Standards* webpage <http://www.biochar-international.org/characterizationstandard>. IBI welcomes feedback and suggestions on the *IBI Biochar Standards*. Please email your comments to BiocharStandards@gmail.com.

Certification Program Update

IBI completed its final legal review of the *IBI Biochar Certification Program* in March and has been testing a beta version of the program's website. We are excited for the imminent launch of this program and will be holding educational webinars in the near future. The webinars will provide important information to stakeholders regarding program requirements, how to successfully complete forms associated with laboratory testing and the chain of custody, as well as provide an opportunity for participants to ask questions.

Stay tuned for additional announcements regarding webinar and program roll-out dates. For questions or further inquiries regarding the *IBI Biochar Certification Program*, please contact us at certification@biochar-international.org.

Biochar Carbon Protocol Submitted to the American Carbon Registry

On April 22, the Quantification Methodology for Biochar Projects (also known as the Biochar Carbon Protocol) was submitted for validation at the American Carbon Registry (ACR)—a leading carbon offset program. Development of the methodology is led by IBI partners The Climate Trust and The Prasino Group. The methodology quantifies the stable carbon component of biochar, defined as carbon expected to remain in soil 100 years after biochar application, as well as the avoided emissions from feedstock combustion and decomposition. To determine the stable carbon component, a new biochar carbon test method was developed with input from an Expert Panel coordinated by IBI.

The methodology will now undergo internal technical review at ACR for completeness, and pending any revisions, the draft protocol will be posted for public comment in the coming weeks. During the public comment period, ACR will coordinate and host a public webinar to review the methodology with all stakeholders in the biochar and carbon market community. IBI will widely circulate the draft methodology during the public comment period, and will advertise the ACR webinar through our website, press releases, and selected mailings. After the public comment period, the methodology will undergo an additional technical and scientific peer review according to established ACR protocols, prior to approval.

IBI to Launch Public Survey to Collect Information on Global Biochar Projects

As part of our ongoing efforts to identify trends in worldwide biochar deployment, IBI will open a public survey in May to gather data on biochar project activity. The survey is a follow-up to the 2010 survey on developing country biochar projects that IBI and Cornell University led on behalf of The World Bank. The upcoming survey will be open to IBI members and all other stakeholders that are conducting biochar projects, regardless of geography, and it will particularly emphasize the economics of these biochar projects. Additional information requested will include the stage of project implementation, location, feedstocks, technologies, scale, stakeholder involvement, and biochar end use. Results will be aggregated and shared with the biochar community. Our intent is to demonstrate the evolution and maturation of biochar projects across the globe.

Business and Organization Member Updates

A listing of all current IBI [Business](#) and [Organization](#) Members can be found on our website. For more information on membership opportunities and benefits, or to join, please see: <http://www.biochar-international.org/join>. Please note, Business and Organization descriptions are submitted by each individual entity, and are not developed or written by IBI.

Renewing Business Member

Control Laboratories

Control Laboratories has been in business since 1955 and in 2006 extended their vast organics testing to include Biochar research and testing. The extensive speculation of the promising benefits of Biochar sparked their interest to aide in putting actual numbers and data behind the claims.

Control Labs has become one of the top Biochar testing facilities in the nation with innovative research and unique tests, as well as expertise in the *IBI Biochar Standards*.

They have developed test packages for all sectors ranging from the producer to consumer to researcher, to aide in better understanding the impacts of biochar for its varying applications. They currently offer Biochar tests for biomass feedstock assessment, general characteristics, carbon sequestration, plant germination, metal retention, agricultural nutrient retention, pellet fuel, swale formation, potting mix, plant available agricultural related constituents, soil sediment removal, water retention, soil compression, soil shrinkage and many more.

For more information, see www.biocharlab.com.



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Report from the Global Alliance on Clean Cookstoves Forum

The Global Alliance on Clean Cookstoves (GACC) hosted the *Clean Cooking Forum 2013: Igniting Change, Fueling Markets & Sparking Adoption* in Phnom Penh, Cambodia from March 18-22, 2013. The goal of the Forum was to advance market-based approaches for wider utilization of clean cookstoves and to allow participants to share innovations in research, market development, standards and testing, project finance, and policy development. Many types of financial models and distribution systems were described and a variety of stove models were on display—including TLUDs and other char-producing stoves.

IBI Advisory Committee member Dr. Ron Larson attended the Forum. While no sessions were specifically devoted to char-making stoves, there were approximately three dozen attendees (mainly from developing countries) who are actively involved in char-making stoves and biochar. This group of participants held discussions and worked to further spread information on biochar at the event. The one afternoon devoted to demonstrating stoves had about a dozen demonstrating their char-making stoves. Dr. Larson found that those active in char-making stoves and biochar benefited a great deal from numerous sessions on country plans, financing, carbon credits, testing, etc.

More information on the Forum and follow-up documentation can be found at: <http://www.cleancooking2013.org/> (the agenda and biographies of all speakers can now be found at the link using the terms “agenda” and “speakers”).

Biochar Briefs: News Roundup for April

We update the website daily with new articles on biochar. For more information, please see: <http://www.biochar-international.org/newsbriefs>.

Australia

A group of biochar experts highlighted the need for the Australian Federal Government to invest in the commercialization of biochar plants. The panel included experts such as Professor Stephen Joseph, physicist Dr. Paul Taylor and biochar company owner Russell Burnett. (link to: <http://www.abc.net.au/rural/tas/content/2013/04/s3742894.htm>).

Canada

The recently launched Canadian Biochar Consortium (CBC) is a non-profit organization consisting of leading biochar experts and professionals in Canada. The group is planning large-scale biochar field trials across the country to test various biochar products for their effectiveness in real-world “field-scale” trials. (link to: <http://www.canadianbiomassmagazine.ca/content/view/4081/57>).

Germany

Professor Bruno Glaser is working with graduate student Daniel Fischer on Terra Preta field trials in the area of the Upper Franconian Bezirkslehrguts in Bayreuth, Germany. They harvested the Terra Preta-amended experimental plots for the second time in the summer of 2012 and found that crop yields can be increased in poor soils that have been amended with Terra Preta—with the amount of carbon in the Terra Preta as a key indicator of increased yield. (link to: <http://www.br.de/fernsehen/bayerisches-fernsehen/sendungen/unser-land/themen-rubriken/landwirtschaft-und-forst/terra-preta-forschung-100.html>).

The Philippines

The Philippine Biochar Association (PBiA) is backing government initiatives to attain rice sufficiency, achieve food security, and mitigate the adverse impacts of climate change. The PBiA expressed its support during the recent first national conference on biochar initiatives in the Philippines. (link to: <http://www.businessmirror.com.ph/index.php/business/agri-commodities/12216-pro-biochar-group-supports-government-s-efforts-to-achieve-sufficiency-in-rice>).

United Kingdom

A new study by Sean Case, a PhD student at the Natural Environment Research Council (NERC) Centre for Ecology & Hydrology (CEH), finds that adding charcoal to land used to grow bioenergy crops can cut soil greenhouse-gas emissions by around a third. "We've shown that adding biochar suppresses CO₂ emissions very significantly over several years," says Case. (link to: <http://planetearth.nerc.ac.uk/news/story.aspx?id=1418&cookieConsent=A>).

Jez Taylor is the head gardener at Daylesford Organic who is pioneering the use of biochar in the United Kingdom. He manages 20 acres and six poly-tunnels of crops that supply Daylesford's farm shops. Mr. Taylor tried a mix of coir and biochar and found that the water-holding action of the biochar improved his results dramatically and is using it in his potting mixes. (link to: <http://www.telegraph.co.uk/gardening/gardeningequipment/9970889/Biochar-a-slow-burn-success.html>).

United States

Karen Ribeiro, a principle at Inner Fortune, argues that we need a larger market to encourage investors to capitalize on larger biochar production capacity to help biochar play a greater role in agricultural and climate solutions. Ms. Ribeiro notes that biochar studies and field trials can encourage policymakers to draft new guidance and move the market forward. (link to: <http://www.csrwire.com/blog/posts/820-climate-solutions-biochar-goes-commercial-but-struggles-without-impact-investment>).

A team of Colorado State University (CSU) agricultural and environmental scientists is looking to find best management practices in crop production which could help conserve water in drought conditions by creating an online tool for farmers to calculate water savings gained from different strategies. The research project is supported with a grant from the U.S. Department of Agriculture Adaptation to Drought Conservation Innovation Grant and Colorado-based company Biochar Solutions is a project partner. (link to: <http://www.waterworld.com/news/2013/04/12/csu-research-is-examining-water-savings-from-different-farming-strategies-during-drought.html>).

Opportunities in Biochar

- Submit an abstract for New Zealand Biochar 2013: **due April 30**. For more information: <http://www.biochar-international.org/node/3746>.
- Submit an Abstract to the 10th Meeting of the Grupo Brasileiro da Sociedade Internacional de Substâncias Húmicas (IHSS): **due May 20**. For more information: <http://www.biochar-international.org/node/4049>.
- Submit an Abstract to the Biochar Symposium at SETAC North America 34th Annual Meeting: **due May 28**. For more information: <http://www.biochar-international.org/node/4095>.
- The Academia Journal of Agricultural Research has a call for papers. For more information: <http://www.biochar-international.org/node/3988>.
- Submit an Expression of Interest for the Second International Biochar Training Course at Nanjing Agricultural University (NJAU), planned for October, 2013. For more information: <http://www.biochar-international.org/node/3845>.

New job postings at: <http://www.biochar-international.org/network/jobs>.

Upcoming Calendar Events

- April 29 – 30: Novel Tree Crops Healing the People, Healing the Land, Healing the Water Te Whangi Trust. Location: New Zealand. For more information: <http://www.biochar-international.org/node/4088>.
- May 4: The Biology of Biochar. Location: Kunghur, Australia. For more information: <http://www.biochar-international.org/node/4038>.
- May 4: Eco Rendezvous – Biomass and Wind. Location: Ontario, Canada. For more information: <http://www.biochar-international.org/node/4070>.
- May 5 – 8: Biochar: Waste to Wealth; a Special Session on Biochar. Location: Hong Kong. For more information: <http://www.biochar-international.org/node/3822>.
- May 13 – 14: WATER, FORESTS, AND PEOPLE: Innovations for a Sustainable Water Future. Location: Beijing, China. For more information: <http://www.biochar-international.org/node/3803>.
- May 20 – 22: Biochar Session at Biomass Asia 2013. Location: Kuala Lumpur, Malaysia. For more information: <http://www.biochar-international.org/node/3929>.
- June 3 – 7: 21st European Biomass Conference and Exhibition. Location: Copenhagen, Denmark. For more information: <http://www.biochar-international.org/node/3778>.
- June 14: Midwest Biochar Conference. Location: Champaign, IL, US. For more information: <http://www.biochar-international.org/node/3897>.
- June 21 – 22: British Biochar 2013: Sustainable use and production of biochar in the UK. Location: University of Oxford, UK. For more information: <http://www.biochar-international.org/node/3901>.
- July 4 – 5: New Zealand Biochar 2013. Location: Palmerston North, New Zealand. For more information: <http://www.biochar-international.org/node/3746>

See the [IBI Calendar page](#) for more events. To add an event to the calendar, send the information to info@biochar-international.org.

Regional Biochar Group Updates

To read more on the 52 regional and national biochar groups, please see IBI's website (link to: <http://www.biochar-international.org/network/communities>). This month includes updates from the Biochar Association of Indonesia, the South East Asia Biochar Interest Group, and the Sonoma Biochar Initiative (United States).

Biochar Association of Indonesia (ABI)

The ABI recently elected a board of directors based on meetings from February 2013. For more information on these individuals, please see:

<http://www.biochar-international.org/regional/Indonesia>.

The South East Asia Biochar Interest Group

Groups in the region are working on developing more advanced toilet composting systems, utilizing dry Terra Preta sanitation systems. More information on these systems can be seen at: <http://www.sswm.info/category/implementation-tools/water-use/hardware/toilet-systems/terra-pret-a-toilet>.

Sonoma Biochar Initiative (United States)

The SBI recently hosted a 9-hour "train the trainer" session with 19 participants at Green String

Farm with expert Peter Hirst and made biochar in several burns of different scale biochar units and learned how to present this technology to an audience. They also conducted their first official public meeting at the Grange Hall, with 40 participants.

The organization recently began work under the new Citizen Science Project working with the public to create 200 biochar test plots and record the results (see: <http://sonomabiocharinitiative.org/citscience>). Biologist Becca Lawton is providing science support with a focus on photo surveys of control plots compared to biochar plots as well as technical data. They will also be working with school gardens to use and test biochar and have just submitted a proposal to the SF Estuary Foundation to fund more extensive Citizen Science research analysis.

SBI has redesigned and expanded their web site to better educate and serve their audience. The website will continue to be built out in coming months to showcase the ongoing results of the Citizen Science and incorporate a social media presence into outreach; for more information, please see: <http://sonomabiocharinitiative.org/>.

Recently Published Biochar Research

IBI tracks all published research on biochar and includes it in our [online bibliography](#). The following articles were added in the last month. Please visit the website bibliography for more information on any of these articles. Due to copyright, we cannot provide full copies of articles unless we have permission from the publisher. If you have published work that is not included, [please email us](#).

Awad, Y. M.; E. Blagodatskaya; Y. S. Ok; Y. Kuzyakov (2013). Effects of polyacrylamide, biopolymer and biochar on the decomposition of ¹⁴C-labelled maize residues and on their stabilization in soil aggregates. *European Journal of Soil Science*.

Azizi, Nor; Young Kwang Kim; Jin Miyawaki; Isao Mochida; Seong Ho Yoon (2013). Catalytic Combustion of Waste Palm Trunk Derived Biochar and Biomass. *Applied Mechanics and Materials* (Volume 315).

Bargmann, I.; M. C. Rillig; W. Buss; A. Kruse; M. Kuecke (2013). Hydrochar and Biochar Effects on Germination of Spring Barley. *Journal of Agronomy and Crop Science*.

Beesley, Luke; Marta Marmiroli; Luca Pagano; Veronica Pigoni; Guido Fellet; Teresa Fresno; Teofilo Vamerli; Marianna Bandiera; Nelson Marmiroli (2013). Biochar addition to an arsenic contaminated soil increases arsenic concentrations in the pore water but reduces uptake to tomato plants (*Solanum lycopersicum* L.). *Science of The Total Environment*. Volumes 454–455, Pages 598–603.

Belcher, Claire M. Ondrej Masek (2013). Chapter 16. Biochar and Carbon Sequestration. *Fire Phenomena and the Earth System: An Interdisciplinary Guide to Fire Science*.

Clough, Tim J.; Leo M. Condon; Claudia Kammann; and Christoph Müller (2013). A Review of Biochar and Soil Nitrogen Dynamics. *Agronomy*, 3, 275-293.

Collins, Harold P; Jason Streubel; Ashok Alva; Lyndon Porter and Bernardo Chaves (2013). Phosphorus Uptake by Potato from Biochar Amended with Anaerobic Digested Dairy Manure Effluent. *Agronomy Journal*.

Cornelissen, Gerard; Vegard Martinsen; Victor Shitumbanuma; Vanja Alling; Gijs D. Breedveld; David W. Rutherford; Magnus Sparrevik; Sarah E. Hale; Alfred Obia; Jan Mulder (2013). *Biochar*

Effect on Maize Yield and Soil Characteristics in Five Conservation Farming Sites in Zambia. *Agronomy* 256-274; www.mdpi.com/journal/agronomy.

Devereux, Rachel C.; Craig J. Sturrock; and Sacha J. Mooney (2013). The effects of biochar on soil physical properties and winter wheat growth. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh*.

Diez, M. Cristina; Marcela Levio; Olga Rubilar; Felipe Gallardo (2013). Biochar as Partial Replacement of Peat in a Biomixture Formulated with 3 Types of Soils to Degrade Pesticides. III Symposium on Agricultural and Agro-Industrial Waste Management; http://www.sbera.org.br/3sigera/obras/ag_tec_02_MCristinaDiez.pdf.

Ekebafé, M.O.; Ekebafé, L.O.; Maliki, M. (2013). Utilisation of biochar and superabsorbent polymers for soil amendment. *Science Progress*, Volume 96, Number 1, pp. 85-94(10).

Hammond, Jim; Simon Shackley; Miranda Prendergast-Miller; Jason Cook; Sarah Buckingham & Valentini A Pappa (2013). Biochar field testing in the UK: outcomes and implications for use. *Carbon Management*. Vol. 4, No. 2, Pages 159-170.

Heiskanen, J.; P. Tammeorg; R.K. Dumroese (2013). Growth of Norway spruce seedlings after transplanting into silty soil amended with biochar: a bioassay in a growth chamber. *Journal of Forest Science*. 59, (3): 125–129; <http://www.agriculturejournals.cz/publicFiles/87793.pdf>.

Hina, Kiran (2013). Application of Biochar Technologies to Wastewater Treatment. PhD in Soil Science, Massey University; http://muir.massey.ac.nz/bitstream/handle/10179/4288/02_whole.pdf?sequence=1.

Jaffé, Rudolf; Yan Ding; Jutta Niggemann; Anssi V. Vähätalo; Aron Stubbins; Robert G. M. Spencer; John Campbell; Thorsten Dittmar (2013). Global Charcoal Mobilization from Soils via Dissolution and Riverine Transport to the Oceans. *Science*. Vol. 340 no. 6130 pp. 345-347.

Jeffery, Simon; Frank G.A. Verheijen; Ana Catarina Bastos; Marijn Van Der Velde (2013). A comment on 'Biochar and its effects on plant productivity and nutrient cycling: a meta-analysis': on the importance of accurate reporting in supporting a fast-moving research field with policy implications. *GCB Bioenergy*.

Joshi, Ekta; Manoj Kumar; Priyanka Gautam; B. Lal; Aanandi Lal Jat (2013). Biochar - The Future of Agriculture. *Popular Kheti*. Volume -1, Issue-1; http://www.popularkheti.com/web_documents/pk-119.pdf.

Kalyan, Yakkala; Yu Mok-Ryun; Yang Jae-Kyu; Chang Yoon-Young (2013). Adsorption of TNT and RDX Contaminants by *Ambrosia trifida* L. var. *trifida* Derived Biochar. *Research Journal of Chemistry and Environment* Vol. 17; http://www.chemenviron.net/chemistry_back_issue/chem_2013_4/10.pdf.

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Kumar, Sandeep; Reginald Ebin Masto; Lal C. Ram; Pinaki Sarkar; Joshy George; Vetrival A. Selvi (2013). Biochar preparation from *Parthenium hysterophorus* and its potential use in soil application. *Ecological Engineering*. Volume 55, Pages 67–72.

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Morales, M. M.; N. Comerford; I. A. Guerrini; N. P. S. Falcão; J. B. Reeves (2013). Sorption and desorption of phosphate on biochar and biochar–soil mixtures. *Soil Use and Management*.

Mukherjee, Atanu and Rattan Lal (2013). Biochar Impacts on Soil Physical Properties and Greenhouse Gas Emissions. *Agronomy*, 3.

Mukome, Fungai N.D.; Johan Six; Sanjai J. Parikh (2013). The effects of walnut shell and wood feedstock biochar amendments on greenhouse gas emissions from a fertile soil. *Geoderma*. Volumes 200–201, Pages 90–98.

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Sahiner, Nurettin; Necdet Karakoyun; Duygu Alpaslan; & Nahit Aktas (2013). Biochar-Embedded Soft Hydrogel and Their Use in Ag Nanoparticle Preparation and Reduction of 4-Nitro Phenol. *International Journal of Polymeric Materials and Polymeric Biomaterials*

Sneath, Helen E.; Tony R. Hutchings; Frans A.A.M. de Leij (2013). Assessment of biochar and iron filling amendments for the remediation of a metal, arsenic and phenanthrene co-contaminated spoil. *Environmental Pollution*. Volume 178, Pages 361–366.

Som, A. Md; Z. Wang; A. Al-Tabba (2013). Palm frond biochar production and characterization. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh*.

Song, Yang; Fang Wang; Fredrick Orori Kengara; Xinglun Yang; Chenggang Gu; and Xin Jiang (2013). Immobilization of Chlorobenzenes in Soil Using Wheat Straw Biochar. *J. Agric. Food Chem.*

Stanger, Rohan; Terry Wall; John Lucas; Merrick Mahoney (2013). Dynamic Elemental Thermal Analysis (DETA) – A characterisation technique for the production of biochar and bio-oil from biomass resources. *Fuel*.

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Ventura, Francesca; Fiorenzo Salvatorelli; Stefano Piana; Linda Pieri; and Paola Rossi Pisa (2013). The effects of biochar on the physical properties of bare soil. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh*.

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Yan, Qiangu; Caixia Wan; Jian Liu; Jinsen Gao; and Fei Yu (2013). Iron Nanoparticles in situ Encapsulated in Biochar-based Carbon as an Effective Catalyst for Conversion of Biomass-derived Syngas to Liquid Hydrocarbons. *Green Chem.*

Yao, Ying; Bin Gao; Jianjun Chen; Ming Zhang; Mandu Inyang; Yuncong Li; Ashok Alva; Liuyan Yang (2013). Engineered carbon (biochar) prepared by direct pyrolysis of Mg-accumulated tomato tissues: characterization and phosphate removal potential. *Bioresource Technology*.

Yuan, Haoran; Tao Lu; Dandan Zhao; Hongyu Huang; Kobayashi Noriyuki; Yong Chen (2013). Influence of temperature on product distribution and biochar properties by municipal sludge pyrolysis. *Journal of Material Cycles and Waste Management*;
<http://link.springer.com/article/10.1007/s10163-013-0126-9#>.

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Zhang, Xiaokai; Hailong Wang; Lizhi He; Kouping Lu; Ajit Sarmah; Jianwu Li; Nanthi S. Bolan; Jianchuan Pei; Huagang Huang (2013). Using biochar for remediation of soils contaminated with heavy metals and organic pollutants. *Environmental Science and Pollution Research*.

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