International Symposium on Functional Biomass-derived Carbon Materials

9th–11th March 2021 I ONLINE

Book of Abstracts

Organised by:

Universidad Zaragoza

In the framework of the GreenCarbon project

http://greencarbon-etn.eu/

GreenCarbon (MSCA-ITN-2016-721991) has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 721991

A free online version is available from zenodo.org

DOI: 10.5281/zenodo.4555167

Welcome to *GreenCarbon2020*!

The primary aim of *GreenCarbon2020* is to increase dissemination of the research activities conducted within the GreenCarbon European Training Network (project H2020-MSCA-ITN-721991). For this purpose, the fourteen early-stage researchers involved in the GreenCarbon project will present the most important findings from their PhD projects.

GreenCarbon 2020 is also open for the global research community as well as policy makers and representatives from the industrial sector. The event also includes the participation of renowned keynote speakers. The topics covered during the symposium include, but are not limited to:

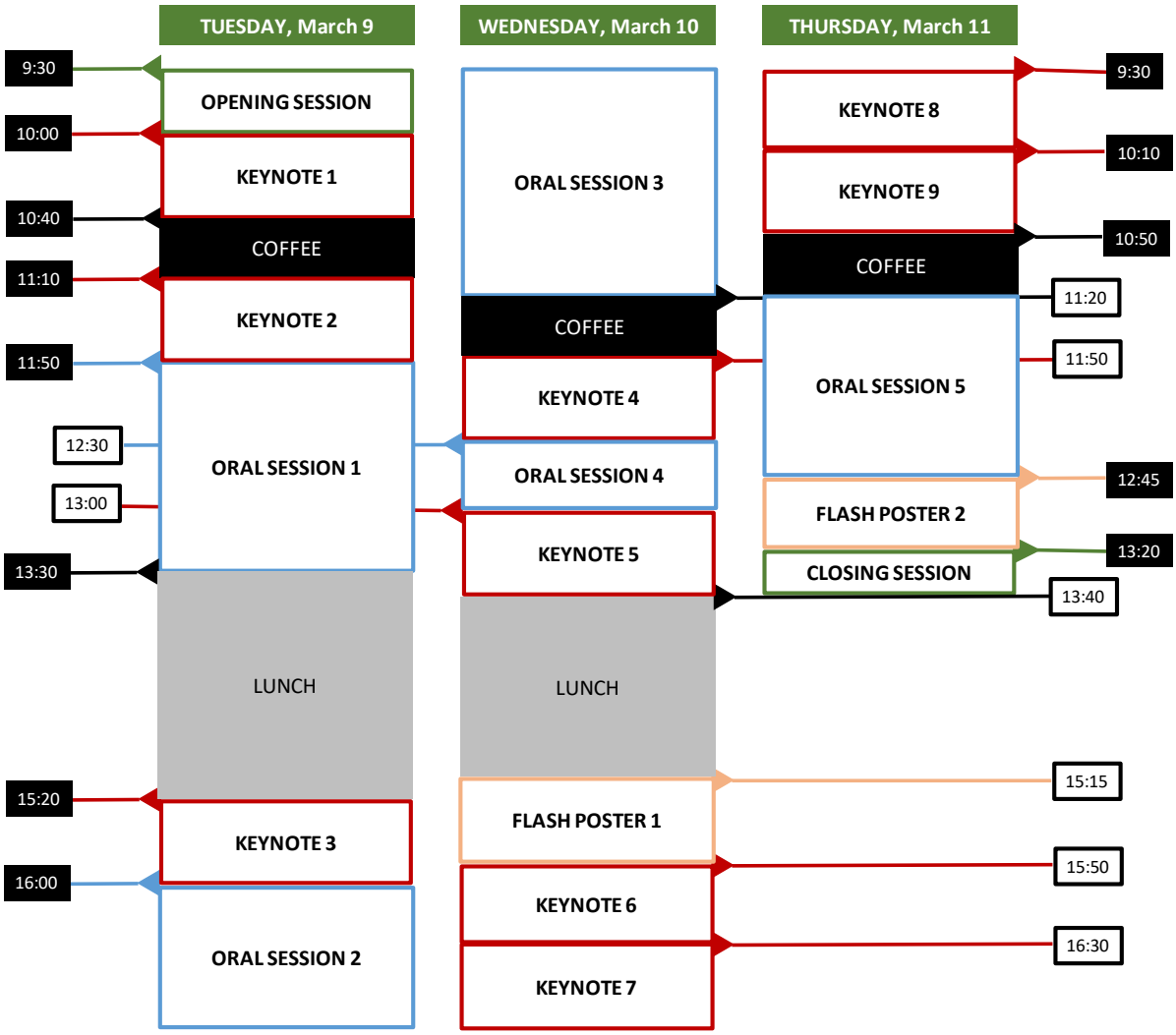
- Production and characterization of biomass-derived carbons through thermochemical processes.
- Synthesis of biomass-derived porous carbons (and composites) and their application in adsorption, catalysis and electrochemical energy storage.
- Biomass-derived carbons for soil conditioning (biochar) and related environmental benefits.
- Other emerging applications of biomass-derived carbons (e.g., in direct carbon fuel cells, as reductants in metallurgical industry, in cementitious composites, etc.).

Selected abstracts have been invited to submit a journal paper to a special issue in the MDPI's *Sustainability* journal (ISSN 2071-1050).

GreenCarbon2020 has been possible thanks to your participation.

Joan J. Manyà – Chairman *GreenCarbon2020*

Programme at a glance



SPONSOR

sustainability

an Open Access Journal by MDPI

https://www.mdpi.com/journal/sustainability

Detailed Programme

Tuesday, March 9, 2021

09:30 – 10:00	Opening session
10:00 – 10:40	**Keynote presentation 1** **Pyrolysis fundamentals and pyrochar characterization** Frederik Ronsse, Ghent University, Belgium
10:40 – 11:10	Coffee Break
11:10 – 11:50	**Keynote presentation 2** **HTC fundamentals and hydrochar characterization** Andrea Kruse, University of Hohenheim, Germany
11:50 – 13:30	**Oral session 1**
	Production of biomass-derived carbons (BCs) through pressurized slow pyrolysis under N_2 and CO_2 atmosphere Gianluca Greco, University of Zaragoza, Spain
	Methodology for the design of a rotary kiln for the pyrolysis of biomass Jorge López-Ordovás, Aston University, UK
	Prediction accuracy in modelling beech wood pyrolysis at different temperatures using a comprehensive, CFD-based single particle pyrolysis model Przemyslaw Maziarka, Ghent University, Belgium
	Valorization of the poultry litter through wet torrefaction and different activation treatments Pablo J. Arauzo, University of Hohenheim, Germany
	Influence of reaction conditions on hydrothermal conversion of sugars Pierpaolo Modugno, Queen Mary University of London, UK
13:30 – 15:20	Lunch time
15:20 – 16:00	**Keynote presentation 3** **Advanced carbon materials from tannins** Vanessa Fierro, Institute Jean Lamour (CNRS), France
16:00 – 17:10	**Oral session 2**
	Comparison of different methods to determine ash and volatile matter content of biochars Markus Lang, RWTH Aachen University, Germany
	Kinetics characterization of barley straw pyrolysis using the Distributed Activation Energy Model (DAEM) Javier Pallarés, University of Zaragoza, Spain
	Impact of particle size and ash chemical composition on pyrolysis and CO_2 gasification of barley straw for activated carbon applications Antonia Gil, University of Zaragoza, Spain
	Hydrothermal carbonization of glucose in the presence of iron ions Vahid Saadattalab, Stockholm University, Sweden

Wednesday, March 10, 2021

09:30 – 11:20	**Oral session 3**
	Biomass based carbon materials for gas storage and separation Sabina Alexandra Nicolae, Queen Mary University of London, UK
	Macroscopic rods of self-assembled monodispersed colloidal hydrochar and related templated SiC and Cu_7Si_2 Xia Wang, Stockholm University, Sweden
	Influence of slow pyrolysis conditions on the adsorption of organic dyes from water Filipe Rego, Aston University, UK
	Production of biomass-derived activated carbons for bio-oil and biogas upgrading Christian Di Stasi, University of Zaragoza, Spain
	Heterogeneous transformation of CO_2 to methanol—Structural study of the support Anthony E. Szego, Stockholm University, Sweden
	Sequential biochar systems Christian Würzer, The University of Edinburgh, UK
11:20 – 11:50	Coffee break
11:50 – 12:30	**Keynote presentation 4** **Biomass-derived carbons for heterogeneous catalysis** Elsa Weiss-Hortala, IMT Mines Albi, France
12:30 – 13:00	**Oral session 4**
	Aqueous phase hydrogenolysis of glycerol over Ni/AC catalysts Raquel Raso, University of Zaragoza, Spain
	Adsorption of propylene glycol on activated carbon: kinetics experiments Jorge Fortea, University of Zaragoza, Spain
13:00 – 13:40	**Keynote presentation 5** **Biomass-derived carbons for adsorption in gas phase** Niklas Hedin, Stockholm University, Sweden
13:40 – 15:15	Lunch time
15:15 – 15:50	**Flash poster presentations 1**
	Hydrothermal carbon as metal-free catalyst and electrocatalyst Enrique García-Bordejé, Instituto de Carboquímica (ICB-CSIC), Spain
	Synthesis of porous carbon materials from nanocellulose Lucas Güemes, Instituto de Carboquímica (ICB-CSIC), Spain
	Turkish hazelnut shells as precursor of sustainable CO_2 adsorbent Ayse Sever Akdag, Hacettepe University, Turkey
	Carbon-nanoparticles hybrids as electrodes in electrochemical energy storage systems Sergio Aina, University of Zaragoza, Spain

Wednesday, March 10, 2021 (*continued*)

Studying carbons derived from urban pruning waste as additives in Li-ion battery anodes
Iván Esteve-Adell, Instituto Tecnológico de la Energía (ITE), Spain

Biomass-based activated nitrogen doped carbons for energy applications
Ance Plavniece, Latvian State Institute of Wood Chemistry, Latvia

15:50 – 16:30 **Keynote presentation 6**
Biomass-derived carbons for Na-ion batteries
Maria Magdalena Titirici, Imperial College London, UK

16:30 – 17:10 **Keynote presentation 7**
Biomass-derived carbons for redox flow batteries
Ana Jorge-Sobrido, Queen Mary University of London, UK

Thursday, March 11, 2021

09:30 – 10:10	**Keynote presentation 8** **Sequential uses of biochar** Ondrej Masek, The University of Edinburgh, UK
10:10 – 10:50	**Keynote presentation 9** **Biochar for soil restoration** Gabriel Gascó, Universidad Politécnica de Madrid, Spain
10:50 – 11:20	Coffee break
11:20 – 12:45	**Oral session 5**
	Biochar from greenhouse waste: Production, characterization and evaluation for its potential use in the horticultural growing media Dilani Rathnayake, Ghent University, Belgium
	Role of biochar in the implementation of a phytomanagement strategy on soils presenting polymetallic pollution Manhattan Lebrun, University of Orléans, France
	Biochar from agro residues in adsorption tests for water treatment Lydia Fryda, UniLaSalle-Ecole des Métiers de l'Environnement, France
	Examining samarium sorption in biochars and carbon-rich materials for water remediation: batch vs. continuous-flow methods Joan Serra, University of Barcelona, Spain
	Comparative analysis of biochars to be used in greenhouse gas abatement and first trends of their application to pig manure Josephine Getz, Technological University Dublin, Ireland
12:45 – 13:20	**Flash poster presentations 2**
	HTC as promising route for enhancing thermal insulation in bioarchitecture Silvia Román, Universidad de Extremadura, Spain
	The effect of biomass-derived carbon materials on the recovery of metals from mining tailings by hydrometallurgical processes Gabriel Gascó, Universidad Politécnica de Madrid, Spain
	Copper and zinc leaching from complex sulphide ore: The effect of biomass-derived activated carbon as catalyst Ana Méndez, Universidad Politécnica de Madrid, Spain
	The use of magnetic biochars as catalysts in the lixiviation of metals from mining tailings María L. Álvarez, Universidad Politécnica de Madrid, Spain
13:20 – 13:40	Closing session

ABSTRACTS

Biochar from greenhouse waste: Production, characterization and evaluation for its potential use in the horticultural growing media

Dilani Rathnayake[1,*], Ondřej Mašek[2], Erik Meers[3], Andrew Goddard[4], Frederik Ronsse[1]

[1] Thermochemical Conversion of Biomass Research Group Department of Green Chemistry and Technology, Faculty of Bioscience Engineering, Ghent University, Coupure Links 653, 9000, Ghent, Belgium
[2] UK Biochar Research Centre, School of GeoSciences, University of Edinburgh, Alexander Crum Brown Road, Edinburgh, EH9 3FF, United Kingdom
[3] Laboratory of Analytical Chemistry and Applied Ecochemistry, Department of Green Chemistry and Technology, Faculty of Bioscience Engineering, Ghent University, 653, Coupure Links, 9000, Ghent, Belgium
[4] Freeland Horticulture ltd, Wroot road quarry, Wroot road, Finningley, Doncaster, DN9 3DU, UK
* Corresponding author email: Dilani.RathnayakeMudiyanselage@UGent.be

Keywords: *Biochar production, co-pyrolysis, plastic, biochar characterization, growing media*

Abstract

Protected agriculture plays a vital role in increasing productivity. Thus, farmers are increasingly practicing greenhouse agriculture. As a result, substantial amount of biomass waste mixed with plastics are being generated; i.e., spent growing media wrapped with plastics (SGP). Separating plastics out of the organic waste further complicates its treatment. Introducing a solid product (i.e., char) valorized out of this waste, which could be used as a growing medium ingredient back in the greenhouse agriculture, benefits the farmers as well as the environment due to waste valorization. Within this context, the potential of co-pyrolysis to valorize SGP waste was examined in this study. The focus was on the solid product obtained through slow co-pyrolysis, which is char. In a first experiment, biochars were produced through co-pyrolysis of plastic grow bags and spent growing medium waste in different ratios using a retort type mini pyrolysis set-up to identify the impact of the low level of plastic incorporation into the feedstock material on biochar properties. Then, biochars were produced through co-pyrolysis of biomass and plastics under different pyrolysis production temperatures using a bench-scale pyrolysis-batch unit at UKBRC to identify the impact of production conditions on biochar physicochemical properties. After initial screening, biochars were produced at a larger scale using the pilot-scale pyrolysis-continuous unit at UKBRC using SGP at 550 °C. These biochars were used to assess their potential as a substitute for peat use in horticultural growing media. Produced biochar samples were characterized for elemental (C, H, N, S, nutrients, and potentially toxic elements), proximate analysis, thermogravimetric analysis, FT-IR, and phytotoxicity. In order to assess the potential of produced biochars to substitute peat in horticultural growing media, seven growing medium formulations were prepared using peat, perlite, and biochar in different ratios. Formulated growing mediums were characterized in terms of physicochemical properties such as particle size distribution, bulk density, water-holding capacity, air-filled porosity, pH, EC, and nutrient contents. Phytotoxicity of formulated mediums was assessed through a germination assay. Then, a plant growth experiment was carried out to assess the impact of formulated growing mediums on flower quality and plant growth parameters of Marigold. According to the results obtained, the inclusion of biochar significantly increased plant growth parameters compared to peat and perlite containing control media. Results obtained from this study suggest that spent growing medium waste together with plastic grow bags offer great potential as a feedstock for biochar production and inclusion of biochar had positive effects on plant germination and growth that might compete with the control. In terms of technical performance, biochar could effectively replace 23% to 35% of use in horticultural growing media without compromising growth performance. The findings of this study will be beneficial for commercial growers to valorize their spent growing media waste together with plastic grow bags while reducing the harmful impact of plastics on the environment. Moreover, it will help to reduce the pressure on peatlands due to horticultural extraction of peat and greenhouse gas emissions associated with degraded peatlands.

Acknowledgement: This study received financial support from the European Union Horizon 2020 Research and Innovative Training Network programme under the Marie Sklodowska-Curie grant agreement No 721991.