UK Biochar Research Centre

Reducing and removing CO_2 while improving soils: a significant and sustainable response to climate change

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Research on Production of BESPOKE BIOCHAR

What is bespoke biochar?

Biochar is the product of thermal decomposition and transformation of biomass in the absence of oxygen (i.e., pyrolysis). The structure, properties and yield of biochar are significantly affected by a number of variables including feedstock, pyrolysis temperature, pressure, residence time and heating rate. As a result, different production processes may yield biochars with physical, chemical and stability properties differing over a broad range and with the potential for either beneficial or harmful effects on soil, plants and the environment.

In contrast, "**Bespoke biochar**", a concept under development at the UKBRC, is a material produced under optimised conditions to deliver a particular function or combination of functions, such as maximum biological stability, maximum agronomic benefit, mitigation of trace gas emission, etc.

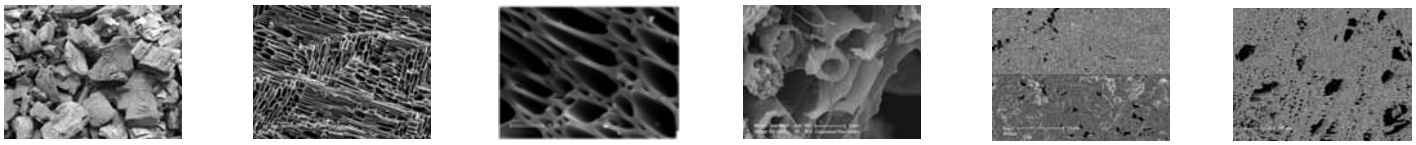


Figure 1: The different physical structures of biochar produced under different conditions and from different feedstock.

Production of Bespoke Biochar

Development and production of bespoke biochar requires very good understanding of which characteristics are key for its function in soil and how these characteristics are influenced by feedstock and production conditions. To develop this level of understanding and the capability to define and produce bespoke biochar, concentrated and systematic research on biochar production and characterisation is necessary. Capacity to produce large numbers of biochar samples under well controlled and monitored conditions is needed, as well as the capability to screen these samples, quickly and reliably, for key characteristics and properties. Once the concept of bespoke biochar is developed in the lab, the challenge for UKBRC is to scale up the process while maintaining the necessary degree of control.

UKBRC Bespoke Biochar Production Strategy

Development of the "bespoke biochar" concept in UKBRC labs has made considerable progress, particularly on the screening of biochar. Our ongoing strategy for bespoke biochar production research consists of three stages.

Stage I: is a lab-scale pyrolysis unit capable of producing up to 100g of biochar per batch. The unit can operate either in a fixed bed or fluidised bed mode and allows us to control precisely the key operating parameters (temperature, heating rate, residence time etc.) and monitor and record its performance.

Stage II: is a continuous production bench-scale unit able to produce up to 2kg of biochar per hour. This unit also allows precise control of the operating conditions and is flexible in terms of feedstock and throughput.

Stage III: is a pilot-scale slow pyrolysis unit capable of producing up to 20kg of biochar per hour in a continuous mode. Due to its multi-zone electric heating, the unit allows for very good control of the production temperature and heating rate, even at this larger scale, and is crucial for our efforts in scaling up bespoke biochar production.

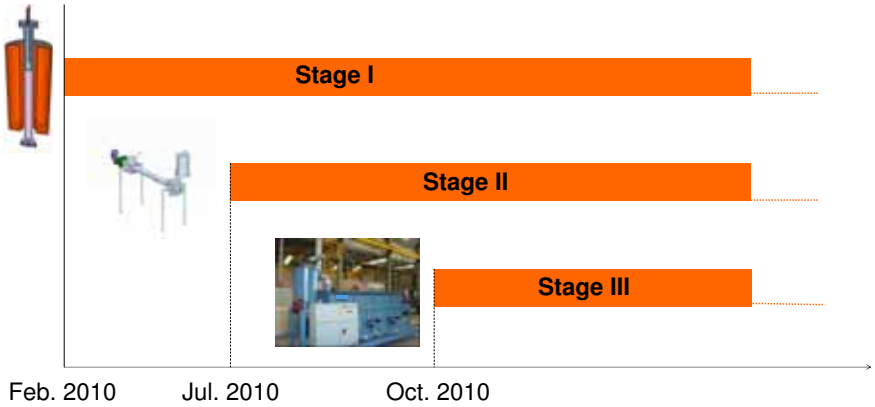
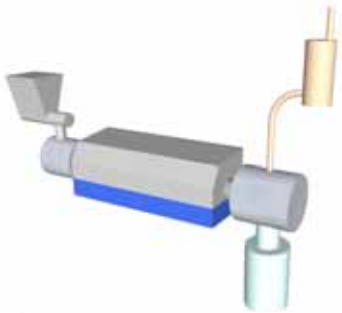


Figure 2: A timeline of when the different stages of our bespoke biochar production strategy start.

a)

b)



c)

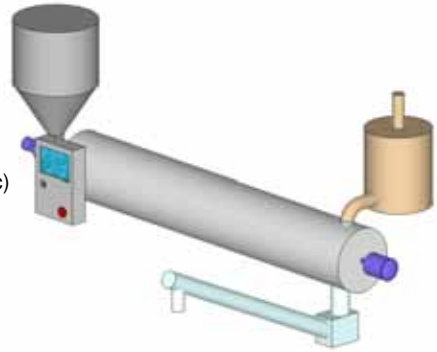


Figure 3: a) Stage I unit, b) Stage II unit and c) Stage III unit

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