Newsletter 2023 WP5 Progress

The objectives of WP5 are to test and characterize Biochar and Activated Carbon production at pilot scale from new feedstock, and then to establish the requirements for Biochar and Activated carbon as final products. Up to day, the results obtained at pilot scale (Tasks 5.1 and 5.2) from raw wild material are presented in deliverable 5.1 and 5.2. Activities started with biomass samples conditioned by CIEMAT and delivered to RE-CORD with the objective of producing biochar from lab scale up to the pilot scale through the slow pyrolysis process. Products obtained were characterized so to demonstrate that biochar has the potential to be considered both as a product by-it-self ready for market, both as precursor material for **high quality activated carbon production.**

Figure 1: *Betula pendula* biochar produced at pilot scale

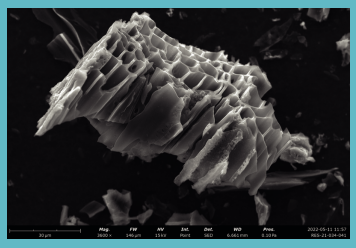

Figure 2: *Betula pendula* biochar sample at 3600x magnitude - Scanning Electron Microscope

In general, the biochar quality is strictly connected to the feedstock nature and quality, the pre-treatment they underwent, the technology used for the thermochemical conversion of the biomass and related slow pyrolysis process parameters set. Therefore, process mass yield and proximate, ultimate and porosity analysis of the biochar obtained at lab scale concurred to the selection of the best process parameters for scaling up the production from the lab to the RE-CORD pilot scale plant. Then, the characterization of the biochars obtained at pilot scale (in terms of process mass yield, total carbon content and H:C molar ratio, water holding capacity and porosity structure) was used to evaluate the product quality for the species selection for the next project steps. In general all the biochars resulted with a very good product quality, in particular related to the high recalcitrant carbon content and to the product stability obtained. Despite biochar samples resulted with a poor development of microporosity and related specific surface area values, good performances in water holding capacity were highlighted. These results confirmed the biochar a high quality product for different potential applications such as soil improver for agronomic purpose, a potential carbon sink for CO2 sequestration in soil application and absorbent material, among others. *Juniperus communis* biochar was also selected to be full characterized following the EU Fertilizing Product Regulation 1009/2019. Results showed how this product complies with the regulation as soil improver. The species with the greatest potential to produce a biochar suitable for multiple end-uses were *Betula pendula, Carpinus betulus, Rubus fruticosus and Ulmus pumila*.

All biochars produced were collected, characterized and supplied to Enviro-Hemp for activated carbons production tests. Results obtained confirmed the advantages of using an already stabilized product (instead of the raw biomass) rich in recalcitrant carbon, as precursor for the activated carbon production: high quality products have been obtained via chemical activation with higher yields than the ones achievable by other activation methods. Furthermore, the products characteristics showed the following remarkable properties: a high microporous nature with specific surface area equal or higher than those of market products (e.g. 1826 m2/g for Cytisus scoparius biochar). In particular, *Cytisus scoparius, Ulmus pumila, Carpinus betulus, Betula pendula and Rosmarinus* officinalis resulted the activated carbon samples highest ranked in terms of specific surface area and pore volume characteristics. Due to their highly microporous nature, the activated carbons produced could potentially find applications beyond odor control, such as energy storage (i.e. supercapacitor devices) and in the incipient market for adsorbed hydrogen and adsorbed methane storage for mobility applications.

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