GREEN FUNCTIONALIZATION OF BIOCHAR VIA MECHANOCHEMICAL APPROACH

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Biochar physical-chemical properties and yields are both influenced by the feedstock and the operating pyrolysis variables (temperature, residence time, heating rate, and reaction environment). Feedstock composition and final temperature are the main factors influencing the porosity, and functionalities, relevant properties for biochar prospects applications [1].
Although biochar has received growing attention as convenient and renewable sources used for several applications such as removing pollutants, remediating soil, and reducing greenhouse gas emissions [2], many studies have reported the positive effect of the physical (steam, plasma, etc.) and chemical modification (acid or alkaline pretreatment, oxidation, nitrogenation, etc.) on improving its performances in specific applications [3].
Recently, considerable attention was paid to this material as a filler for polymer matrices to provide polymer composites with enhanced electrical and mechanical properties[4]. To better affect the polymer properties, good filler dispersibility can be realized by using nanometric particle size and the right interaction between the filler and the polymer matrix.
Here we show the ability of biochar to be chemically modified by introducing specific molecules on the carbon surface to modulate the polarity and the properties of the final composites, by using a new and sustainable mechanochemical procedure.
To this aim, in this study the biochar from populous nigra treated at low pyrolysis temperature (T= 285°C) and slow heating rate (10 °C/min) in an inert environment (N_2= 12 slm) is characterized and tailored for application as filler. The biochar produced is shown for the first time to bond ionically with dodecyl triphenyl phosphonium bromide (DTPPBr), with a mechanochemical approach providing new interesting chemical modified carbon fillers with possible application as antimicrobial materials.
In one step procedure, the filler is nanometrically reduced and is properly functionalized via cation exchange in only 30 minutes in solvent-free conditions, providing a salt uptake of about 15wt%.
The product can be recovered without solvent assistance providing a very environmentally friendly procedure that meets most of the principles of green chemistry.
The procedure is suitable for scale-up and the concepts developed in this work can be transferred to applied industrial chemistry.

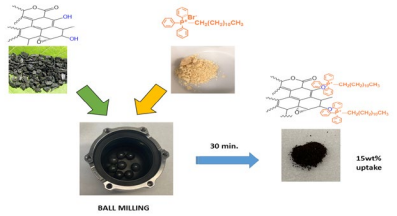

Figure 1. Schematic representation of the mechanochemical functionalization

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