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Saccharides as raw material for biochar-like production

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Introduction

Many studies have been inspired by nature to discovery new materials or to obtain others that mimics natural processes. The abundance of saccharides in nature make them attractive to raise the value of a material or its functionality. Commonly the biochar is obtained from the transformation of biomass (carbon source) in coal-like material by thermal decomposition, resulting in the partial depolymerization of cellulose into smaller molecules and/or their repolymerization which could lead to a higher concentration of functional groups. This work was performed comparing three saccharides as precursor of biochar: glucose, cellobiose and α -cellulose. The biochar was produced using a microwave-assisted hydrothermal carbonization method (MAHC), once previous studies have shown that this process was effective in the production the biochar-like material. The MAHC of saccharides was performed at 180°C for 240 min in the presence of a catalyst reagent.[1] The carbonized materials were analyzed by ^{13}C NMR and scanning electron microscopy.

Results and Discussions

^{13}C solid-state NMR spectra confirmed the existence of functional groups (carboxyls, hydroxyls and aromatic groups) in the carbonized material at chemical shifts from 100 to 230 ppm, as well as the presence of oxygen-substituted protonated and non-protonated C=C bonds resonating at 150 ppm.[2]

Scanning electron microscopy micrographs showed the production of carbonized particles with submicron spherical shapes (with about 2.0 μm in diameter) for glucose, cellobiose and cellulose. However, the cellulose showed a tendency of agglomeration, indicating that carbon spheres were not as well formed as seen in the glucose and cellobiose materials. This feature was reinforced by existence of “neck” structures in the cellulose particles.

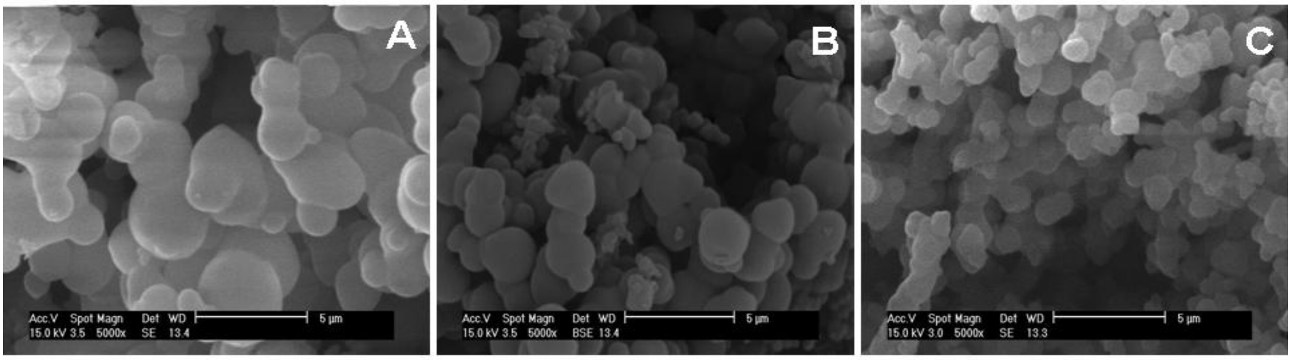

Figure 1. SEM micrographs of microwave-assisted hydrothermally carbonized saccharides (A) glucose; (B) cellobiose (C) and α-cellulose.

Conclusions

In resume, all saccharide sources yielded a chemically similar biochar-like material but with slight morphological differences. Further studies of carbonized materials are being carried on for their chemical structure characterization, properties and functional groups enhancing.

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