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Influence of hydrocarbonization conditions on the porosity of derived carbon dioxide activated carbons

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The production of Activated Carbons (ACs) involves a way to provide an added value to biomass resources. These materials have traditionally been prepared from physical or chemical activation processes (AP), which show some drawbacks such as the use of a great amount of energy supply, or the generation of contaminated water, respectively.

In this sense, hydrothermal carbonization (HC) of biomass has been recently proposed as an interesting way to produce various carbon-based materials. Regarding the production of porous solids by HC, most of the results found in the bibliography show that the porosity of hydrochars is scarce, probably due to pore blockage by carbon products from decarboxilation reactions, as well as to the polymerization of new structures which tend to be placed on the HC surface. In the same way that AP allow the selective removal of carbon atoms and thus the development of porosity in chars made by conventional pyrolysis; we studied the feasibility of producing ACs by carbon dioxide activation of hydrochars produced from walnut shells. Thus, the influence of HC operating parameters (temperature, time and ratio biomass/water) was related to the characteristics of hydrochars and derived-ACs.

HC processes were carried out in a conventional stainless steel autoclave with a capacity of 150 ml (Berghof, Germany). Walnut shell (5 g, Ø of 1-2 mm) was added to a variable amount of deionized water. After keeping the mixture under stirring for 2 h, it was placed on the autoclave and was heated at the prescribed temperature (190-220 ºC) during the defined holding time (10-90 h). Then, the resulting hydrochars were activated with CO_2 at 800-850ºC during 30 min (the high reactivity of the precursor did not allow the use of greater periods of time). The ACs porosity characteristics were studied by N_2 adsorption at 77 K (Autosorb, Quantachrome) and SEM micrography (Hitachi S-3600N).

The results obtained indicate that walnut shell HC show a low porosity, which can be markedly developed by CO_2 activation. Also, although the use of greater HC time and temperature did not have any apparent effect on the HC textural characteristics, it showed a positive influence on the porosity derived-ACs.

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