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Abstract

Evaluation of Natural Materials as Adsorbents of Probe Molecules †

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Adsorption processes are widely used for the removal of a very diverse range of molecules [1–3]. This work presents a study on the use of natural adsorbents for the removal of model molecules (dyes, pesticides and drugs). The molecules studied were methylene blue, yellow 17 acid, 4-Chloro-2-methylphenoxyacetic acid (MCPA), 4-nitrophenol and diclofenac sodium (Voltaren) in aqueous solution. The natural adsorbents studied were materials of vegetal and mineral origin, namely Angolan nuati and njilite woods, wood pellets, the minerals perlite, vermiculite, and expanded clay, natural charcoal and lignocellulosic ash. Although activated carbon is one of the preferred adsorbents for the removal of these types of molecules, its use is dependent on its relatively high cost. Therefore, the search for alternative, non-conventional and low-cost adsorbents is a matter of interest. This work is part of this effort, and evaluates aspects such as the removal of specific molecules and adsorption mechanisms, including kinetics, the determination of equilibrium isotherms, and the influence of experimental parameters such as: adsorbent mass/solution volume ratio, pH of the adsorption medium, and acid and basic adsorbent modification.

The acidic or basic nature of an adsorbent can significantly influence its adsorption capacity. To evaluate this possible effect, the studied materials were subjected to an acidic and basic modification, Figure 1, and their adsorption capacity for selected molecules was compared with the corresponding values already obtained with initial concentrations of adsorptive molecules in the case of the original unmodified materials.

Figure 1. Example of an unmodified lignocellulosic adsorbent (**A**), and modified acid (**B**) and basic adsorbents (**C**).

These modifications caused changes in porous structure, surface chemistry, chemical nature (acid, neutral or basic), shape, colour, stability, and consequently also in elemental chemical composition. The results obtained in this study indicate that some of raw materials are potential adsorbents in their unmodified form, while others allow the removal of model molecules only when modified. It should be noted that this work follows a circular economy approach based on the use of adsorbent materials of natural and renewable origin.

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