WASTES – Solutions, Treatments and Opportunities II – Vilarinho, Castro & Lopes (Eds)
© 2018 Taylor & Francis Group, London, ISBN 978-1-138-19669-8

Activated carbons from Angolan wood wastes for the adsorption of MCPA pesticide

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ABSTRACT: The work now reported presents the activated carbons production from Angolan woods wastes, namely Candeia, Hama, Njiliti, Nuati and Tchitiotioli. The physical activation with carbon dioxide produced materials with apparent surface area between 603 and 801 m^2/g, pore volume from 0.26 to 0.36 cm^3/g, mean pore width from 0.68 to 0.98 nm, and low external surface areas, less than 47 m^2/g for all samples. All samples present a basic nature with point of zero charge in the range 8.58 to 11.90. Selected samples were tested for the adsorption of a problematic pesticide, MCPA (4-chloro-2-methylphenoxyacetic acid) from aqueous solutions. The maximum adsorption was between 85 and 295 mg/g after 24h of equilibrium. With this work a time window of potential applications for these precursors is open, with a not negligible economic impact for the country.

1 INTRODUCTION

The valorisation of wastes without commercial value by its use as precursors for the production of materials with added value is increasingly relevant. One example is the use of biomass wastes for the activated carbons (ACs) production (Bansal et al. 2005, Mourão et al. 2011). The work now reported can have a significant positive impact as we have used wood wastes from Angolan trees for the production of activated carbons by activation with carbon dioxide. These wastes are usually burnt by the population to produce heat, so its use for the production of materials with a significant potential are of interest for Angola a developing country (FOSA—Forestry Outlook Study for Africa—Country Report—Angola).

Activated carbons are used in a wide range of applications performed in gas and liquid medium that include, among others, medicinal uses, gas storage and on environmental issues as pollutants removal from water streams (Bansal et al. 2005, Marsh et al. 2006). The pollutants can be of diverse nature such as emerging pollutants (e.g. drugs, pharmaceuticals), metals (e.g. cadmium, mercury) and herbicides and pesticides (Rathore et al. 2012).

Amongst the processes available to remove pollutants from water the adsorption on activated carbons is one of the most efficient methods as it allows a high adsorption capacity and a good selectivity in particular when they are used with other physical processes such as filtration or coagulation. The uptake of an adsorbate from aqueous solutions by ACs is complex, it depends on various factors, which include the type of precursor, the physical nature (surface area, pore size, pore volume, ash content, particle size) and functional groups present on the adsorbent, the nature of adsorbate (pKa, polarity, molecular weight, size, solubility) and the solution conditions (pH, temperature) (Belo et al. 2016, Dias et al. 2007, Marsh et al. 2006, Rufford et al. 2014).