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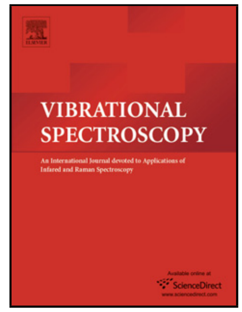

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Authors: Tayra R. Brazil, Mauro S.O. Junior, Maurício R. Baldan, Marcos Massi, Mirabel C. Rezende

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Effect of different superficial treatments on structural, morphological and superficial area of Kraft lignin based charcoal

Tayra R. Brazil[a*], Mauro S. O. Junior[a], Maurício R. Baldan[b], Marcos Massi[a,c] and Mirabel C. Rezende[a]

[a] Science and Technology Institute – Federal University of São Paulo - Rua Talim, 330, 12231-280 - São José dos Campos/SP – Brazil.

[b] National Institute of Space Research - Associated Laboratory of Sensors and Materials - Av. dos Astronautas, 1758, 12227-010 - São José dos Campos/SP - Brazil.

[c] School of Engineering-PPGEMN, Mackenzie Presbyterian University, Rua da Consolação, 896, 01302-907, São Paulo/SP - Brazil.

Corresponding author: tayra_rb@hotmail.com

Abstract

Lignin is a biomass derived from an abundant renewable source, rich in carbon and with potential application in modern society. The goal of this work is to add more value to lignin through its thermal conversion in charcoal, as well contribute to solutions linked to environmental preservation. Charcoal was obtained from Kraft lignin and its surface was modified using chemical (acid attack) and physical (microwave plasma) methods, in order to get charcoals different characteristics. In this work, the prepared charcoals were characterized by field emission gun - scanning electron microscope (FEG-SEM), Raman spectroscopy, Fourier transform infrared spectroscopy (FT-IR), and superficial area by BET analyses. Microscopic analyses evidenced morphological differences in the samples as consequence of the used superficial treatments. Raman spectroscopy results point to an increase in the carbon material disorder after chemical and physical treatments. The acid attack of charcoal increased its superficial area by 40% (403 m^2/g) in relation to the charcoal without chemical treatment (287 m^2/g). Physical treatment based on microwave plasma promoted a further increase in superficial area of 63% (468 m^2/g). FT-IR showed that chemically treated charcoals presented more functional groups. Based on these results, it can be verified that the production of activated charcoal from lignin is viable and its superficial area can be increased using acid and plasma treatments, the latter being a more efficient and clean method.

Keywords: Kraft lignin; Activated carbon; Carbonization; Surface treatment

1. Introduction

Lignin is a macromolecule characterized by a complex chemical structure presenting valuable physico-chemical properties and variable chemical composition [1-5]. In this context, lignin is a prominent biomass, since it has a high availability in the pulp and paper companies. Thus, in the face of environmental concerns, there is a growing interest in harnessing the properties of lignin, an abundant biomass, in nobler uses for society, such as activated carbon. Faced with this interest, the search for the conversion of lignin into a product with higher added value has been a constant challenge [6-8]. Is important to highlight that the lignin is a carbon rich molecule and its structure is similar to bituminous charcoal, making this material a potential precursor in the activated charcoal production [9-10]. Activated charcoal is technically defined as a carbon material presenting porous and a non-graphitic structure with a reduced quantity of heteroatoms – oxygen and nitrogen – in the functional groups present on its surface [12,13]. Carbon materials can be natural or synthetic. They are formed by layers of sp^2 carbons in a hexagonal arrangement, with different degrees of organization and a graphitic-like structure. However, carbon material may also present, to a lesser extent, the presence of sp^3 carbons, similar to diamond-like structure [14].

The process to obtain activated charcoal involves carbonization and activation steps. Kinetic studies of these steps are very important to optimize the charcoal production process [11].