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Valorisation of Tectona Grandis tree sawdust through the production of high activated carbon for environment applications

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ABSTRACT

This work presents a first approach concerning the use of Tectona Grandis tree sawdust (from East Timor) for high activated carbon production, by physical activation with carbon dioxide at different temperatures. The activated carbons (AC) obtained exhibit a well-developed porous structure with a pore size distribution varying from micro to mesopores. Selected AC was successfully evaluated for pesticide removal, specific to 4-chloro-2-methylphenoxyacetic acid, from the liquid phase. The results presented are very promising, allowing to establish that Tectona Grandis sawdust is as an excellent precursor for the basic AC production and allow to expect good performance of theses adsorbents on the removal of a broad range of pollutants. It should also be noted that, this achievement is very relevant for developing countries, such East Timor, where Tectona Grandis sawdust is available and may constitute a source of income creating a handle to the technical and industrial development of this region.

1. Introduction

The valorisation of wood wastes, like from Tectona Grandis, by the production of added value materials, such as activated carbons (AC), is one of the possible strategies to expand the income sources and increase the local economic activity. This type of approach is very important in particular for the developing countries of the world, like East Timor. Tectona Grandis (Teak) grows naturally in Southeast Asia and it represents more than 34% of the afforested land area of East Timor, an island in Southeast Asia, characterized by tropical and subtropical moist mountain forests totalling 507,000 ha (Miranda et al., 2011). Furthermore, Teak sawdust present a high carbon content, as around 50.0% (Kongsomart et al., 2015), which is an excellent characteristic for a potential natural AC precursor.

AC can be produced from a variety of precursors, with different origins and composition, by physical or chemical activation using a variety of physical or chemical activating agents with an assortment of activation temperatures and activation time. The use of biomass in the AC production allows to, reduce their price, and converts unwanted matter, surplus waste, in order of millions of tons per year, into useful valuable adsorbents (Aghababaei et al., 2017; Chen et al., 2016). In practice, coal, agricultural by-products or lignocellulosic materials, which are inexpensive and had a high carbon and low inorganic content, are the main sources for the commercial AC production (Suhas et al., 2016, 2017; Li et al., 2016; Liu et al., 2015; Tan et al., 2017; Yahya et al., 2015).

In another perspective, the continued use of pesticides in agricultural plantations produces the contamination of soils and watercourses. In particular, 4-chloro-2-methyl-phenoxyacetic acid (MCPA) is a post-emergent phenoxy acid herbicide, which deserves a specific attention among the pollutants commonly found in soil and waters, being extensively used in agriculture for the control of broadleaf weeds (Belo et al., 2017; Cansado et al., 2010; Cougnaud et al., 2005; Kamaraj et al., 2014; Salman and Hameed, 2010).

MCPA maximum acceptable concentration in drinkable water, in Portugal, is legislated as 0.1 $\mu g\,L^{-1}$ (Decree-Law No. 306/2007). Its removal becomes urgent and several techniques have been tested for the elimination of pesticides from contaminated areas including adsorption, conventional and advanced oxidation processes, coagulation/flocculation/sedimentation, membrane filtration and biodegradation (Sewu et al., 2017). Nevertheless, adsorption onto AC are referred as the most efficient and, as a superior advanced technique to treat contaminated water for the elimination of toxic organic contaminants, such pesticides and phenolic compounds (Cansado et al., 2012; Ignatowicz, 2009).

Regardless of its qualities, the use of the AC also presents some

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