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Carbon-based materials prepared from pine gasification residues for acetaminophen adsorption

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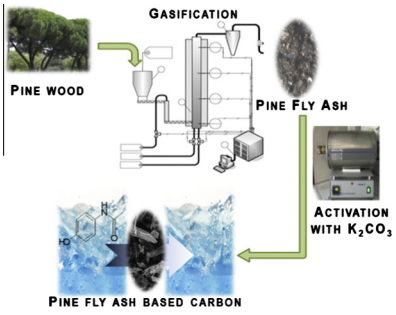
HIGHLIGHTS

- Fly ash from pine gasification was used as precursor of carbon-based materials.
- Materials with A_{BET} of 1171 $m^2 g^{-1}$ were obtain by chemical activation with K_2CO_3.
- The solids were tested for the removal of acetaminophen from aqueous solution.
- Molecular dimensions of monomer and dimer were considered in the discussion.
- The affinity of paracetamol for the carbon is maximized by pores with width of 0.7 nm.

GRAPHICAL ABSTRACT



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ABSTRACT

Fly ash, a residue produced from pine gasification, was used as precursor of carbon-based materials assayed in acetaminophen adsorption. Materials prepared by activation with K_2CO_3, presented high porosity development ($A_{BET} \approx 1200\ m^2\ g^{-1}$) and samples calcined at 900 °C presented high volumes of large micropores and mesopores. Kinetic and equilibrium acetaminophen adsorption data showed that the process obeys to the pseudo-second order kinetic equation and Langmuir model, respectively. The rate of acetaminophen adsorption depends of the presence of larger micropores. For the lab-made samples monolayer adsorption capacities attained values similar to those of commercial carbons. The influence of the micropore size distribution of the carbons in the acetaminophen adsorption process justified the lower adsorption affinities of the lab-made carbons. The importance of pores of a specific dimension (0.7 nm) to enhance the affinity of the molecule towards the carbon surface was demonstrated. The increase of temperature lead to higher monolayer adsorption capacities, most likely due to the easier accessibility of the acetaminophen species to the narrowest micropores.

1. Introduction

In the industrialized countries energy production is, to a large extent, based on fossil fuels, which leads to the release of greenhouse gases into the atmosphere, causing serious and well known environmental problems. In this context, energy production through biomass gasification is nowadays considered a low carbon emission technology being an alternative to combustion, since it is,

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