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Agricultural residues as precursors for activated carbon production—A review

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Abstract

A review of the production of activated carbons from agricultural residues is presented. The effects of various process parameters on the pyrolysis stage are reviewed. Influences of activating conditions, physical and chemical, on the active carbon properties are discussed. Under certain process conditions several active carbons with BET surface areas, ranging between 250 and 2410 m^2/g and pore volumes of 0.022 and 91.4 cm^3/g, have been produced. A comparison in characteristics and uses of activated carbons from agricultural residues with those issued from tires, and commercial carbons, have been made. A review is carried out of the reaction kinetic modelling, applied to pyrolysis of agricultural wastes and activation of their pyrolytic char.

Keywords: Activated carbons; Agricultural wastes; Pyrolysis; Activation; Modelling

Contents

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1. Introduction

Thermo-chemical processes such as pyrolysis or gasification have been widely applied to biomass, gain due to its energy content. Pyrolysis is one form of energy recovery process, which has the potential to generate char, oil and gas product [1]. Because of the thermal treatment, which removes the moisture and the volatile matter contents of the biomass, the remaining solid char shows different properties than the parent biomass materials. The remarkable differences are mainly in porosity, surface area, pore structures (micropores, mesopores and macropores) and physicochemical properties such as composition, elemental analysis and ash content [2]. These changes in the properties usually lead to high reactivity, and hence, an alternative usage of char as an adsorbent material becomes possible [1]. Thus, the char becomes an attractive by-product, with applications including production of activated carbons (ACs), which is useful as a sorbent for air pollution control as well as for wastewater treatment [3]. ACs are carbons of highly microporous form with both high internal surface area and porosity, and commercially the most common adsorbents used for the removal of organic compounds from air and water streams. They also often serve as catalysts and catalyst supports. The market is indeed vast.

The process parameters, which have the largest influence on the products of pyrolysis, are the particle size, temperature and heating rate. The process conditions can be optimized to maximize the production of the pyrolytic char, oil or gas, all of which have potential uses as fuels. Any cheap material, with a high carbon content and low inorganics,