UNIVERSITY OF Hull

10th European Conference on Coal Research and its Applications

(10th ECCRIA)

Organised by the Coal Research Forum

Monday-Wednesday, 15th-17th September 2014

The Business School, University of Hull, UK

Sponsored by

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PROPERTIES AND PERFORMANCE OF MESOPOROUS ACTIVATED CARBONS FROM SCRAP TYRES, BITUMINOUS WASTES and COAL

B. Acevedo, *C. Barriocanal

Instituto Nacional del Carbón, CSIC, Apartado 73, 33011 Oviedo. Spain

Abstract:

Effluents from the textile, plastic, food, cosmetics or paper industries contain dyes that need to be removed to avoid water contamination. The chemicals present in the waste range from organic to polymers or inorganic compounds. In addition even very low concentrations of dyes are visible and therefore need to be eliminated. Dyes are non-biodegradable or photo-degradable. Moreover the decolouration of textile dye effluents does not occur when treated aerobically by municipal sewerage systems, and some are known to be carcinogenic and mutagenic. These industries consume an enormous amount of water that needs to be treated, posing a serious economic and environmental problem. Although activated carbons may be used to treat these effluents, the cost of such adsorbents is high. Hence there is a need to find low-cost sorbents from wastes.

Tyre wastes and their blends with coal and a bituminous waste material obtained from the benzol distillation column of a by-product section of a coking plant were employed as a precursor for the production of activated carbons (ACs). Pyrolysis up to 850 °C followed by physical activation with CO_2 produced mesoporous carbons with different pore size distributions and surface areas. The surface chemistry of the samples was studied by measuring the point of zero charge (pHpzc) and by temperature programmed desorption (TPD). The activated carbons obtained contained higher amounts of basic functional groups. Their textural and surface chemistry characteristics make them highly suitable for adsorbing acid dyes of large molecular size, such as Congo red, from solutions. The adsorption kinetics was found to conform closely to the pseudo-second-order kinetic model. To determine the adsorption mechanism, the kinetic data were also analysed using the Weber and Morris intraparticle diffusion model and the Boyd model to distinguish between the pore and film diffusion steps. The equilibrium isotherms were of the Langmuir isotherm type. The efficiency of the low-cost ACs prepared for the removal of Congo red dye was similar to that reported in the literature for coal-based ACs and greater than that of other low-cost ACs.

Keywords: : Scrap tyres, activated carbons, bituminous waste.

Acknowledgement: The research leading to these results has received funding from the Spanish MICINN CTM2009-10227. BA thanks the Government of the Principado the Asturias for the award of a predoctoral grant with funds from the PCTI Asturias.

*: *Corresponding author:*
E-mail: carmenbr@incar.csic.es
Tel: +34985 11 90 90 int.216, fax.-34 985 29 76 62