

Activated carbon fiber from natural precursors: a review of preparation methods with experimental study on jute fiber

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ABSTRACT

Activated carbon fiber (ACF) has distinct advantages over other commercial porous storage materials in terms of capacity, kinetics and durability. Due to high processing cost of synthetic ACF, production of ACF from low-cost precursors, such as biomass or agricultural wastes, has drawn attention in recent times. In the first part of this study, a critical review of preparation methods of ACF based on ligno-cellulosic biomass and major factors affecting the key properties of the prepared ACF is presented. In the second part, an experimental study on jute fiber investigating chemical activation methods and properties of resultant ACFs are reported. Three key process parameters, that is, pretreatment method, activation temperature and concentration of activation agent were varied to get optimum result with respect to yield and adsorption capacity. Prepared ACFs were characterized by SEM and energy-dispersive X-ray spectroscopy analysis, iodine number and BET surface area test, and pore volume measurement. Additionally, adsorption isotherms, adsorption kinetics and adsorption capacities of the ACF for two organic dyes – methylene blue (MB) and 4-nitrophenol (4-NP), were investigated. The paper also describes the limitations of biomass-based ACFs and the challenges in commercializing them. Finally, scopes of further research to improve adsorption and mechanical properties as well as to meet the diversified market demand of biomass-based ACF are discussed.

Keywords: Activated carbon fiber; Jute fiber; Adsorption; Dye removal; Adsorption isotherm; Adsorption kinetics; Biomass

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