Preparation of Sludge Based Activated Carbon Using Hydrothermal Carbonization for Basic Dye and Humic Acid Adsorption from Aqueous Solution

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Abstract

Preparation of Sludge-based Activated carbon(SBAC) required to the carbonization step followed by the activation process. The conventional carbonization method such as pyrolysis needs to use high energy due to high moisture and poor water dewaterability of wet sludge. Recently, the hydrothermal carbonization(HTC) as a promising wet biomass conversion technology has been introduced to solve simultaneously the proper disposal method of wet sludge and its valorization by conversion into value-added products. In this study, SBAC was prepared from high moisture wastewater sludge by hydrothermal carbonization at several temperatures (170, 200, 230, and 260°C) followed by the physical activation with CO2 and the chemical activation with KOH. Moreover, the utilization of high surface area SBAC for adsorption of methylene blue(MB) as a basic dye and humic acid (HA) was investigated. The characterization of hydrochars(HCs) and SBACs were undertaken using the FTIR, SEM-EDS, BET, TG-DTA, and Zeta potential. According to the results, the chemical activation (1200-1600m^2/g) of HCs was much more effective than the physical activation (below 300m^2/g) for their development of porosity and specific surface area. Furthermore, the results indicated that by increasing the temperature of HTC, at the same operation condition of the chemical activation, the surface area and porosity of SBAC were increased. The high production yield and the best specific surface area (up to 1612.91 m^2/g) of SBAC were obtained at the HTC temperature of 260°C and sequential KOH activation. The adsorption equilibrium and kinetics of MB and HA onto best SBAC were carried out in batch mode. The Langmuir isotherm and the pseudo-second-order kinetic model give the best fittings with experimental data. The maximum adsorption capacity of MB and HA at 25°C was 588.24 mg/g and 26.32 mg/g, respectively, which showed better performance compare with two commercial activated carbons. In conclusion, SBAC prepared from hydrochar of wastewater sludge can be used as a low-cost and effective adsorbent for removing basic dyes and humic acid adsorption from aqueous solutions.

Keywords— *Adsorption, Hydrothermal Carbonization, Humic acid and Methylene blue, Sludge-Based Activated carbon*

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Recent Publications (up to 5)

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- Khoshbouy R, Takahashi F, Yoshikawa K, Preparation of High-Surface-Area Activated Carbon via Hydrothermal Carbonization of Biowaste and Using Physical & Chemical Activation for Methylene blue Removal, 5th Asian Conference on Biomass Science, Sendai, Japan, 2017



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