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Preparation of sludge based activated carbon using hydrothermal carbonization for basic dye and humic acid adsorption from aqueous solution

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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° followed by the physical activation with CO_2 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 (1200-1600 m^2/g) of HCs was much more effective than the physical activation (below 300 m/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 (upto 1612.91 m^2/g) of SBAC were obtained at the HTC temperature of 260° 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° was 588.24 mg^2/g and 26.32 mg^2/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.

Biography

Reza Khoshbouy has completed his BSc and MSc at Sahand University of Technology, Tabriz, Iran. He started his PhD course in April 2016 in the Department of Environmental Science and Technology at Tokyo Institute of Technology. His major fields are water purification, adsorption technology, waste management and environmental engineering. Currently he is a second-year Doctoral student (D2) in Prof. K Yoshikawa laboratory. His research focuses on development of cost effective adsorbent for water and wastewater treatment from biomass-based waste and wastewater sludge using hydrothermal carbonization and activation process.

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