Geophysical Research Abstracts
Vol. 18, EGU2016-13435, 2016
EGU General Assembly 2016

Fixed-bed adsorption study of methylene blue onto pyrolytic tire char

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In this work, the adsorption efficiency of acid treated pyrolytic tire char to cationic methylene blue (MB) dye adsorption from aqueous solutions was investigated by fixed-bed adsorption column experiments. The effects of the initial dye concentration (10 - 40 mg L-1) and feed flow rate (50 - 150 mL min -1) with a fixed bed height (15 cm) were studied in order to determine the breakthrough characteristics of the adsorption system. The Adams-Bohart, Yoon-Nelson and Thomas model were applied to the adsorption of MB onto char at different operational conditions to predict the breakthrough curves and to determine the characteristic parameters of the column. The results showed that the maximum adsorbed quantities decreased with increasing flow rate and increased with increasing initial MB concentration. Breakthrough time and exhaustion time increased with decreasing inlet dye concentration and flow rate. In contrast with Adams-Bohart model, Yoon-Nelson model followed by Thomas model were found more suitable to describe the fixed-bed adsorption of methylene blue by char. The correlation coefficient values R2 for both models at different operating conditions are higher than 0.9 and the low average relative error values provided very good fittings of experimental data at different operating conditions. Higher adsorption capacity of 3.85 mg g -1 was obtained at 15 cm of adsorbent bed height, flow rate of 100 mL min -1and initial MB concentration of 40 mg L-1. Although that activated carbons exhibited higher adsorption capacities in the literature, acid-treated pyrolytic tire char was found to be considerably efficient adsorbent for the removal of MB dye column taking into account the advantages of the simpler production process compared to activated carbons, as well as, the availability of waste tire feedstock and concurrent waste tire management.