Adeyemo, Imoleayo Elijah (2017): Adsorption of Diuron Herbicide on selected Biochars. Supervisors: Fischer, Emmerling (Masterthesis).

ABSTRACT

In recent time, diuron has been detected in surface water and groundwater. Research has shown that 70% of water samples collected from rivers around Europe contain a maximum concentration of diuron (864 ng/L). In the environment, the maximum permissible concentration of an herbicide such as diuron in the drinking water is 100 ng/L.

In this study, biochars made from different biomass labelled as B1, B2, B3 and B4 were used as an adsorbent for the removal of diuron herbicide in solution. The physicochemical properties of the biochars were determined, methylene blue adsorption test reveals that B2 has the largest surface area in the order B2>B4>B3>B1 with 132.60, 27.10, 3.07 and 1.35 m2/g respectively, pH value ranges from 8.95 (B1) to 10.02 (B2).

The Cation exchange capacity was determined using the NH4CL extraction method. The order of decreasing CEC is B2>B4>B3>B1 with values 20.64, 10.87, 8.04 and 3.15 mmolc/100g respectively.

The FTIR analysis revealed some similarities among the prominent spectra band for all the 4 biochars. Batch adsorption was performed by varying adsorbent dosage, initial concentration, contact time, and pH. Kinetic models applied to experimental data indicated that the pseudo-first-order model has the better fit. The effect of pH on the adsorption was negligible at three different pH: 3.34, 6.07 and 9.05.

The equilibrium data were analysed using Freundlich and Langmuir isotherm models. At room temperature, B2, B3 and B4 have better fit for Langmuir model whereas B1 has an equal fit for Freundlich and Langmuir although the latter has a higher calculated adsorption capacity. The K_f calculated from Freundlich model was 1.617 mg/g whereas the Q_0 calculated from the Langmuir isotherm was 3.218 mg/g. The adsorption capacity of B2, B3 and B4 for the removal of diuron was calculated to be 71.43 mg/g, 1.57 mg/g and 7.35 mg/g respectively. Biochars B1, B3 and B4 achieved adsorption efficiency (B1=99.90%, B3=99.53%, B4=99.92%) while using adsorbent dose of 0.5 g to adsorb 30 mg/L of diuron and B2 at 0.05 g adsorbent dose adsorbed 30 mg/L diuron achieving 99.95% adsorption efficiency.

The kinetics study also showed that the reaction kinetics follow the pseudo first order reaction model with rate constant 0.00124 min^{-1}, 0.00123 min^{-1}, 0.00990 min^{-1} and 0.00130 min^{-1} for B2, B2, B3 and B4 respectively.

The study concluded that B1, B2, B3 and B4 produced at 800°C and at optimum reaction conditions can be used for the effective removal of diuron in the aquatic environment.