Preparation of activated carbon from the residues of the mushroom (Agaricus bisporus) production chain for the adsorption of the 2,4-dichlorophenoxyacetic herbicide

Joseane S. Lazarotto, Kátia da Boit Martinello, Jordana Georgin, Dison S. P. Franco, Matias S. Netto, Daniel G. A. Piccilli, Luis F. O. Silva, Eder C. Lima, Guilherme L. Dotto

Abstract

The production of the edible mushroom Agaricus bisporus occurs on a world scale, where tons are constantly produced. At the same time, this production generates a large amount of waste that needs to be adequately conditioned. Therefore, mushroom residues were used to develop activated carbon for the removal of 2,4-D—the developed adsorbent showed a microporous structure with several spaces on the surface. The FTIR analysis showed that the activated carbon has functional groups such as aromatic rings, carboxylate, hydroxyl. It was found that the optimum adsorption of the 2,4-D occurs at pH 4 and adsorbent dosage of 0.4 g L−1; The equilibrium data were better fitted to the Freundlich model. However, for calculating the thermodynamic parameters, it was considered the Langmuir equilibrium constant (KL). The value of Langmuir Qmax was 241.7 mg g−1 at 298 K. The thermodynamic behavior indicated a spontaneous and favorable, and exothermic. The magnitude of the adsorption enthalpy is in agreement with physical adsorption. System equilibrium was attained before 30 min regardless of 2,4-D concentration. The kinetic curves showed good statistical adjustment to the linear driving force (LDF) model, with capacity values close to the experimental ones (qexp = 194.6 mg g−1; qpred = 187.3 mg g−1), at 100 mg L−1 of 2,4-D. The adsorbent removed up to 70% of the simulated effluent when using the Jacuí river as the sample. Regeneration studies showed that the activated carbon could be used up to 9 times without losing significant efficiency. Last, the process cost production was estimated to be 2.39 USD kg−1 of activated carbon. Therefore, it can be concluded that activated carbon developed from edible mushroom

residues is a promising alternative as an adsorbent for the treatment of actual effluents containing 2,4-D herbicide.

Keywords

ctivated carbon, Adsorption, *Agaricus bisporus,* 2, 4-dichlorophenoxyacetic acid