ID: 5022

Removal of Phenol from Water Using Acorns Barks as Adsorbent

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ABSTRACT

In this research study, a new adsorbent prepared from acorns barks was used to investigate the removal of phenol from aqueous solution in a batch system. The effects of solution pH, initial phenol concentration and adsorbent mass on the adsorption capacity were studied, thus, the adsorption kinetics and isotherms were modeled.

Keywords: Adsorption, phenol, acorns barks, organic pollutants.

1 Introduction

Wastewater contains a mixture of pollutants, among which phenols and their derivatives are the most common organic pollutants of wastewater that require careful treatment. Phenols are toxic to humans, animals, and aquatic life, and they increase the oxygen demand of receiving water. Phenolic compounds are very harmful to organisms even at low concentrations due to their high toxicity and carcinogenic properties. Elimination of phenolic compounds from water by adsorption on activated carbon is a well-established and powerful technique for elimination of phenolic compounds. However, due to its high price and its regeneration cost, activated carbon becomes inconvenient as an adsorbent. Nowadays, one of the great challenges in the adsorption technologies is the exploring of new potential and low-cost adsorbents using biological material. In this study, acorns barks were used as an adsorbent for the elimination of a phenol from water.

2 Experimental

2.1 Preparation of activated acorns barks

For the preparation of carbon from acorns barks, the barks were washed with distilled water and then dried in an oven at 105 °C for 24 h. Ten g of the raw material was immersed in 100 mL of H2SO4 solution (40 %) and kept at 105 °C for 2 h. The acid treated acorns barks was washed several times with distilled water and then dried at 105 °C for 24 h. The obtained sample was calcined at 500 °C for 2 h, crushed and sieved at a diameter ≤ 500 µm

2.2 Adsorption experiments

Batch adsorption experiments were carried out in 1000 ml of Erlenmeyer flasks in which 500 ml of aqueous solution was mixing with a determined mass of activated acorns barks. The mixture was shaken under ambient temperature at 150 rpm for 4 h to attain equilibrium. Samples were collected at predetermined time intervals, and then filtered through a filter (0.45 µm) for the determination of phenol concentration. The concentration of phenol in water was determined by measuring the absorbance on a UV–Vis spectrophotometer Shimadzu UVmini-1240, at a wavelength of 510 nm.

3 Results and Discussion

Adsorption experiments were showed the influence of pH, adsorbent mass and initial phenol concentration on treatment efficacy. The higher equilibrium adsorption capacity was about 15.79 mg/g and corresponds to the following conditions: initial phenol concentration 20 mg/L, pH medium 4, and mass of activated acorns barks 0.5 g.

The kinetic data obtained from batch studies have been analyzed by pseudo-first-order, pseudo-second-

DOI: 10.21467/abstracts.170 ISBN: 978-81-970666-1-0 (eBook)

order and intraparticle diffusion models. The results suggest that the pseudo-second-order kinetic model fits best because of its highest value of the R^2 (0.998). Three widely used models, Langmuir, Freundlich, and Temkin were applied, the experimental data were well described by Freundlich isotherm (R^2=0.992) showing heterolayer phenol formation on the adsorbent surface.

4 Conclusions

In this work, the activated acorns barks were used as adsorbent for the elimination of phenol from aqueous solution. The results showed that the adsorption capacity increases with the phenol concentration and decreases by increasing the mass of adsorbent. The kinetic data were very well described by the pseudo-second-order kinetic model and the Freundlich isotherm.

ISBN: 978-81-970666-1-0

Series: AIJR Abstracts

DOI: 10.21467/abstracts.170