p-Nitrophenol Adsorption on Polystyrene-Co-Divinylbenzene Functionalized Copolymers

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Abstract

The removal of phenolic compounds form wastewater is of significant importance due to the damages caused to the environment and human life [1-3]. The polymeric adsorbents were intense studied in the adsorption processes and are now considered efficient in the removal of different pollutants from wastewater, including phenolic compounds [4-6].

In this study we introduce two new polystyrene-co-divinylbenzene copolymers, functionalized with carboxylic groups. The two copolymers, PC12 (with 12% divinylbenzene) and PC6.7 (with 6.7% divinylbenzene) were characterized and tested as adsorbents for the removal of p-nitrophenol from aqueous solution. The effect of different parameters on the removal efficiency was investigated. The kinetics and adsorption isotherm were also evaluated.

The copolymers were characterized by means of IR spectroscopy. FTIR spectra were carried out using a Shimadzu Prestige-21 spectrometer in the range 400–4000 cm^{-1}, using KBr pellets and resolution of 4 cm^{-1}. N_2 adsorption–desorption isotherms of copolymers were performed on Micromeritics ASAP 2020 instrument. The specific surface area was calculated using the Brunauer–Emmett–Teller (BET) method and the pore size distribution using the Barrett–Joyner–Halenda(BJH) method from the desorption curves. Thermal analysis (TG/DSC) was carried out using a NETZSCH-STA 449C instrument. The curves were recorded in the range of 25–1200 °C with a heating rate of 10 K min^{-1}, using platinum crucibles. The experiments were carried out in artificial air at a flow rate of 20 mL min^{-1}. The morphology of the nanopowders was investigating by scanning electron microscopy (SEM), using a FEI Quanta FEG 250 microscope.

The adsorption experiments were performed at 25 °C, using 50 mg adsorbent added at 25 mL p-nitrophenol solution with initial concentrations of 100 mg L^{-1}. All experiments were performed at a 200 rpm shaking speed for 8 h to ensure the equilibrium of the adsorption process. The p-nitrophenol concentration was monitored by spectrophotometric analysis using a Schimadzu UV–VIS Spectrophotometer. The absorbance values were measured according to the maximum UV-absorption, at the wavelength of 316 nm.

The copolymers proved a good adsorption capacity. The removal efficiency of p-nitrophenol using PC6.7 adsorbent was 86% while using PC12 was 78%.

The experimental data were fitted with Langmuir, Freundlich, Redlich-Peterson and Sips isotherms. The maximum adsorption capacity of p-nitrophenol, resulted from Langmuir isotherm was 213.4 mg g^{-1} using PC6.7 adsorbent and 80.8 mg g^{-1} using PC12.

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