Removal of pharmaceutically active compounds (PhACs) from effluent using activated Palm Kernel Shell (PKS)

By

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Abstract

Palm kernel shell (PKS) were used as the precursor for the preparation of activated carbon and optimized to remove the pharmaceutically active compounds (PhACs) included Atenolol (ATE), Acebutolol (ACE) and Carbamazepine (CBM) that are the major contaminants in the waterbody.

The PKS was first sieved into different particle size (≤0.15mm, 0.5-0.71mm and 1-1.4mm) and physically activated by carbon dioxide at temperatures ranged from 700 to 900°C for 1 to 1.5 hours. BET surface area analysis showed that the highest surface area of 711.52m²/g and micro-porosity of 42% can be obtained by activating powder size PKS at 900°C for 1.5 hours with carbon dioxide at the flow rate of 50ml/min.

Kinetic study have shown that rapid adsorption of PhACs started in the first 90 minutes and reached equilibrium at the 4th hour. The rate of adsorption was directly proportion to the surface area of the adsorbent while the influence of the pore size distribution was minor. Film diffusion was the rate-limiting step in the adsorption process as demonstrated by the Boyd kinetic model. The kinetic data was best fitted with Ritchie-second-order model and confirmed by diffusion-chemisorption model implying that chemisorption occurred between the adsorbate and adsorbent. The isotherm adsorption showed that the maximum rate of adsorption of ATE, ACE and CBM were 0.69, 0.67 and 0.72 mmol/g and the experimental data fitted better to Sips and Redlich-Peterson isotherm followed by Langmuir, Freundlich and Temkin isotherm models indicated the PhACs were adsorbed on the monolayer adsorbent surface. The rate of PhACs adsorption could be explained by electrostatic and non-electrostatic interaction and higher adsorption rate observed in alkali environment while the CBM adsorption was independent of pH change. The results showed that PKS was possible for the aqueous adsorption of the PhACs.