

Sorption potential of oil palm shell for the removal of chlorinated phenol from aqueous solution: Kinetic investigation

ABSTRACT

In this study, activated carbons (ACs) from oil palm shell (OPS) were prepared using the two-stage self-generated atmosphere method, comprising of a semi carbonization stage and a chemical activation stage, which were fixed at 300 oC and 500 oC respectively. The prepared adsorbents were tested in the removal of 2,4-dichlorophenol (2,4-DCP) from aqueous solution. The samples were impregnated by varying the zinc chloride (ZnCl₂) to precursor (OPS) ratio, after which, the final products, ACs, underwent several aspects of chemical and physical characterizations, i.e. percentage of yield, moisture content, ash content, pH, porosity, adsorption kinetics and isotherms (2,4-DCP) and surface chemistry of the adsorbent. The results indicated that the percentage of yield, moisture content and ash content had increased in proportional to the increase in ZnCl₂ ratio. It was found that AC₄, with the impregnation ration of 1:4 (OPS:ZnCl₂) had the highest adsorption capacity of 26.40 mg/g. While the maximum Brunauer, Emmett and Teller (BET) surface area of AC₄ was found to be around 1020 m² /g. Adsorption studies indicated an increased in adsorption capacity in proportional to the increase in adsorbate initial concentration and adsorbent dosage, whereas a higher pH decreased the adsorption capacity. The adsorption isotherm of all the prepared ACs fitted well to the Langmuir model, while the sorption kinetics followed the pseudo-second order, indicating that the adsorption was a single layer chemisorption process.