

## **Column dynamic studies and breakthrough curve analysis for Cd(II) and Cu(II) ions adsorption onto palm oil boiler mill fly ash (POFA)**

### **ABSTRACT**

This paper investigates the adsorption characteristics of palm oil boiler mill fly ash (POFA) derived from an agricultural waste material in removing Cd(II) and Cu(II) from aqueous solution via column studies. The performance of the study is described through the breakthrough curves concept under relevant operating conditions such as column bed depths (1, 1.5, and 2 cm) and influent metal concentrations (5, 10, and 20 mg/L). The Cd(II) and Cu(II) uptake mechanism is particularly bed depth- and concentration-dependant, favoring higher bed depth and lower influent metal concentration. The highest bed capacity of 34.91 mg Cd(II)/g and 21.93 mg Cu(II)/g of POFA was achieved at 20 mg/L of influent metal concentrations, column bed depth of 2 cm, and flow rate of 5 mL/min. The whole breakthrough curve simulation for both metal ions were best described using the Thomas and Yoon-Nelson models, but it is apparent that the initial region of the breakthrough for Cd(II) was better described using the BDST model. The results illustrate that POFA could be utilized effectively for the removal of Cd(II) and Cu(II) ions from aqueous solution in a fixed-bed column system.

**Keyword:** Adsorption characteristics; Breakthrough curve modeling; Fixed-bed column system; Heavy metals; Palm oil boiler mill fly ash (POFA)