

UNIVERSITI TEKNOLOGI MARA

**ADSORPTION MECHANISM AND
KINETIC OF HYBRID MAGNETIC
KNF-CHT-ALG- Fe_3O_4 @ SiO_2
HYDROGEL COMPOSITE FOR PB
(II) IONS IN WASTEWATER**

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ABSTRACT

Excessive toxic metals are commonly found in polluted wastewater. This study aimed to synthesise kenaf-based adsorbents for the adsorption of lead (II) ions. The physical and chemical characteristics of the kenaf (KNF) core and fibre were determined using field emission scanning electron microscope (FESEM), thermogravimetric analysis (TGA), and Fourier-transform infrared spectroscopy (FTIR). The further synthesised beads were characterised through FESEM and FTIR, while inductively coupled plasma (ICP) was employed to determine the percentage of adsorption. The FESEM analysis demonstrated that the KNF core had a rougher surface morphology than the KNF fibre. The TGA analysis confirmed that the KNF core was coarser and contained a higher residue of approximately 75.91%. The FTIR spectra established intense functional groups in the KNF core, such as hydroxyl and carboxyl, attracting more Pb (II) ions. The KNF core was then used to synthesise KNF-CHT-ALG and KNF-CHT-ALG-Fe₃O₄@SiO₂ beads. The beads confirmed the enhancement in surface morphology and the existence of numerous functional groups for Pb (II) ions to bind. The ICP analysis demonstrated highest removal of Pb (II) ion onto KNF-CHT-ALG beads with percentage of 95%. Additionally, batch adsorption experiments were conducted at pH 2–7, initial Pb (II) ions concentration of 50-250 mg/L and contact time at 5–60 minutes. The isotherm and kinetic study of the adsorption fitted well to Langmuir model and the Pseudo-Second Order model with an R² value of 0.9938 and 0.9999, respectively. The maximum adsorption capacity of Pb (II) ions onto KNF-CHT-ALG beads is 33.557 mg/g. After 5 times of recycling process, the KNF-CHT-ALG beads still showed good adsorption towards Pb (II) ions with maximum removal of 95%. The KNF is a crop found in abundance in Malaysia, which could reduce the production cost of adsorbents. The significant outcomes would minimise the dependency on chemical adsorbents and accelerate the removal process of heavy metals in wastewater.

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