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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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science
(Civil Engineering)

College of Engineering

July 2022

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-Fe_3O_4@SiO_2 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 R^2 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.

ACKNOWLEDGEMENT

First and foremost, I praised and thanked Allah the Almighty, for His showers of blessings throughout my journey to complete the research work successfully.

This study was financially supported by the Fundamental Research Grant Scheme (FRGS) (Grant number: FRGS/1/2019/TK10/UITM/02/7). I am beyond grateful to the Lembaga Kenaf Dan Tembakau Negara (LKTN) Pahang, MyBiorec Laboratory, School of Civil Engineering, College of Engineering, Universiti Teknologi MARA, Shah Alam, Selangor, Instrumental Lab 2 Laboratory, School of Chemical Engineering, Universiti Teknologi MARA, Shah Alam, Selangor, and the Centre for Research and Instrumentation Management (CRIM), Universiti Kebangsaan Malaysia, Bangi, for the permission to utilise their facilities.

I would like to express my deep and sincere gratitude to my research supervisors, Ts. Dr. Nurul Fariha Binti Lokman, Dr. Sharifah Binti Abdullah and Assoc. Prof. Dr. Tay Chia-Chay for giving me the opportunity to do research and providing invaluable guidance throughout this research. Their vision, sincerity and motivation have deeply inspired me. They have taught me the methodology to carry out the research and to present the research works as clearly as possible. It was a great privilege and honor to work and study under their guidance. I am extremely grateful for what they have offered me.

I am extremely grateful to my lovely parents (Anuar Bin Abdullah and Roziah Binti Awang Kechik) for their love, prayers, caring and sacrifices for educating and preparing me for my future. I am very much thankful to my partner (Raja Muhammad Naufal Bin Raja Naufal) for his love, understanding, prayers and continuing support to complete this research work. I also want to express my thanks to my siblings (Nurul Emylia Syarina Binti Anuar, Ameir Iqbal Bin Anuar and Emylin Sofia Binti Anuar) for their support and valuable prayers. My special thanks go to my friend and PhD senior (Aina Binti Abdul Aziz, Nor Asyikin Binti Ismail, Nur Dalila, Nur Saadah and Puteri Effanur Hidayah) for the endless encouragement and knowledge shared throughout this research study.

I am extending my thanks to all laboratory staff of the College of Engineering for their kindness and genuine support in completing this study. I am so overwhelmed with their endless help to complete the laboratory work.

Finally, my thanks go to all the people who have supported me to complete the research work directly or indirectly.

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