

Immobilization of Uranium and Thorium in Mining-affected Soils using Oil Palm Fronds Activated Carbon

Nurin Natasha Johari^a & Yong Soon Kong^{ab*}

Structured Abstract

Background: Soil contamination from uranium and thorium mining creates serious environmental and health risks. This happens due to radionuclides leaking into the affected soils. This study aims to immobilize U and Th in mining-affected soils using oil palm fronds activated carbon, OPFAC. OPFAC was chosen because it can effectively absorb these harmful radionuclides, helping limit their concentration and movement in contaminated soils.

Methods: In the experimental approach, IAC soil samples from Lipis, Pahang were amended with OPFAC and subjected to sequential batch leaching using deionized water, 0.3% CaCl₂, and 0.3% (NH₄)₂SO₄ solutions. Leachates were filtered, acidified, and tested for uranium and thorium using inductively coupled plasma optical emission spectrometry (ICP-OES). This research ensures the results are accurate by using standardized calibration in batch leaching experiments. The three leaching agents mimicked different environmental chemical conditions. This study will rigorously ensure that the data are accurate and that the laboratory data use batch leaching. The three leaching agents also represent a range of different environmental chemical conditions. These experimental leaching approaches help understand how radionuclides might be leached from soils and assess the effectiveness of OPFAC soil amendment.

Results: This study demonstrates that uranium and thorium were effectively immobilized in IAC soils amended with oil palm frond activated carbon (OPFAC), as confirmed by batch leaching experiments. This research illustrates the usefulness of the literature for immobilizing uranium and thorium in IAC soils amended with oil palm frond activated carbon (OPFAC) as demonstrated in batch leaching studies. The IAC soils amended with OPFAC exhibited lower radionuclide leaching concentrations under all conditions tested in batch leaching experiments, with the greatest retention in ammonium sulfate.

Conclusion: Activated carbon derived from oil palm fronds has successfully reduced uranium and thorium leaching from soils polluted with IAC and is considered a sustainable and effective remediation method. It has been confirmed with reliable and consistent results under different leaching conditions which will be commercially valuable as a remedial approach providing long-term immobilization of radionuclides in environments affected by mining.

Keywords: Oil palm frond activated carbon, IAC soils, radionuclides, batch leaching

*Correspondence: yongsk@uitm.edu.my

^a School of Chemistry & Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia

^b Soil Assessment and Remediation Research Group, Universiti Teknologi MARA, Shah Alam, Malaysia