PhD. Dissertation Defend Examination

Presented by

Miss Autchariya Boontanom

Advisor: Assoc. Prof. Dr. Rungsima Yeetsorn

Applications of commercial iron oxide powder and nanoparticles derived from mill scale waste

Highlight Summary

Mill scale, an undervalued iron-rich byproduct of the steel industry, poses significant environmental and economic challenges. This dissertation presents a "waste-to-solution" strategy, valorizing mill scale into a multifunctional sorbent for hexavalent chromium (Cr(VI)) detoxification.

Raw mill scale was converted into **high-purity magnetite (Fe_3O_4) microparticles** (>99.7% purity) via a regulated hydrogen reduction process using water vapor as a retarding agent. These magnetic particles were encapsulated within an alginate-based hydrogel matrix alongside activated carbon and L-ascorbic acid. The resulting composite demonstrated superior remediation efficiency, achieving 100% removal of Cr(VI) (50 mg/L) within 360 minutes in laboratory settings. Synergistically combining adsorption, chemical reduction to Cr(III), and magnetic separation, the sorbent proved effective even against extreme industrial loads (~2000 mg/L), reducing concentrations to undetectable levels (<0.01 mg/L) via a sequential batch approach. Furthermore, the material exhibited high reusability, maintaining >80% efficiency over 5 cycles at 100 mg/L.

This study establishes a sustainable circular economy approach, simultaneously addressing metallurgical waste management and providing a high-value material for treating hazardous industrial effluents.

Keywords: Mill Scale, Value Addition, Hydrogen Reduction, Hexavalent Chromium, Composite Hydrogel, Adsorption, Magnetic Separation, Environmental Remediation.

Date	Time	Venue
15/01/2026	13:00	Berlin Meeting Room (307) TGGS Building