



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: **Removal of Arsenic from Water using Hybrid SLM-Electrocoagulation Technique**

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SHORT ABSTRACT

This research focuses on a novel hybrid technique combining supported liquid membrane (SLM) separation with electrocoagulation for effective arsenic removal from water. Utilizing sesame oil, an environmentally benign solvent, and Aliquat® 336, the study developed a pseudo-binary liquid membrane system. The work includes comprehensive physicochemical analysis and molecular modelling of the membrane system. It reveals that As(V) is more favourable for extraction due to its larger ionic size and higher positive charge compared to As(III). Two-phase equilibrium studies and advanced statistical and machine learning models, including artificial neural networks and genetic algorithms, optimized the extraction process. A three-phase SLM setup demonstrated efficient separation and recovery of arsenic species, with performance enhanced by synergistic effects between As(III) and As(V).

The hybrid SLM-electrocoagulation system integrated iron and graphite electrodes to simultaneously remove arsenic through concentration gradients and co-precipitation. Characterization of the resulting iron-arsenic complexes confirmed phase transformations and oxidation of As(III) to As(V). Nine adsorption isotherm models viz. Langmuir model, Freundlich model, Redlich Peterson model, Sips isotherm, Temkin model, Dubinin-Radushkevich isotherm, Jovanovic model, Halsey isotherm and Harkins-Jura model and six adsorption kinetic models viz. pseudo first order, pseudo second order, Elovich model, fractional power function, intraparticle diffusion and liquid film diffusion model have been explored to understand the adsorption phenomenon in depth. All the adsorption modelling has been validated through statistical error analysis. Adsorption models and kinetics further elucidated the removal mechanism, with Dubinin-Radushkevich and Freundlich isotherms fitting well for heterogeneous and physical adsorption processes. On the other hand, pseudo first order model is found to fit the kinetic data for all based on the statistical error analysis.

Field application on groundwater samples from arsenic-affected regions in Assam and West Bengal validated the technique's efficacy, achieving arsenic levels below WHO-recommended limits. The study underscores its potential for scalable implementation while producing value-added byproducts like construction materials and insecticides.