INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Bio-Based Engineered Adsorbents for Sequestration of Persistent Emerging Pollutants: Process Optimization and Practical Applications in Water Treatment**

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SHORT ABSTRACT

The rapid growth of industries and cities puts significant strain on natural resources, leading to severe ecological impacts. One of the most pressing issues is water pollution caused by persistent emerging pollutants (PEPs). These pollutants include pharmaceuticals, pesticides, herbicides, personal care products, endocrine disruptors, illicit drugs, food additives, hydrocarbons, metabolites, microplastics, and more. PEPs are not typically regulated under current environmental laws as they occur in relatively low concentrations. However, their persistent or pseudo-persistent nature can lead to various environmental and health impacts on water ecosystems and living organisms. Therefore, it is imperative to sequester these contaminants from water systems.

While various treatment methods exist, adsorption emerges as a prominent approach for sequestering these contaminants due to its efficiency at low pollutant concentrations, ease of implementation, cost-effectiveness, selectivity, economic feasibility, and potential to achieve environmental sustainability without causing secondary pollution. The selection of precursors and modification of adsorbents/biosorbents are crucial factors that influence the efficiency of the adsorption process for different target pollutants. This thesis work primarily focuses on developing bio-based engineered adsorbents from natural derivatives, including agricultural byproducts (lignocellulosic wastes) and biopolymers (Chitosan and Carboxymethyl cellulose), addressing the significant challenges associated with adsorbents include difficulties in their recovery post-treatment and limited surface functionality, which hinder the applicability of the adsorption process for selectively targeting pollutants. These limitations could be overcome by developing magnetic adsorbents or transforming precursors into bead form.

Optimizing process parameters such as pH, adsorbent/biosorbent dosage, initial pollutant concentration, contact time, and temperature helps establish suitable conditions for pollutant sequestration. The second significant aspect of this thesis involves phytotoxicity evaluation before and after treatment using model organisms to assess the safety and efficacy of the adsorption process. Furthermore, this thesis aims to bridge the gap between laboratory-scale studies and practical applications by considering real-time factors such as reusability and column studies. The research findings contribute to a theoretical understanding of the adsorption process for various PEPs and offer practical insights into the feasibility and sustainability of using bio-based engineered adsorbents for large-scale water treatment. These findings are expected to have significant implications for water quality management and environmental sustainability, potentially influencing the regulation of persistent emerging pollutants in water ecosystems.