

Notification No.: **575/2025**

Date of Award: **28-02-2025**

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Topic of Research: **Synthesis and Complexation Studies of Biopolymer-Clay Composites and their Potential Application in Wastewater Remediation**

Findings

This research addresses the pressing issue of wastewater pollution caused by industrialization and urbanization, which introduces heavy metals, dyes, and organic toxins into the environment. To combat this, the study explores innovative and sustainable biopolymer-clay composites as efficient adsorbents for wastewater treatment. Biopolymers, derived from natural sources, are biodegradable, non-toxic, and renewable, while clay offers high surface area and ion-exchange capacity. Combining these materials enhances their adsorption properties, making them effective for removing harmful contaminants. The thesis involves synthesizing and optimizing novel biopolymer-clay composites, focusing particularly on their ability to remove cationic dyes from water. It examines the composite's adsorption efficacy, kinetics, and isotherms to better understand their performance.

Chapter 1 reviews existing literature to identify research gaps and establish the study's relevance, highlighting the interdisciplinary nature of the work across materials science and environmental engineering. Chapter 2 details the materials and methods used. Chapter 3 explores the formation of a gelatin A–carboxymethyl cellulose (GC) complex and its role in methylene blue dye removal. The influence of additives like glutaraldehyde and halloysite was also studied. Chapter 4 extends this work to a gelatin A–sodium alginate system, converting the complex into films to boost adsorption surface area. Factors such as film thickness, clay type (Laponite, HNT), and concentration were analyzed. Chapter 5 evaluates the optimized films' adsorption performance against four cationic dyes (Methylene blue, Auramine O, Rhodamine B, and Crystal violet), confirming their potential as eco-friendly, cost-effective wastewater treatment materials.

Keywords: Biopolymer, Clay, Composite, Wastewater remediation, and Complexation.