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RECENT ADVANCES IN ADSORPTION TECHNIQUES USING ORGANIC AND INORGANIC ADSORBENTS FOR WASTEWATER TREATMENTS: A REVIEW

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This Final Year Project Report entitled "**Recent Advances in Adsorption Techniques Using Organic and Inorganic Adsorbents for Wastewater Treatments: A Review**" was submitted by Nurul Athirah Balqis binti Junaizi in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Applied Chemistry, in the Faculty of Applied Sciences, and was approved by

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ABSTRACT

RECENT ADVANCES IN ADSORPTION TECHNIQUES USING ORGANIC AND INORGANIC ADSORBENTS FOR WASTEWATER TREATMENTS: A REVIEW

Contamination of water bodies due to industrial, agricultural, and domestic activities has intensified environmental challenges, with pollutants such as heavy metals, dyes, and organic compounds posing risks to ecosystems and human health. Among various treatment methods, adsorption stands out for its practicality, eco-friendliness, and efficiency. Recent advancements in adsorption technologies utilizing organic and inorganic adsorbents have significantly enhanced wastewater treatment capabilities. This study reviews recent developments in organic and inorganic adsorbents, focusing on their synthesis, modification, and application. Organic adsorbents, such as activated carbon (AC), biochar (BC), and polysaccharide-based materials, are lauded for their sustainability, biodegradability, and high adsorption efficiency. However, their selectivity and mechanical properties often necessitate chemical modifications to enhance performance. On the other hand, inorganic adsorbents, including zeolites, activated alumina, and silica, offer advantages like high thermal and chemical stability and ion-exchange capacity. The pore structure and surface functionality of these materials are adaptable for modification, thus enabling to target and remove the desired pollutants efficiently. Despite these advancements, challenges persist, including the limited selectivity of adsorbents in complex wastewater matrices and environmental concerns related to the disposal of the spent inorganic materials. Innovations in adsorbent modification, including functional group grafting and composite development, have addressed some limitations, but the economic and environmental implications of large-scale applications remain areas of concern. This review highlights the potential of combined organic-inorganic systems and identifies future research directions to enhance the efficiency and sustainability of adsorption technologies for wastewater treatment.

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