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Review

Cellulose-Based Sorbents: A Comprehensive Review of Current Advances in Water Remediation and Future Prospects

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Abstract: Cellulose-based sorbents are promising materials for wastewater treatment due to their environmental friendliness, biodegradability, and high sorption capacity. This paper presents an overview of cellulose modification methods, including carboxylation, amination, oxidation, graphene, and plasma treatments, as well as combined approaches. Their effect on key physicochemical properties, such as porosity, morphology, and chemical stability, is considered. Examples from the literature confirm the effectiveness of modified cellulose sorbents in removing heavy metal ions and organic pollutants from wastewater. The analysis shows that combined methods allow for creating materials with improved characteristics that are resistant to extreme operating conditions. The main advantages and disadvantages of cellulose sorbents, as well as challenges associated with their scalability and cost-effectiveness, are discussed. The paper emphasizes the importance of further research to advance these materials as a key element of sustainable water treatment technologies.

Keywords: cellulose-based sorbents; methods of obtaining sorbents; sorption properties; cellulose modification; water purification; ecological sorbents; ion exchange; adsorption; green technologies; complexation

1. Introduction

Water purification from pollutants is one of the priority tasks of modern society, especially in the context of industrial growth and urbanization, accompanied by an increase in wastewater volumes. Traditional purification methods, including coagulation, flotation, filtration and the use of activated carbon, have proven their effectiveness at a basic level. However, their use is associated with high energy intensity, significant operating costs and limited ability to remove specific pollutants, such as heavy metals and complex organic