Utilization of Drinking Water Treatment Sludge (DWTS) as an Adsorbent for the Removal of Linear Alkylbenzene Sulfonic Acid (LAS)

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ABSTRACT

This research explores the untapped potential of alum sludge; a semi-solid waste material produced during the drinking water treatment process when aluminum sulfate (commonly known as alum) is used as a coagulant to remove impurities. Alum sludge is often considered a disposal burden due to the presence of high amount of aluminum hydroxide compounds and fine particulates. In this study, it was investigated as a sustainable adsorbent for removing Linear Alkylbenzene Sulfonic Acid (LAS), a common anionic surfactant in detergent solutions. Amid growing environmental concerns about wastewater contamination, this study presents an innovative approach to utilizing waste materials for effective pollutant removal. A series of experiments were conducted to assess the adsorption capacity of alum sludge under varying conditions, including particle size, dosage, contact time, and pH levels. The results showed that smaller particle sizes and a 1:2 sludge-to-detergent solution (42 ppm) ratio maximized LAS removal, achieving up to 99.5% efficiency. The adsorption process was more efficient at lower pH levels, suggesting a chemical interaction between LAS and the sludge. The Langmuir adsorption isotherm model best described the process, indicating monolayer adsorption of LAS on the sludge surface. This study not only demonstrates the effectiveness of alum sludge as an adsorbent for LAS removal but also contributes to the development of low-cost, eco-friendly solutions for wastewater treatment. Additionally, the findings emphasize the potential of utilizing waste materials for environmental remediation, offering a promising method for treating surfactant-contaminated wastewater. The research lays the foundation for further exploration of alum sludge in large-scale applications, advancing sustainability in the reuse of washing effluent for various purposes.