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Trimethoprim Removal from Aqueous Solutions via Volcanic Ash-Soil Adsorption: Process Modeling and Optimization

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(This article belongs to the Section Wastewater Treatment and Reuse)

Volcanic Ash-Soil as a Sustainable Adsorbent for Trimethoprim Removal

Description

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Within the framework of the **PRIMA-SAFE** project, a new study published in *Water* investigates the use of **volcanic ash-derived soil (VADS)** as a sustainable and cost-effective adsorbent for removing **trimethoprim (TRM)**—a commonly detected antibiotic in reclaimed water. The research also applies **Response Surface Methodology (RSM)** to model and optimize the removal process, addressing critical challenges in water reuse and pharmaceutical pollution.

Key Findings

- VADS achieved a **maximum TRM removal efficiency of 77.6%** under optimized conditions: 4.5 mg/L initial concentration, 45.5 min contact time, 747 rpm stirring speed, and 0.04 g/mL solid-to-liquid ratio.
- The adsorption process was **accurately modeled and validated**, with an average prediction error of just 3%.
- XRD analysis revealed that TRM adsorption induced **mineralogical changes in the volcanic ash**, confirming strong interactions through **chemisorption**.
- The proposed adsorption mechanism includes **hydrogen bonding, ?–? interactions**, and **metal-ligand complexation**, involving key minerals such as forsterite and fayalite.

Implications

This study highlights the potential of **natural volcanic materials** in the development of **eco-friendly water treatment technologies**. The findings are particularly relevant for safe and efficient water reuse in agriculture, aligning with PRIMA-SAFE's mission to enhance sustainability and reduce environmental risks across the Mediterranean region.

Reference

Lavecchia R., Zuorro A., Baaloudj O., Brienza M. (2024).
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