

Overcoming Barriers to MgO-Based Reagents in Mine Water Treatment: A Sociotechnical View

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ABSTRACT

Introduction: Despite well-documented economic and environmental benefits, adoption of innovative mine wastewater treatment technologies has remained limited. Conventional policy approaches—such as tech-to-market programs, TRL frameworks, and grant-based incentives—have delivered mostly incremental change and failed to overcome entrenched industry norms. To investigate this disconnect, we examine barriers to adoption through a sociotechnical systems lens, highlighting the complex interplay of institutional, technical, cultural, and market dynamics that shape innovation diffusion in the mining sector.

Methodology: This study applies a sociotechnical transition framework to the case of a magnesium oxide (MgO)-based reagent introduced as a niche innovation in mine wastewater treatment. Through document analysis, interviews, and stakeholder mapping, we examine how entrenched regimes—including policy systems, procurement norms, and scientific standards—respond to emerging technologies and influence their uptake.

Results and Conclusions: The MgO-based reagent demonstrates clear technical and environmental advantages, including lower sludge volumes and improved metal removal. However, adoption remains constrained by structural factors such as inflexible regulatory codes, limited pilot funding, and market power concentrated in legacy technology providers. The sociotechnical analysis reveals that non-technical barriers—including institutional inertia, path dependencies, and vested interests—play a critical role in slowing innovation diffusion. Our findings advocate for a policy shift from technology-centric strategies to more holistic innovation frameworks that engage with system-wide dynamics. This approach offers practical insights for mining firms, researchers, and regulators working to accelerate sustainable technology transitions in the sector.

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