Effect of High-Energy Milling (HEM) on Lithium Extraction Efficiency from Underclay

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Traditional methods for extracting lithium from lithium-bearing clay minerals, such as acidification, salt roasting, calcination, chlorination, and alkalization, require high temperatures and involve harmful chemicals, posing significant environmental challenges. To mitigate these issues, this research investigates the potential of High-Energy Milling (HEM) combined with mild lixiviants as a sustainable alternative to enhance lithium extraction efficiency from the underclay component of coal refuse, while reducing temperature requirements and minimizing environmental impact.

The study focuses on how HEM modifies the internal structure of underclay to improve lithium leaching kinetics. By varying milling parameters such as time, ball-to-powder ratios, and milling speeds, we aim to determine optimal conditions for lithium liberation. Characterization techniques, including X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM), are employed to provide a comprehensive analysis of structural changes induced by mechanical activation. XRD is used to track crystallinity and phase transformations, SEM reveals morphological changes and particle size distribution, while TEM allows for high-resolution observation of atomic-level defects and amorphization within the clay matrix.

Lithium leaching tests using mild lixiviants under ambient conditions are then conducted to evaluate extraction efficiency and kinetics. The combined insights from structural characterization and leaching experiments are expected to demonstrate how HEM influences the breakdown of the crystal lattice, facilitates lithium release, and ultimately improves extraction performance. This research contributes to the development of eco-friendly lithium recovery methods from coal refuse, advancing sustainable resource utilization.