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Title: A Review on REE Extraction from Coal Gangue: Enhancing Leachability through Grinding and Alkali Roasting Methods.

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Abstract:

Mineral encapsulation and chemical inertness impose limitations on the effective extraction and recovery of rare earth elements (REEs) from coal gangue. The focus of this review is on two crucial pretreatment methods that enhance acid leaching: selective grinding and alkali roasting. Previous studies have reported that physical separation methods are not effective and efficient in the extraction and recovery of REEs from coal gangue, despite some recoveries being made. This review examines selective grinding as a pretreatment step to enhance particle size distribution, minimize grind size, reduce grind time, and increase mineral exposure while liberating REE-bearing phases. Whereas the alkali roasting pretreatment step alters the physicochemical properties of the coal gangue, an increase in pore size and surface area enhances leachant penetration. This is achieved through the roasting of gangue samples, usually with Na_2CO_3 or NaCl, at temperatures ranging from 700 to 900 °C. Findings highlights combining these pretreatments lowers acid consumption while increasing REE leachability. Mineral transformation mechanisms, reaction kinetics and selectivity in extracting REEs from coal gangue requires more studies and attention. Limited insitu analysis and sustainable assessment hinders practical application. Future studies should emphasize advanced characterization, ecofriendly leaching, combined activation and techno economic evaluations for a sustainable large-scale metal recovery.

Keyword: coal gangue, selective grinding, alkali roasting, acid leaching, rare earth elements