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Optimizing Silicon Availability: Dissolution of Quartz and Spodumene Phases from Alpha-Spodumene for Sustainable Zeolite Synthesis.

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Resumo-Abstract

The study focuses on the dissolution of quartz and spodumene phases from alpha-spodumene minerals, aiming to provide silicon for the synthesis of alternative materials, such as zeolites. Given the increasing demand for sustainable solutions, particularly in the chemical and environmental sectors, this research seeks to overcome the challenges associated with the dissolution of alpha-spodumene, a mineral-rich in aluminosilicates [1-3]. The primary objective was to determine the optimal conditions for dissolving the aforementioned phases through alkaline digestion and fusion, with the parameters of temperature, time, and NaOH concentration being analyzed. Characterization techniques such as XRD, XRF, and SEM were employed to evaluate the dissolution process. To refine the experimental conditions, chemical kinetics tools were combined with Box-Behnken experimental design (BBD) [4]. A total of fifteen alkaline digestion experiments were conducted at temperatures ranging from 60°C to 110°C for durations between 2 and 48 hours, while nine experiments focused on alkaline fusion, using temperatures between 500°C and 700°C, and NaOH concentrations from 1.1 to 3.3 g. The results were synthesized into 3D plots correlating temperature, time, and phase dissolution, showing that the most aggressive conditions (110°C for 72 hours with 3 mol/L NaOH) were effective but energetically inefficient, indicating the need for further optimization.

Keywords: alpha-spodumene, alkaline digestion, alkaline fusion, chemical kinetics, experimental design.

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