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The Influence of the Silicon Saturation Coefficient on a Calcification-carbonation Method for Clean and Efficient Use of Bauxite

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Abstract

A hydrometallurgical calcification-carbonation method is proposed to change the structure of the red mud of Bayer alumina production for clean utilization of low-grade bauxite resources. The utilization process consists of the flowing steps: i) silicon containing phases in bauxite are transformed into hydrogarnet; ii) hydrogarnet subsequently changed into $Al(OH)_3$, $CaO{\cdot}SiO_2$ and $CaCO_3$ through the carbonation process by CO_2; and iii) $Al(OH)_3$ is digested by alkali when the digestion temperature is below 100℃. The thermodynamics of the calcification and carbonation processes were elucidated, and the effects of the saturation coefficient of SiO_2 in hydrogarnet on the new process were investigated. The results show that the silicon saturation coefficient rapidly increases with temperature. The digestion ratio of alumina from hydrogarnet exceeds 50% when the saturation coefficient is either higher than 0.79 or less than 0.3. After a low-grade bauxite treatment, the alkali content in the new red mud decreases to 0.49 wt % and the A/S (ratio of alumina and silicon) decreases to below 0.5%. Furthermore, the recovery ratio of alumina increases by 15% compared to the traditional Bayer process. The new modified red mud can be used directly in the cement industry, and efficient and clean use of low-grade bauxite can be realized by this method.

Keywords: calcification-carbonation method, bauxite, saturation coefficient, red mud structure

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