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Reaction behaviors and amorphization effects of titanate species in pure substance systems relating to Bayer digestion

Yanxiu Wang, Ting-an Zhang*, Guozhi Lv, Weiguang Zhang, Xiaofeng Zhu, Liqun Xie

Key Laboratory of Ecological Metallurgy of Multi-metal Intergrown Ores of Ministry of Education, Special Metallurgy and Process Engineering Institute, Northeastern University, Shenyang 110819, Liaoning, China

Abstract

To understand the adverse effects of TiO_2 on alumina leaching, the reaction behavior of TiO_2 in a series of pure substance systems relating to Bayer digestion was systematically investigated based on thermodynamics, experiments, and comprehensive analyses. The results show that TiO_2 is almost unreactive without alkali in the Bayer system. When free alkali does exist, TiO_2 preferentially forms amorphous, metastable sodium titanate as a reactive intermediate and induces more side reactions. The physicochemical characteristics and the transformation of the amorphous metastable phase were described in detail. The findings from this study provide strong evidence explaining titanate species' reduction of the dissolution efficiency of alumina through amorphization and the elimination of adverse titanate effects via promoting the crystallization of amorphous metastable phase. Knowledge of these mechanisms deepens the understanding of the effects of titanate species in the Bayer process and assists in the prevention and control of titanate industrial hazards.

Key words TiO_2 ; reaction behavior; alumina digestion; amorphization effect; Bayer process

* Corresponding author: Northeastern University, Shenyang 110819, China
Tel.: +86 024 83681563; fax: +86 024 83681563; E-mail address: zta2000@163.net

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