Decomposition of ilmenite by ZnO/ZnS: Enhanced leaching in acid solutions

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Abstract

Acid leaching of ilmenite (FeTiO₃) obtained from beach sand was found to be more effective when roasted with ZnO or ZnS at 900 °C. Remarkably higher iron and titanium leaching rates were observed when compared with normal ilmenite in 5.0 M HCl at 30 °C and 6.0 M H₂SO₄ at 110 °C, respectively. Roasting of ilmenite with ZnO or ZnS converts acid resistant FeTiO₃ to more reactive Fe₂O₃ and Zn₂TiO₄, resulting in enhanced leaching. Roasting FeTiO₃ with ZnS generates SO₂ as a byproduct, which can be used to produce H₂SO₄ acid required in the sulfate process. Added ZnO or ZnS can be recovered as ZnO, therefore the overall process acts as a catalytic decomposition of FeTiO₃. Ores containing ZnS, such as sphalerite, are possible raw materials instead of ZnS, in a commercial application. XRD analysis confirms the formation of zinc titanate, and XPS results indicate the presence of both Fe²/Fe³⁺ in naturally weathered ilmenite.

Keywords: Ilmenite, XPS, XRD, acid leaching, roasting, ZnO/ZnS.

1. Introduction

Ilmenite (FeFiO₃) is the most abundant titanium-bearing mineral used for the production of titanium dioxide (TiO₂) through hydrometallurgical and pyrometallurgical processes (Zhang et al., 2011b). Rutile, ilmenite, and leucoxene are the three main titanium-bearing minerals. Because ore deposits with high rutile content are depleting, the demand for natural ilmenite, such as that present in beach sand, will continue to dominate in the titanium industry. TiO₂ is extensively used as a pigment in pharmaceutical, paint, textile, food, ceramic, and paper industries (Abdel-Aal et al., 2000). The three main crystalline forms of TiO₂ are rutile, anatase, and brookite (Yanqing et al., 2000). Anatase is widely used as a photocatalyst in semiconductor applications (Gázquez et al., 2014), and, brookite is the least

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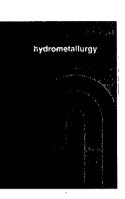
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