UPGRADING ILMENITE TO SYNTHETIC RUTILE BY BALL MILLING INDUCED SULPHURISATION REDUCTION USING COMMERCIAL SULPHUR

H. C. S. Subasinghe*, A. S. Ratnayake

Department of Applied Earth Sciences, Faculty of Applied Sciences, Uva Wellassa University, Sri Lanka

chandimasubasinghe00@gmail.com

Abstract

An efficient examination of the impact of processing time on sulphurisation of ilmenite was completed by a blend of mechanical activation and isothermal annealing. In this study, the ball milling induced sulphurisation was identified using X-ray diffraction (XRD), X-ray fluorescence (XRF), and particle size analysis. Initial ilmenite was characterized with over 95% of $FeTiO_3$, ~2% of SiO_2, ~1% of Al_2O_3 and the rest compensated by other minor oxides. Ilmenite was mixed with commercial sulphur in three ratios by weight as 1:1, 2:1 and 4:1. These mixtures were separately milled for 4 and 6 hours each. The particle sizes of ilmenite/sulphur mixtures were highly reduced irrespective of material ratio, and all the 6 hours milled samples had a considerable percentage converted to nanoparticles. The decrease in the intensity of sulphur peaks in XRD spectra obtained after milling indicated a possible dissolution of sulphur into ilmenite structure. This designates the formation of a mixed composite structure. Pseudobrookite, pseudorutile and pyrite peaks were observed in the XRD spectra of milled samples. All the samples were isothermally annealed at 600°C, 800°C, 1000°C, and 1200°C, separately. The results obtained had similar variations in samples annealed at 800°C, 1000°C, and 1200°C. Consequently, it indicates 800°C as the effective temperature for sulphurisation of ilmenite. Each ratio produced similar results and the optimum ratio of ilmenite: sulphur was obtained at 4:1. Pseudobrookite and pseudorutile peaks were disappeared and anatase, brookite and rutile peaks appeared in the XRD spectra of the annealed samples. Further, pyrite was converted to pyrrhotite in the samples annealed at 1000°C. Consequently, pyrrhotite was converted to elemental iron and sulphur after annealing for 2 hours at 1200°C. Therefore, it was concluded that mechanical attrition applies beneficial outcome on the diminishing temperatures of ilmenite reduction. Finally, the steady deoxidizing of titanium oxides was terminated after isothermal annealing.

Keywords: Mineral processing, ilmenite, sulphur, sulphurisation, rutile

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