Plasma Reduction Process to Minimise Bauxite Residue

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Abstract

Bauxite of Indian origin typically contains 40 – 50 % Al₂O₃, 20 – 28 % Fe₂O₃, 3 – 10 % TiO₂, 4 – 10 % SiO₂, 20 – 30% LOI and other associated oxides in minor quantities. Due to the higher percentage of Fe₂O₃ in bauxite, generation of Bauxite Residue (or Red Mud), which is costly and problematic to manage, is substantially increased for these bauxites in the Bayer process. In view of this, the recovery of the iron content in bauxite by Plasma Reduction prior to the Bayer process is an interesting option. In this study, laboratory scale simulations have been made to reduce the Fe₂O₃ content in bauxite using the Plasma Reduction process where metallic iron is recovered. The iron produced by this process contains around 85.5% Fe with 85% recovery. The slag rich in alumina and residual iron in the form of FeO can be fed to the Bayer process for the production of alumina.

Key words: Plasma smelting reduction; Arc Plasma smelting reactor; iron from bauxite; Alumina.

1. Introduction

The conventional process for alumina production employing the well-established Bayer Process generates large quantities of Bauxite Residue (or Red Mud) the storage of which is a concern to the alumina industry and the communities in which they operate. So far, outside of some niche applications, no commercial technology has been developed for bulk utilisation of Residue. Utilisation of Bauxite Residue (Red Mud) has been generally limited to either laboratory or pilot scale simulations. However, significant research effort globally is being applied to address this challenge through the application of novel technologies. One such unique and state-of-the-art process is the plasma reduction process which envisages the reduction of iron oxide present in bauxite prior to being fed to the Bayer Process for the extraction of alumina. [1-5]

Bauxite of Indian origin typically contains 40 – 50 % Al₂O₃, 20 – 28 % Fe₂O₃, 3 – 10 % TiO₂, 4 – 10 % SiO₂, 20 – 30% LOI and other associated oxides in minor quantities. For the production of one tone of alumina, 1 to 2 tonnes of residue is generated out of 2 to 3 tonnes of bauxite. It is now a clear research challenge to reduce to a minimum the percentage of iron oxides present in bauxite prior to bauxite being refined into alumina in the Bayer process. The present work is directed towards this result, and a suitable laboratory scale process has been developed. By employing this process, it has been possible to reduce the bauxite iron oxide content by 85%, and the metallic iron produced contains around 85% Fe. The alumina rich slag produced can be fed to the Bayer process for alumina production.