Abstract

This investigation encompasses development of high alumina (80%) bricks with reactive mullite and zircon flour. The bricks have been fabricated through a conventional commercial processing route with the difference in the manipulation of their chemistry. The microstructure, physical, thermal and mechanical properties of the fabricated bricks have been examined to understand their potential as refractory lining material in vacuum arc degassing ladles. Microstructural characterization of the raw materials and the bricks have been carried out using optical microscopy and X-ray diffraction analyses. The evaluation of physical and thermal properties involved measurement of apparent porosity, bulk density, thermal expansion, conductivity and permanent linear change after reheating. The characetrization of mechanical properties included estimations of cold crushing strength, refractoriness under load, modulus of rupture, modulus of elasticity, fracture toughness, fracture surface energy and creep resistance. The thermal shock resistance of the prepared bricks was evaluated using measurement of retained modulus of rupture and modulus of elasticity after preselected number of thermal cycles. The information generated from these spalling resistance measurements have been substantiated using indirect estimations of various thermal shock resistance parameters. In the final stage of the experimental studies, an industrial trial has been made using zircon containing high alumina bricks.

The experimental results encompasses structure property data of eight types of bricks made from Indian bauxite, Chinese bauxite and Chinese bauxite with additives; the additives used were reactive mullite and zircon flour with varying proportions between 0 - 15%. One of the major highlights of this experimental investigation is the establishment of a guideline that the employed additives can improve the overall combination of the brick properties in a way that these are adaptable for refractory lining in steel ladles. The manifestations of the improved properties of the additive containing bricks have been discussed in terms of their microstructural constituents. A well-developed mullite network has been attributed to the improved quality of the additive containing bricks; whereas toughening of these network by precipitated zirconia appears to be the major reason for obtaining the best combination of properties in zircon containing high alumina bricks. An industrial trial with one variety of these bricks has been carried out to demonstrate their potential for immediate industrial applicability.