National Institute of Technology Rourkela

Registration Seminar

Seminar Title	: Carbon Based Alumina-Spinel Castable
Speaker	: Shaswat Mishra (Rollno : 522cr1004)
Supervisor	: Prof. Debasish Sarkar
Venue	: Ceramic Department Seminar Room
Date and Time	: 06 Jan 2025 (4.30 PM)

Abstract : Developing high-performance refractory castables is crucial for meeting the difficulties of modern high-temperature industrial processes, such as steelmaking, non-ferrous metallurgy, and other critical applications. This research systematically optimizes alumina-spinel castables with customized compositions to improve their workability, mechanical strength, thermal stability, and corrosion resistance. The study initiates the optimization of high alumina cement (HAC) by monitoring the CA ($CaAl_2O_4$) and CA_2 ($CaAl_4O_7$) phase ratios to enhance hydration behavior, setting characteristics, and high-temperature performance. Highlighting the introduction of strontium oxide (SrO) as a substitute for calcium oxide (CaO) in HAC formulations. The development of $SrAl_2O_4$ phases through SrO addition is expected to enhance phase stability, mechanical integrity, and slag resistance, confirming better compatibility with alumina and spinel aggregates.

Alumina-spinel castables will be established using the optimized HAC compositions. Key aspects include integrating in situ spinel to enhance the thermal shock resistance, chemical stability, and high-temperature strength of castable. Microfine silica will be integrated to enhance packing density, reduce porosity, and improve flowability, leading to better workability and microstructural refinement. The study will concentrate on the fabrication of carbon-containing alumina-spinel castables, an innovative approach with considerable industrial potential, building on the results of the alumina-spinel castable optimization. Incorporating carbon enhances thermal shock resistance and non-wettability against molten slags, but its oxidation at elevated temperatures poses challenges. Furthermore, antioxidants such as Al and Si powders will be studied for their efficacy in protecting carbon phases while preserving overall castable performance.

The ultimate goal of this work is to develop a new class of carbon-based alumina-spinel castable that outstrips conventional materials in terms of mechanical strength, thermal stability, slag resistance, and durability under critical service conditions. With its enhanced service life and cost-effectiveness, this innovative material will be an effective solution for the refractory sector. It will also open the door to innovative refractory technologies in industrial applications.