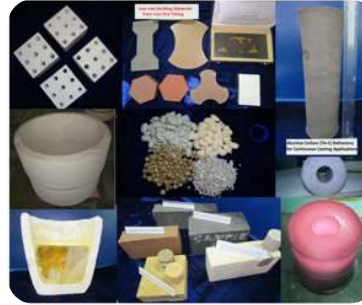




सिएसआईआर-केन्द्रीय काँच ও সেরামিক গবেষণা সংস্থা
सीएसआईआर-केंद्रीय काँच एवं सिरामिक अनुसंधान संस्थान
CSIR-Central Glass & Ceramic Research Institute
"Innovation in Ceramics and Glass for mankind"



Refractory & Traditional Ceramics Division

CSIR-CGCRI, 196 Raja S. C. Mullick Road
Kolkata-700032



History

The Refractories and Traditional Ceramics Division traces its origins to the establishment of CSIR-Central Glass and Ceramic Research Institute, one of the earliest national laboratories created under the Council of Scientific and Industrial Research (CSIR). Although the Institute was formally inaugurated in 1950, its activities began in 1944 with a mandate to promote scientific and industrial research in glass, ceramics, refractories, vitreous enamels, and related materials of national importance. Refractories and pottery (traditional ceramics) were among the core focus areas envisioned at the inception of the Institute.

National Missions & SDGs

- **Atmanirbhar Bharat**
- **Refractory Waste Utilization**
- **Carbon Neutral Refractories**
- **Refractories for Green Steel**
- **Skill Development Initiative**



Mission & Relevance

The Refractories and Traditional Ceramics Division is dedicated to advancing scientific and technological innovations in refractories and traditional ceramics to meet the evolving needs of high-temperature processing industries. The Division has developed a broad spectrum of refractory materials and technologies for critical sector, including steel, cement, and other industries, thereby contributing to industrial efficiency, resource conservation, and national self-reliance. Its extensive portfolio of externally funded projects, supported by industry, public sector undertakings, and government agencies, underscores its pivotal role in strengthening India's refractory and traditional ceramics ecosystem, fostering sustainable growth, and supporting strategic industrial development.

Through its emphasis on scalable processes, reliability, and performance, the division serves as a critical link between laboratory innovation and real-world energy applications, contributing to technological self-reliance and sustainable industrial growth.

Scientists



Kinetics of solid state processes, Intercalation of clays and layered double hydroxides, Fire-resistant coating, High temperature refractories, Chemically bonded ceramics

Dr. Kausik Dana, Divisional Chair



Solid state sintering, New generation refractory, Refractory raw materials, Refractory recycling

Dr. Somnath Sinhamahapatra, Associate Chair



High-performance refractories and castables, High-performance oxide-nonoxide composites, Ceramic coatings

Mrs. Paromita Das



Continuous casting refractories, Refractories for steel Industries, Castables

Dr. Venkatesh Pilli



Monolithic refractories, Colloidal binder for castables, Polymer-derived ceramics

Mr. Nelson Kandulna

Technical Staff



Gopal Debnath



Vakiti Pradeep Reddy



Rajesh Kumar Bahinipati



Satyajit Pasari



Souma Bose Das



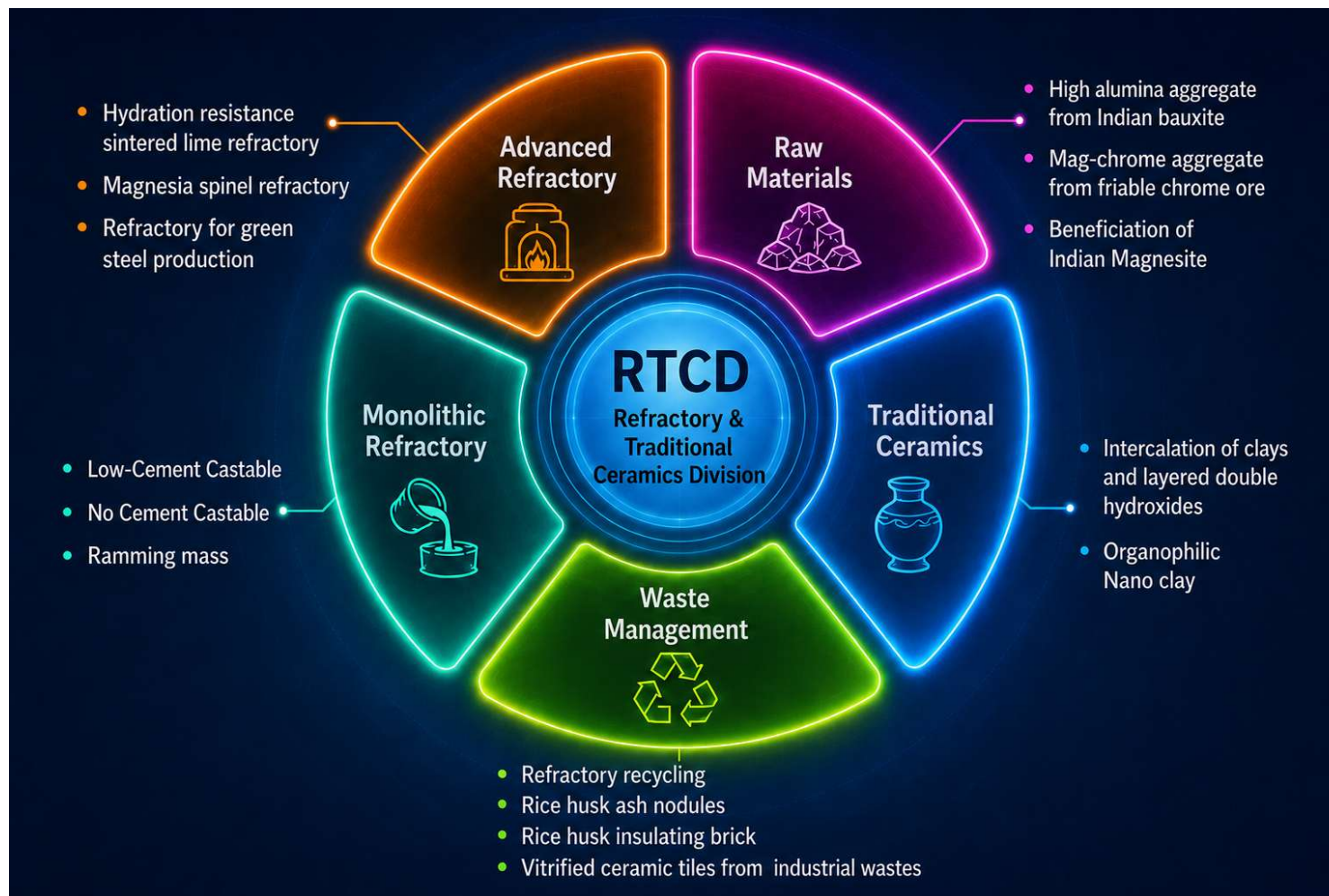
Anirban Kole



Mritunjay Sardar



Research Expertise & Key Strengths



- **High-Temperature Refractories**
- **Clay and Traditional Ceramics**
- **Refractory Recycling**
- **Refractory Aggregates**
- **Carbon Containing Refractories**
- **Refractory Castable**
- **Consultancy/Technical Services**

Major R&D Facilities



Horizontal Push Rod Dilatometer (up to 1600 °C)



Thermal Analyzer TG-DTA (up to 1600 °C)



Electric Screw Press (400 Ton)



Thermal Mechanical Analyzer (up to 1600 °C)



High-Temperature Creep



RUL Automatic Hot Load Testing Furnace (up to 1600 °C)



Laser Flash Thermal Conductivity (up to 1000 °C)





Technologies Developed



Bauxite, Mag-Chrome, and Mag-Al Spinel Aggregates from Indian Raw Material

- ❖ The developed Bauxite, Mag-Chrome, and Mag-Al Spinel exhibited excellent mechanical and thermo-mechanical performance, characterized by dense and homogeneous microstructures, and improved corrosion resistance, contributing to the enhanced performance in refractories for high-temperature steel-making applications.

Refractory Aggregates

- ❖ Refractories are critical for high-temperature industries, especially in the steel production sector. India faces shortages of high-quality aggregates, while abundant low-grade raw material contains impurities such as iron oxide and titania that form deleterious phases. The developed aggregates from Indian raw material, through beneficiation and phase modification, enhanced refractory performance and contribute to the reduced import dependence.

Rice Husk Ash (RHA) Nodules

- ❖ Rice husk ash powder containing more than 90% silica was converted to nodules by a novel technique. Judicious selection of surface active agent played a major role for nodulization and strength development. The nodules products after proper heat treatment shows excellent heat insulation properties for application in steel industry ladle. The technology has been transferred to Indian industries for commercial exploitation.



Laboratory trials with RHA nodules carried out at Nova Steel, Japan



RHA nodules produced on a commercial scale

Nodulization



Hydration Resistant Lime Refractory via Plasma Processing and Sintering Route

Hydration Resistant Lime Refractory

- ❖ Calcium oxide is an excellent refractory material due to its high thermodynamic stability and abundant availability. However, its severe hydration tendency limits practical use. Hydration-resistant, low-porosity CaO can be rapidly produced in a moving-bed plasma reactor within 1–3 minutes through optimized particle size distribution, plasma parameters, and suitable additives.

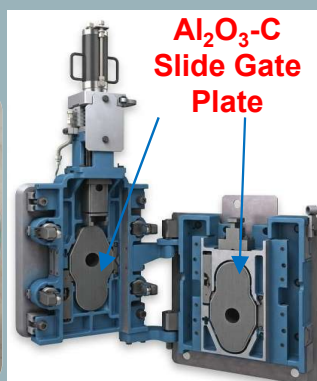
Value Added Refractory



Technologies (under development)

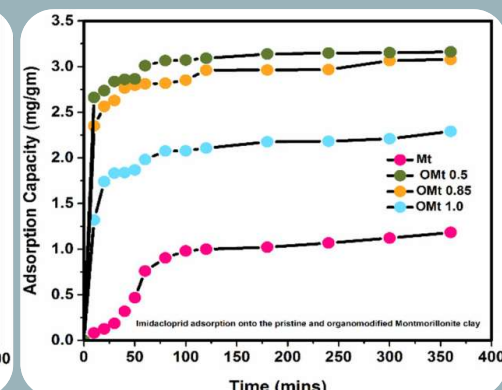
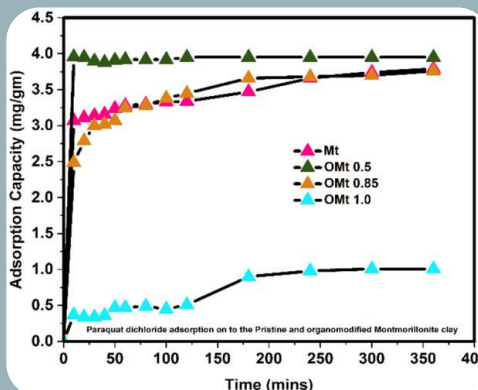


MgO-C refractory with recycled aggregates: A process chain has been established for the development of MgO-C refractory (9 inch x 4.4 inch x 3 inch) with 40 % recycled aggregates, with properties comparable to the conventional MgO-C refractory.



Development of low-carbon Al_2O_3 -C refractories using N220 nano carbon and modified alumina aggregates:

Al_2O_3 -C refractories were prepared using modified aggregates, mixed with carbon sources N220 carbon black & graphite, binder, and antioxidants, then pressed, cured (220°C), and coked at 1000 – 1600°C . The developed refractory showed better mechanical properties compared to conventional composition and low-carbon without modified aggregates.



Organically modified clay prepared from Indian resources for pollutant removal from wastewater: A process chain was established for the effective removal of Paraquat, Imidacloprid, chlorpyrifos, and fosetyl-Al using the organically modified nano clay.



MgO-C refractory from sintered MgO aggregates developed from $\text{Mg}(\text{OH})_2$ derived from the sea bittern: A process chain was established for the development of MgO-C refractory prototype from the sintered magnesia aggregate with 0.5% TiO_2 , with porosity of less than 1%. The developed MgO-C refractory achieved RUL $>1700^\circ\text{C}$, demonstrating excellent high-temperature load-bearing stability.

Futuristic Technologies

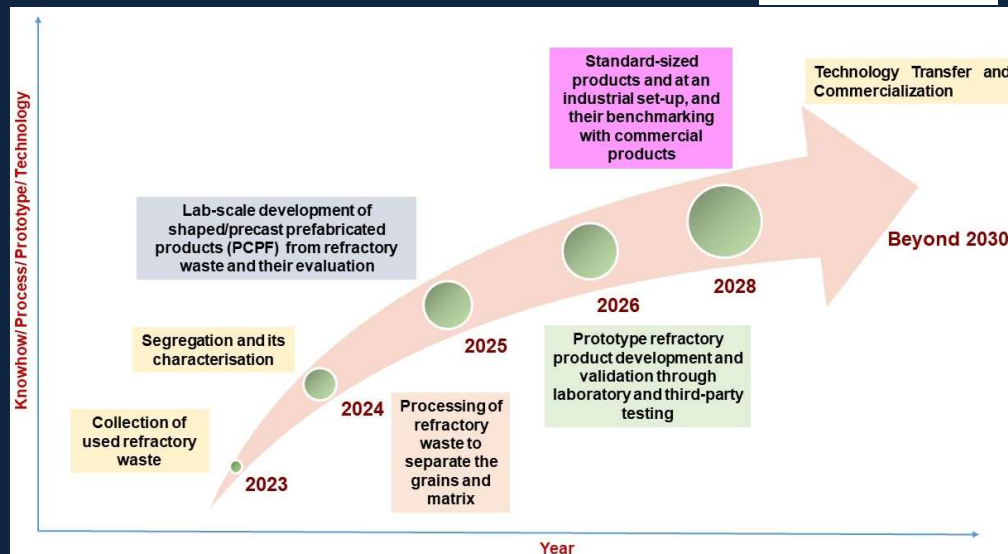


Magnesia-Carbon Refractory Using Recycled Aggregates

Key Performance Indicators (KPIs):

- Refractory Waste Utilization and Recovery Efficiency
- Development and Performance Validation of Recycled Refractory Products
- Technology Readiness and Industrial Adoption

Target: Demonstrate industrial-scale feasibility and create a technology ready for transfer to Indian refractory manufacturing industries.



Funding (2021-2026)

Total Projects	19
Aggregate funding	758.05 Lakhs (INR)

Funding agencies



Key collaborators (Academia / National Laboratory)



Key Stakeholder



Industry sectors engaged



- ❖ Private MNC and Public Sector PSUs
- ❖ Modes of engagement (licensing, co-development, consultancy)

Key Beneficiaries

TATA STEEL Pvt. Ltd.

P.O. Bistupur
Jamshedpur - 831 001
Jharkhand, India

TRL Krosaki Refractories Ltd.

Belpahar, Dist-Jharsuguda,
Odisha, India, Pin-768218

Rashtriya Ispat Nigam Ltd.

Visakhapatnam Steel Plant,
Visakhapatnam - 530031,
Andhra Pradesh, India.



Calderys India Refractories Ltd.

2 st. Georges Gate Road –
Agarwala House – 6th Floor –
Kolkata - 700022 - India



Almatis India Ltd.

No. 6, Little Russel Street, Middleton
St, Kankaria Estates, Park Street
area, Kolkata, West Bengal 700071



OCL India Ltd.

21st Floor, One Unity Center
Senapati Bapat Marg, Prabhadevi
Mumbai – 400013



Kerneos Private Ltd.

PS ARCADIA CENTRAL, 4A, Camac
St, Elgin, Kolkata, West Bengal
700071

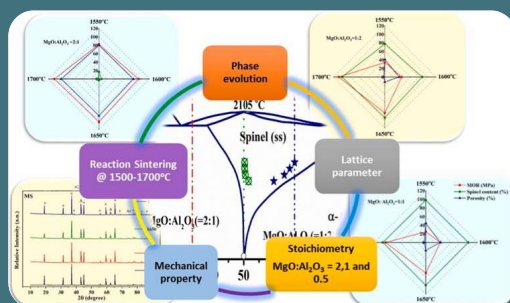


Hindalco Industries Ltd.

21st Floor, One Unity Center
Senapati Bapat Marg, Prabhadevi
Mumbai – 400013



Key Publications



Phase evolution, stoichiometry development and properties in reaction sintered magnesium aluminate spinel: Effects of $\text{MgO}:\text{Al}_2\text{O}_3$ ratio and sintering temperature

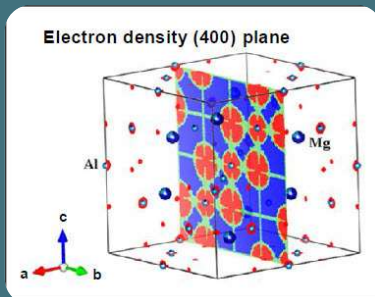
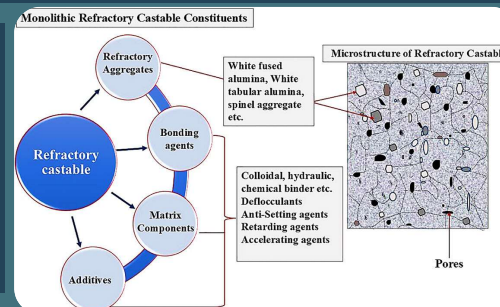
Ceramics International (2026) (Article in press)

Magnesium aluminate spinels with different $\text{MgO}:\text{Al}_2\text{O}_3$ ratios were reaction-sintered at 1550–1700 °C. The sintering temperature and composition controlled spinel formation, densification, and mechanical properties. Alumina-rich spinel exhibited the highest flexural strength due to its favorable phase chemistry and microstructure.

Colloidal binders for monolithic castable refractories: A review

International Journal of Applied Ceramic Technology 23.1 (2026): e70147

Bonding agents are essential in monolithic castable refractories, influencing placement, drying, corrosion resistance, and high-temperature performance. This review examines various colloidal binders, their chemistry, classifications, advantages, limitations, and their effects on castable properties, while highlighting future opportunities for advanced refractory bonding systems.



Magnesium Aluminate Spinel: Structure, Properties, Synthesis and Applications

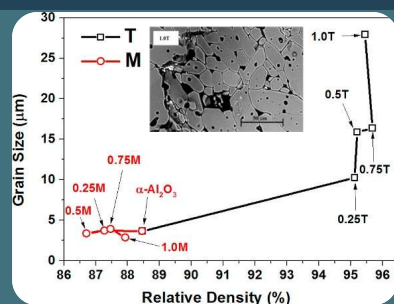
Transactions of the Indian Ceramic Society 81.3 (2022): 97-120

Magnesium aluminate spinel (MgAl_2O_4) is a synthetic material valued for its excellent thermal, mechanical, optical, and chemical properties, enabling applications in refractories, sensors, and infrared windows. This review discusses the crystal structure, non-stoichiometry, formation mechanisms, synthesis routes, properties, and applications, and highlights challenges in producing dense spin via conventional mixed-oxide processing.

Partial replacement of metakaolin with red ceramic waste in geopolymer

Ceramics International 47, no. 3 (2021): 3473-3483.

In this study, red ceramic waste was used to replace metakaolin (up to 66.6%) in geopolymer binders. Partial replacement (33.3%) maintained compressive strength, while higher levels reduces the strength. In geopolymer mortars, 33–50% replacement achieved maximum strength due to improved particle packing, despite a lower binder content.



Rationalizing the role of magnesia and titania on sintering of α -alumina

Ceramics International 42.14 (2016): 15405-15413

The roles of MgO and TiO_2 as α -alumina sintering additives were investigated. MgO formed spinel before densification and showed little effect on densification or grain growth up to 1700 °C. In contrast, TiO_2 significantly enhanced densification and grain growth, producing grains 7.7–10 times larger with higher aspect ratios. Grain-boundary junctions near 120° indicated solid-state sintering without liquid-phase formation.



IP Snapshot



Plasma-Fused Magnesia-Rich Mag-Al Spinel Aggregates



Mag-Chrome Aggregates



Dense Mag-Al Spinel Aggregates



High Alumina Refractory Brick From Silimanite Beach Sand



Hydration Resistant Lime Refractory

❑ A PROCESS FOR THE PRODUCTION OF DENSE MAGNESIA-RICH MAGNESIUM ALUMINATE SPINEL AS REFRACTORY AGGREGATE

❑ A PROCESS FOR THE PRODUCTION OF VALUE ADDED REFRACTORY AGGREGATES FROM LOW GRADE BAUXITE AND VALUE ADDED REFRACTORY AGGREGATES PRODUCED THEREBY

❑ A PROCESS FOR THE PRODUCTION OF MAGNESITE - CHROME AGGREGATES AS REFRACTORY MATERIAL

❑ A PROCESS FOR THE PRODUCTION OF PLASMA FUSED MAGNESIA RICH MAGNESIUM ALUMINATE SPINEL USEFUL AS REFRACTORY AGGREGATES

❑ AN IMPROVED PROCESS FOR PRODUCTION OF DENSE HIGH ALUMINA REFRACTORY AGGREGATES FROM SILLIMANITE SAND

❑ A LOW-CEMENT REFRACTORY COMPOSITION CONTAINING 51-75% ALUMINA FOR PREPARING REFRACTORY CASTABLES

❑ A PROCESS FOR PREPARATION OF REFRACTORY CASTABLES CONTAINING 45-50% ALUMINA

❑ A PROCESS FOR THE PREPARATION OF LOW CEMENT REFRACTORY CASTABLES CONTAINING 51 TO 75% ALUMINA

❑ A PROCESS FOR THE MANUFACTURE OF HIGH ALUMINA REFRACTORY BRICKS FROM SILIMANITE BEACH SAND

❑ A NOVEL PROCESS FOR THE PREPARATION OF HYDRATION RESISTANT LIME

Refractory Aggregates

Shaped/Unshaped Refractory



RTCD



A Kaleidoscope of Eras



Women's Compendium



Safety Manual



Technology Compendium



How to Reach Us

Contact

General Enquires: pro.cgcri@csir.res.in

Scientific & Technological: pmd.cgcri@csir.res.in