



Innovative Refractory Technologies for Steel Ladle Safety & Efficiency – Kerolan & Licodry

Advanced refractory protection for steel ladles operating under extreme conditions above 1600°C

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The Challenge: Extreme Operating Conditions

Steel ladles face some of the most brutal conditions in metallurgy:

- **1600°C+ molten steel exposure**
- **Violent thermal shock** every tap / heat cycle
- **Continuous 24/7 operation**, limited turnaround time
- **Mechanical abrasion** from steel flow and impact
- **Slag & metal infiltration** attacking the lining
- **High-pressure safety environment** where failure isn't an option

The Risk?

- Sudden breakages
- Emergency shutdowns
- Major safety hazards
- Expensive unplanned maintenance



1600°C

Operating Temperature

Extreme heat exposure

24/7

Continuous Operation

Non-stop production demands

What is the role of the Safety Lining

Typical Ladle Structure

- **Working lining:** Direct contact with molten steel, designed for wear resistance
- **Safety lining:** Critical backup layer providing structural support and infiltration barrier
- **Insulation layer:** Thermal management to protect the steel shell
- **Steel shell:** Structural containment vessel

Functions of the Safety Lining

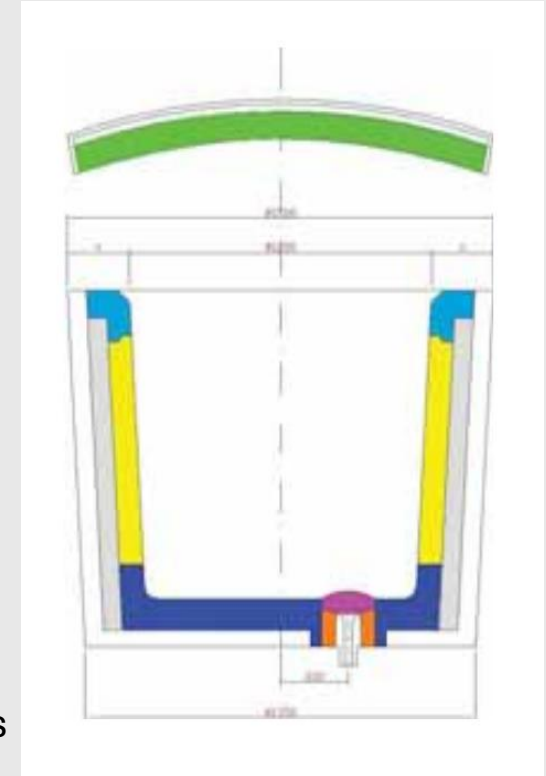
- Provides mechanical support to the working lining
- Accommodates thermal expansion
- Serves as the final barrier against steel and slag penetration

Modern Requirements for Safety Linings

- **Higher productivity:** shorter repairing cycles and reduced pre-heat time
- **Energy efficiency:** lower heat loss and reduced pre-heat energy demand
- **Operational safety:** prevention of steam explosions; minimized cracking
- **Reliability under thermal cycling:** stable thermo-mechanical performance over long campaigns

Limits of Conventional Cement-Bonded Systems

- Water retention and shrinkage during drying
- Increased risk of cracking and spalling.



Two Monolithic Safety Systems - One Objective

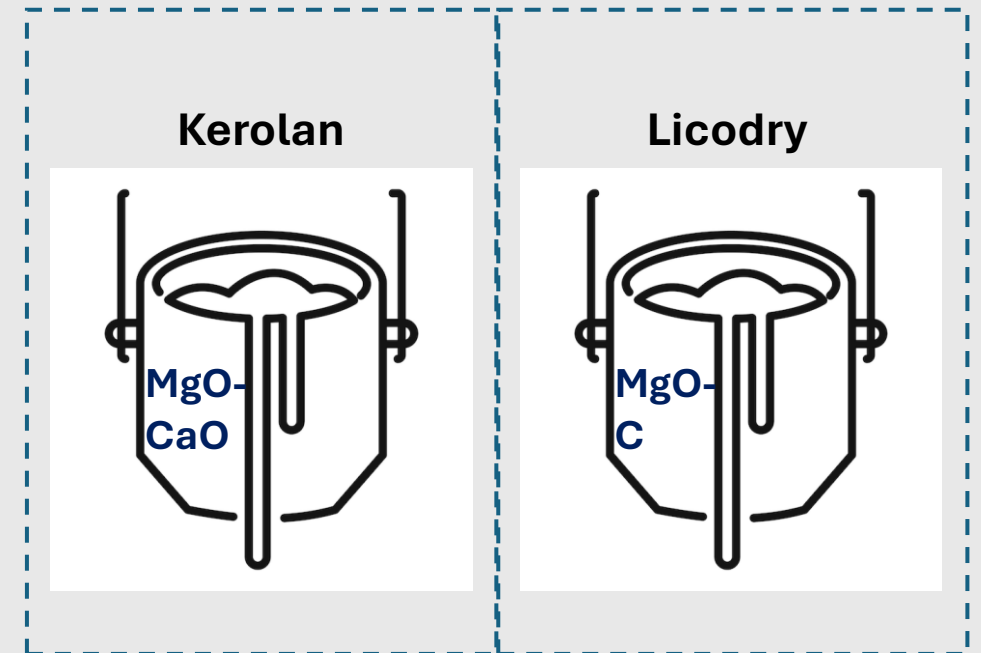
To address these requirements, Linco Baxo developed two complementary systems:

- a) **Kerolan** - dry-ramming alumina-based family for ladles with **dolomite bricks (MgO-CaO)** working linings.
- b) **Licodry 95** - **colloidal silica-bonded, cement-free castable** for ladles with **magnesite-carbon (MgO-C)** working linings.

Both systems:

- **Eliminate free water** during installation.
- Allow **faster and safer heat-up**.
- Improve **campaign life, safety and energy efficiency**.

They target **different ladle philosophies and slag chemistries**, so they should be seen as **optimized solutions for different contexts**, not as competitors.



Kerolan – Dry-Ramming Alumina - Based Safety Lining

Kerolan: alumina-based dry-ramming mixes for steel ladles with **dolomite brick** working lining.

Water-free technology: no water addition, no cement; enables **direct heat-up without curing or drying.**

Main grades:

KEROLAN 780 SR

73% alumina dry ramming concrete

17% silica carbide

Suitable for spout and walls exposed
to impact and higher attack from slag

KEROLAN 880

82% high-alumina version

Recommended for ladle bottom and side
wall areas with moderate wear and lower
slag attack

Installed by **pneumatic ramming in successive layers of 25–50 mm lifts**, targeting densities **>2.6 g/cm³**

KEROLAN vs. Alternative Materials

1

Refractory Bricks

Require joints, prone to premature wear and infiltration. Long installation times reduce efficiency.

2

Castables

Require mixing with water and setting times. Risk of drying defects compromises reliability.

3

Gunning Application

Quick application but lower density and shorter service life compared to ramming.

4

KEROLAN Solution

Combines all advantages: fast application, maximum density, no joints, and no setting time required.

Technical Specifications

Kerolan 880

Property	Value
Alumina (Al ₂ O ₃)	89%
Hot Crushing Strength (1400°C)	> 50 MPa
Bulk Density	> 2.7 g/cm ³
Open Porosity	< 14%

Kerolan 780 SR

Property	Value
Alumina (Al ₂ O ₃)	80%
Silica Carbide (SiC)	15%
Hot Crushing Strength (1400°C)	> 50 MPa
Bulk Density	2.7 g/cm ³
Open Porosity	< 13%

Thermal Conductivity

Optimized to reduce heat losses and improve energy efficiency throughout ladle operations.



Adopt KEROLAN Today

KEROLAN represents an advanced solution for ladle safety and service life, offering concrete advantages in reliability, cost reduction, and production continuity. The additional thermal advantage makes it ideal for improving plant energy efficiency.



Safer Operations

Enhanced protection for operators and equipment



Longer Campaigns

Extended service life reduces replacement frequency ($\approx 30\%$ + Campaign Life)



Higher Efficiency

Improved energy performance and reduced downtime

Adopt KEROLAN as your standard material for safer, longer-lasting, and more efficient ladle campaigns.

Email us at info@lincobaxo.com

What is LICODRY?

Colloidal Silica-Bonded, Cement-Free Castable

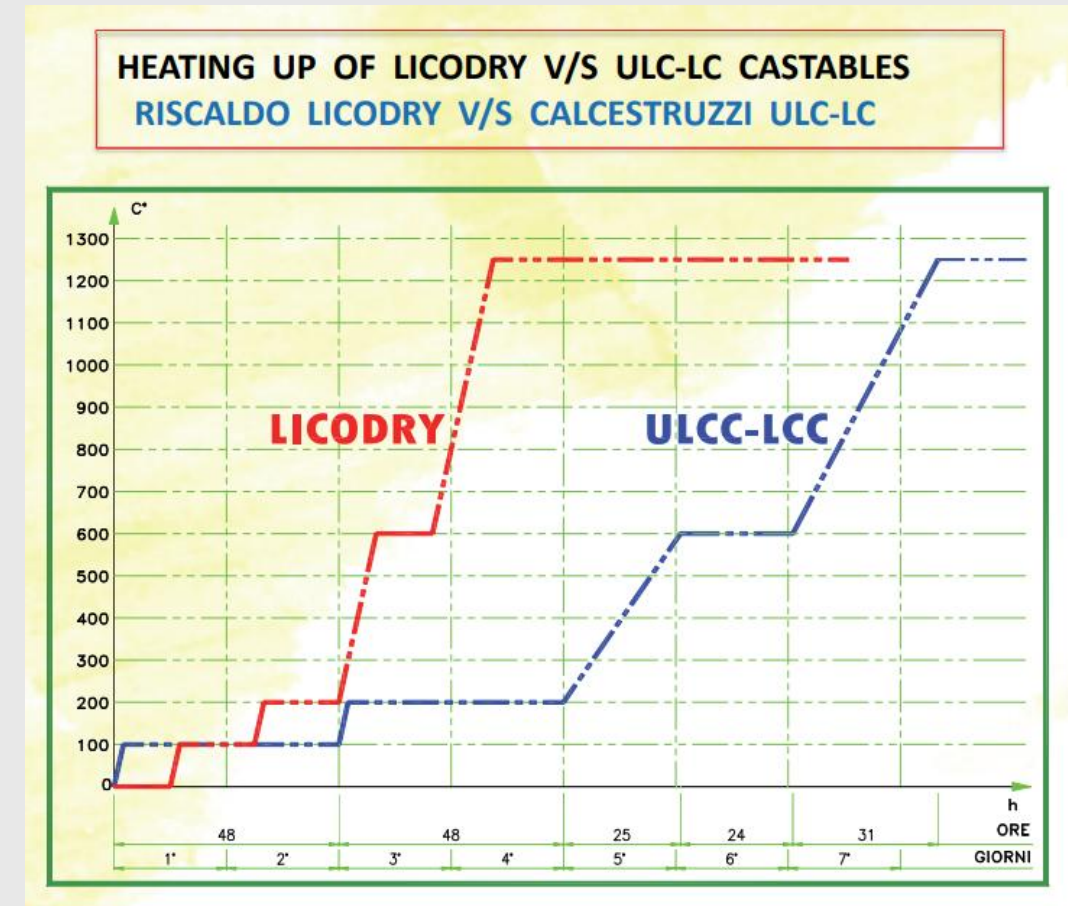
Licodry 95: high-alumina ($\approx 94\% \text{ Al}_2\text{O}_3$) castable bonded with **colloidal silica** instead of hydraulic cement.

Developed for ladles with **MgO-C (magnesia carbon) bricks** working linings where **chemical compatibility and zero-water installation** are essential.

Applied by casting or vibrating; colloidal binder forms a continuous **SiO_2 -gel network** during setting:

- Provides mechanical strength at room temperature.
- Offers a direct path for sintering at high temperature.

No hydrated phases → **no steam-spalling risk**; permits faster heat-up.



Technical Advantages Over Conventional Solutions

Cement-Free Technology

Eliminates hydraulic binders that weaken at high temperatures, ensuring consistent performance

Superior Refractoriness

Higher mechanical strength and temperature resistance compared to ULCC-LCC materials

Enhanced Efficiency

Reduced drying time and faster heating rates lead to significant energy savings

Microstructural Stability

Stable grain size distribution reduces microcracking and extends service life

Strategic Benefits for Modern Steel Plants



Cost Reduction

Lower energy consumption during heating and extended campaign life reduce operational expenses



Enhanced Safety

Reduced risk of steam explosions and lining failures protects operators and equipment



Operational Efficiency

Simplified installation and reduced maintenance requirements streamline operations

The colloidal silica technology in LICODRY represents a paradigm shift from traditional cement-based refractories, offering steel plants a competitive advantage through improved safety, reduced costs, and enhanced operational reliability.

Licodry 95 - Technical Specifications

Chemical Composition

Alumina (Al_2O_3)	94%
Calcium Oxide (CaO)	0,1%
Iron oxide (Fe_2O_3)	0,1%

Physical Properties

Cold crushing strength	>80 MPa
Bulk density	> 2,9 g/cm ³
Open porosity	<13%
Refractoriness under load	>1650°C



These specifications demonstrate LICODRY's exceptional performance characteristics. The high alumina content ensures excellent refractoriness, while the controlled porosity provides optimal thermal insulation without compromising structural integrity.

Licodry Recommendations & Next Steps

LICODRY's colloidal silica technology delivers measurable improvements in safety, durability, and operational efficiency for steel ladle applications. The elimination of cement binders and implementation of advanced bonding systems creates a superior refractory solution.

Pilot Testing

Implement controlled trials on selected ladles to validate performance benefits in your specific operating conditions

Progressive Adoption

Develop phased implementation plan to transition from conventional materials to LICODRY as the standard solution

Training & Support

Establish technical support protocols and operator training programs for optimal installation and performance

Ready to transform your ladle campaigns with proven colloidal silica technology?

Email us at info@lincobaxo.com



Thank you for your attention

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