

Finding the Shine: Knight Material Technologies' Lining Technology is Delivering Millions of Dollars in Savings to Mining Operation

Situation

There is a growing reliance on refractory gold and copper ore deposits due to the scarcity of accessible reserves. Some of these ore bodies require advanced processing technologies, like Pressure Oxidation (POX) to maximize yield per ton.

The growing scarcity of easily accessible gold and copper reserves has pushed mining operations toward increasingly complex refractory ore mining extraction projects, representing an estimated 24 percent of current gold reserves and 22 percent of gold resources worldwide.¹ Refractory ores contain gold particles encased in other minerals, presenting a challenging recovery process that resists traditional methods of gold extraction and yields a low rate of return.



POX technology represents one of the most efficient methods for processing refractory ores. While refractory ores require more sophisticated and expensive treatment methods, they typically offer significantly higher grades—averaging 2.25 grams per metric ton compared to 1.21 grams for non-refractory ores.

The global scale of investment in POX technology is substantial, with recently constructed facilities in Russia and Turkey costing nearly \$1 billion, and additional facilities in development expected to exceed \$2.5 billion. Mining companies depend on reliable POX processing technology to improve profitability. Mining operations can avoid downtime by implementing a maintenance plan for the protective linings that shield equipment from the processing system's extreme temperatures and corrosive conditions.

This case study examines the optimization of a POX autoclave system, where extreme operating conditions—with temperatures ranging from 150°C (302°F) to 212°C (415°F) and pressures exceeding several hundred PSI—create unique operational challenges. The complete solution involves advanced, acid-resistant materials and carefully developed installation techniques in addition to a comprehensive approach to maintenance for system reliability and longevity.

Under Pressure: The High Cost of Downtime

A facility running a Knight Material Technologies lining system in their autoclave was starting to see an increase in maintenance costs. The lining system had been in operation for over two decades, and repairs were becoming more frequent in all three courses of the lining system.

These issues led to:

- Extended bi-annual maintenance periods
- Increasing mid-course and back-course repairs
- Higher maintenance costs due to larger repair crews
- Reduced throughput caused by an increase in operational downtime

Each day the autoclave is down or not in service can represent at least \$1 million USD in lost production. The shorter the maintenance periods, the sooner the autoclave can resume production, thus increasing profitability.

The Knight Solution to Re-lining Projects

Knight Material Technologies (KMT) recommended a comprehensive re-lining solution to address the root causes of increasing maintenance requirements. The re-lining project required careful planning and execution to minimize the facility's downtime while ensuring proper installation of all components. Knight's solution integrated multiple protective layers:

- **PYROFLEX®** membrane applied directly to the metal shell
- Specialized fiberglass layer protecting the membrane
- Three courses of acid-resistant brick providing thermal insulation

PYROFLEX® acid-resistant membrane: this innovative membrane system serves as the critical barrier protecting the steel vessel. PYROFLEX delivers:

- Comprehensive steel vessel protection from chemical attack
- Direct adhesion to metal surfaces without additional adhesives
- Seamless, uniform coverage without lap joints
- Superior accommodation for thermal expansion
- Excellent resistance to chemical degradation
- Quick installation with no curing requirements



The Knight Solution to Re-lining Projects (continued)

KNIGHT-WARE® PV33P acid-resistant brick: engineered specifically for extreme pressure oxidation environments, these specialized bricks provide superior resistance to both chemical attack and thermal stress. KMT acid-resistant brick offers:

- Exceptional durability in high-temperature conditions
- Superior resistance to chemical degradation (ASTM Specification C279 Type II Acid Brick)
- Custom brick shapes and sizes for your autoclave design
- Compliance with rigorous industry standards



Acid-resistant mortar: specially formulated for high-temperature POX applications, KMT's proprietary mortar provides:

- Superior bonding strength for acid-resistant brick installation
- Enhanced protection for the membrane system
- Exceptional resistance to acid corrosion and slurry erosion
- Reliable performance under extreme temperature and pressure conditions



Knight Implementation: Precision in Action

The complete re-lining project was executed in 2022, requiring approximately 35 days of downtime for full installation. KMT deployed specialized crews of dozens of technicians, varying based on project phase requirements. The installation process demanded precise attention to detail and adherence to strict quality control measures to ensure optimal performance of the new lining system.

Following installation, KMT established a systematic maintenance program with biannual inspections of the brick lining. Inspections are conducted by experienced teams that have refined their procedures through decades of service. This proactive inspection and maintenance will extend reliability and service life of the new lining.

Smart Maintenance Pays Off

The re-line investment ROI is approximately 3 years. The complete re-lining solution has also delivered substantial operational improvements through enhanced maintenance efficiency:

- Inspection and repair times reduced by 50% annually
- Minimized emergency repair requirements between scheduled maintenance periods.
- After the re-line, the site has generated an extra \$8 to \$10 million annually from reduced downtime. (calculated at a base minimum of \$1 million per day)

Systematic documentation of repairs and wear patterns helps forecast future maintenance needs for predictive scheduling. These predictive maintenance windows enhance repair effectiveness and extend service lifespan.

A Partnership Legacy of Trust

This successful re-lining project represents just one chapter in a two-decade partnership between Knight Material Technologies and the customer. The longevity of this relationship demonstrates the customer's trust in KMT's commitment and reliability in providing long-term, dependable solutions for critical mineral processing equipment.

The mining operation continues to rely on KMT's expertise for regular maintenance and servicing of their POX autoclave systems, consistently improving results following the 2022 re-lining project. This ongoing partnership showcases how strategic maintenance investments can deliver substantial returns through improved operational efficiency and reduced downtime.

Knight's efficient design allows for rapid turnaround times when maintenance is required: one week for routine inspections and minor repairs, or two weeks for major replacements, minimizing costly downtime.

A POX Benchmark That Paves the Way

As POX technology continues to play a more crucial role in efficient mineral extraction, the ability to maintain these systems with minimal downtime becomes increasingly important. KMT's comprehensive approach to autoclave maintenance and re-lining demonstrates how modern materials, installation techniques and a predictable maintenance plan can significantly improve operational efficiency in demanding industrial applications.

The project is a benchmark for other mining operations facing similar challenges with their POX systems. The re-line illustrates how strategic maintenance investments can deliver substantial long-term value through improved system reliability and enhanced production efficiency. Mining operations around the globe rely on Knight Material Technologies as a leading provider of critical solutions for the mining and mineral processing industry to protect critical equipment and maximize uptime.

Reference

- 1 <https://www.mckinsey.com/industries/metals-and-mining/our-insights/refractory-gold-ores-challenges-and-opportunities-for-a-key-source-of-growth>