



COOLING INNOVATION IN PRACTICE

9TH INTERNATIONAL PGM CONFERENCE

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Agenda

- Introduction to Challenges
- Technical Background
- Rebuild Methodology
- Lessons Learned
- Operational Performance
- Conclusion



Introduction: PGM furnace challenges

PGM SMELTING: WHERE THINGS GET HOT... FAST!

Key challenges in PGM Furnace design:

1. Aggressive chemical environment
 - Chloride-accelerated sulphidation
 - Refractory compatibility
 - Product interfaces
2. Thermal profiles
 - Large matte superheat
 - Tidal zone



Sibanye-Stillwater F1 Upgrade Project:

1. Increase sidewall campaign life from 30 to 48 months
2. Increase hearth campaign life to 12 years



Introduction: PGM furnace challenges

PGM SMELTING: WHERE THINGS GET HOT... FAST!

PROJECT TIMELINE

Sibanye-Stillwater
Marikana Smelter
(formerly Lonmin-Smelter)
operation started.
PLANT OPERATION

1971

2021

F1 STUDY AWARDED

March - F1 Upgrade study
awarded to Tenova
Pyromet

January - F1 Upgrade
study completed
STUDY COMPLETED

2022

Introduction: PGM furnace challenges

PGM SMELTING: WHERE THINGS GET HOT... FAST!

September – F1 Upgrade
Project Completed and
First tap

FIRST TAP

2022

UPGRADE STARTED

March - F1 Upgrade
Execution Started

2022

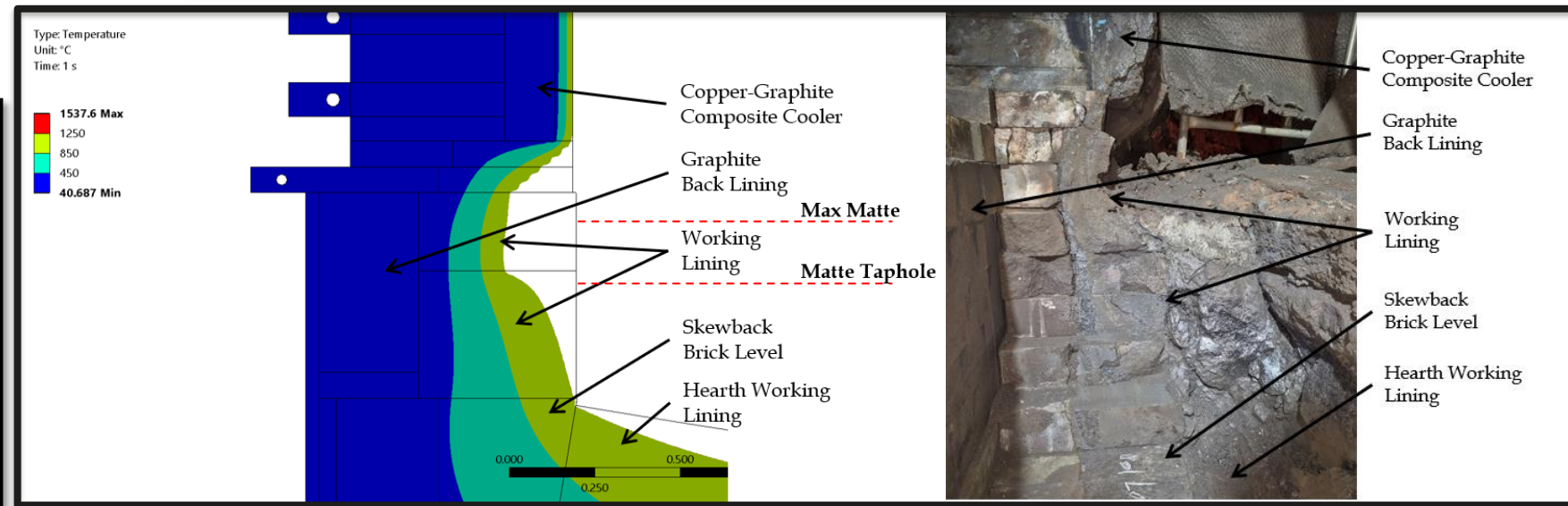
2025

PARTIAL REBUILD

January - F1 Hot Partial
Sidewall Rebuild

Technical Background

GRAPHITE TO THE RESCUE: SUPERHERO OF THE SIDEWALL



Rebuild Methodology

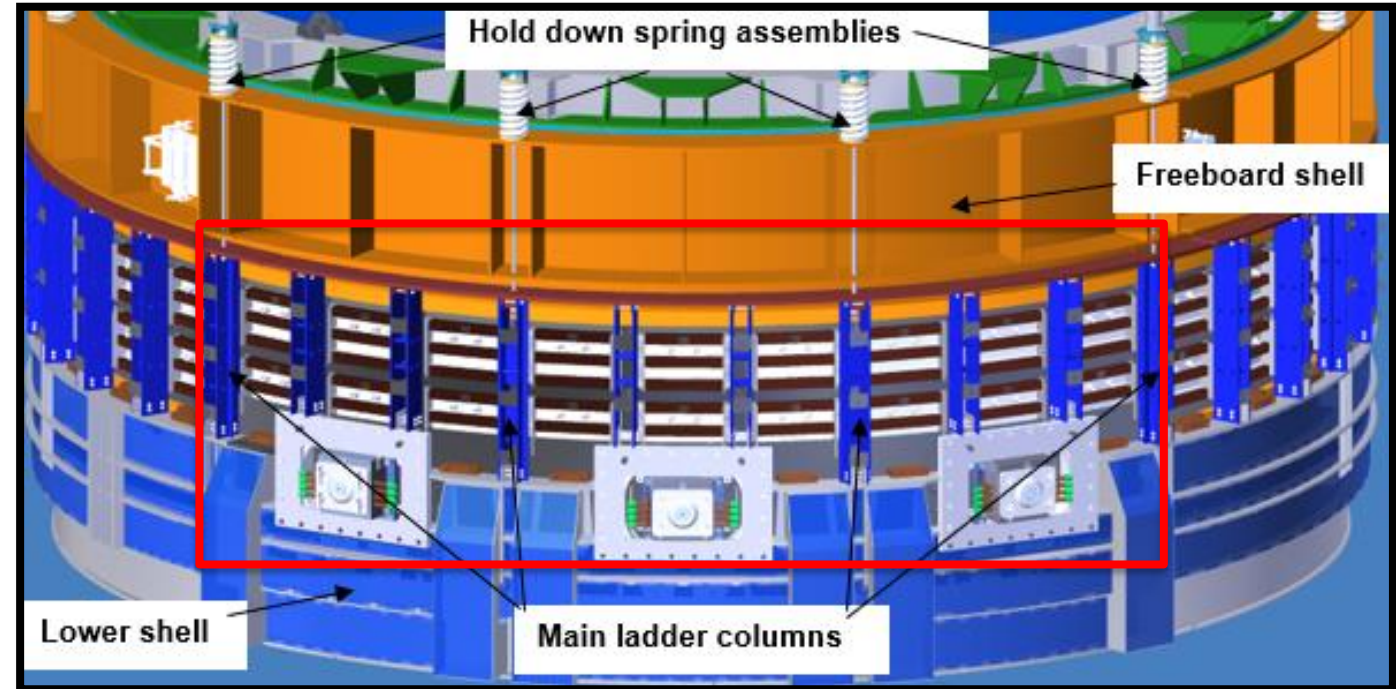
EXTREME MAKEOVER: FURNACE EDITION

Objective:

Repair matte taphole lintels (tidal zone)

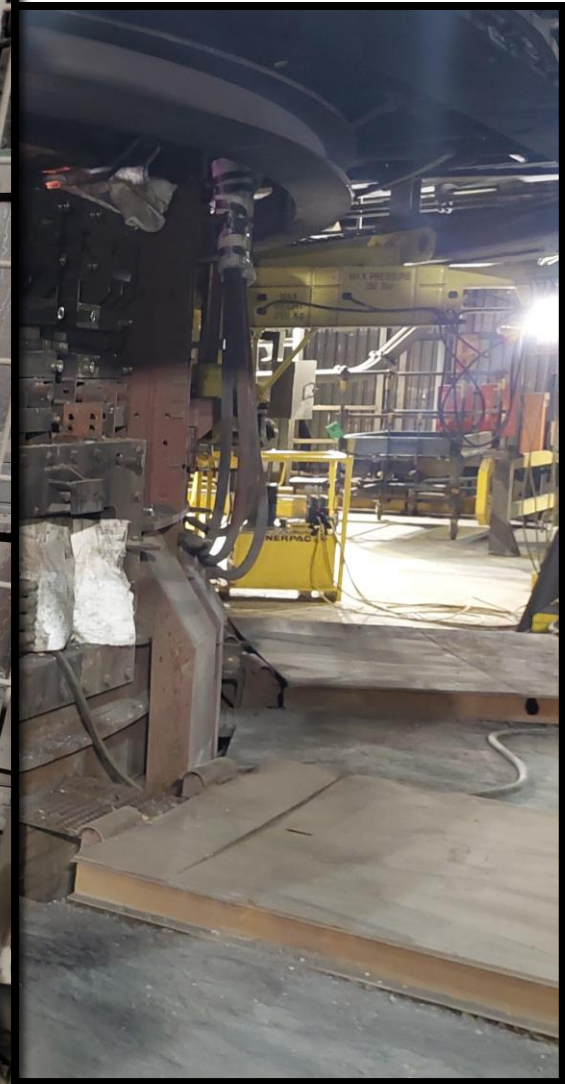
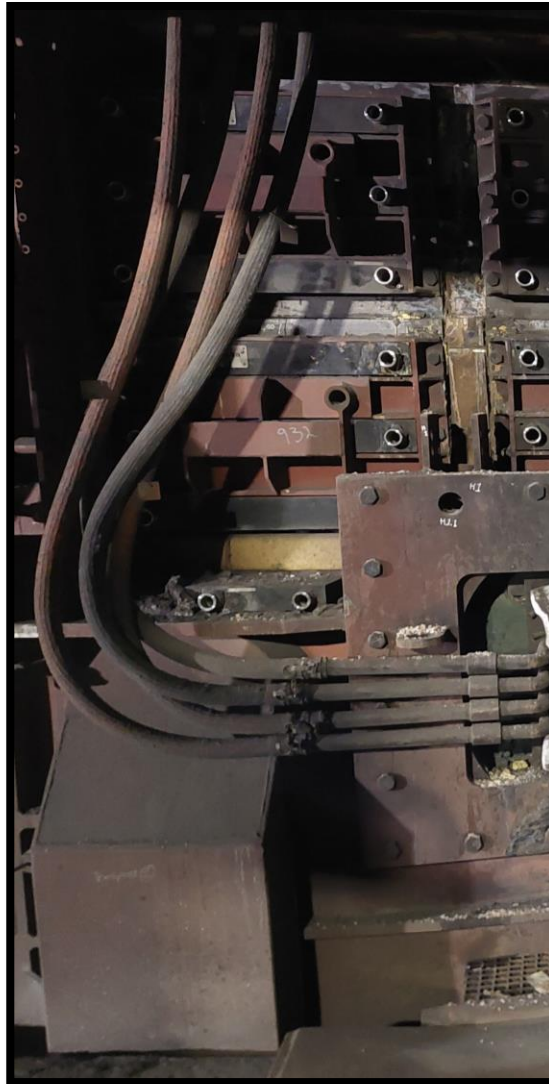
Method:

- Drain and power down furnace
- Remove 18 composite coolers
- Remove lower sidewall refractory
- Inspect remaining refractory
- Re-install new lower sidewall refractory
- Re-install composite coolers
- Power up furnace



Rebuild Methodology: Preparation

EXTREME MAKEOVER: FURNACE EDITION



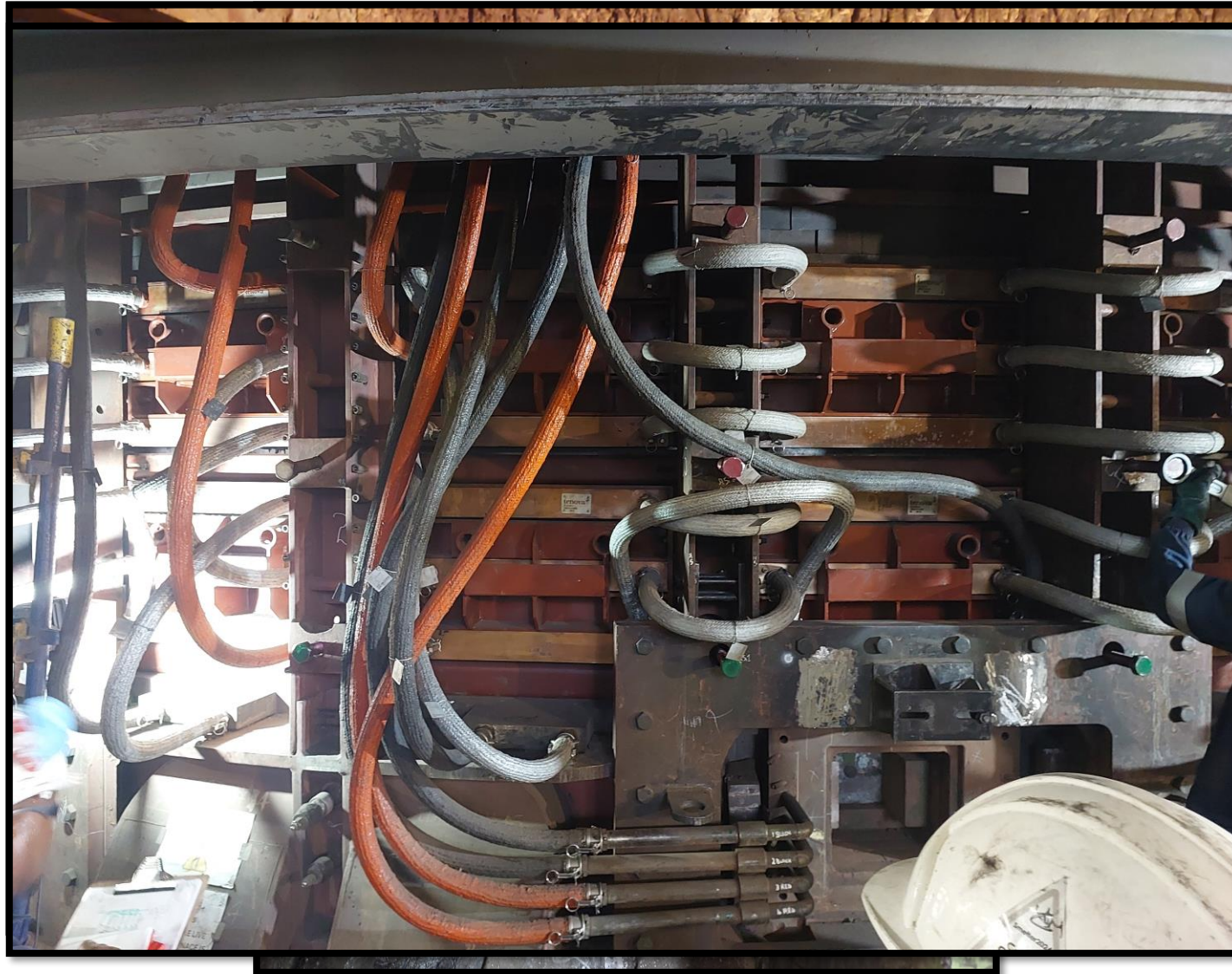
Rebuild Methodology: Demolition

THE GOOD, THE BAD, THE SLAGGY



Rebuild Methodology: Installation & Commissioning

LIKE LEGO, BUT HOTTER AND HEAVIER



Lessons Learned

IF AT FIRST YOU DON'T SUCCEED... ADD A HYDRAULIC JACK!



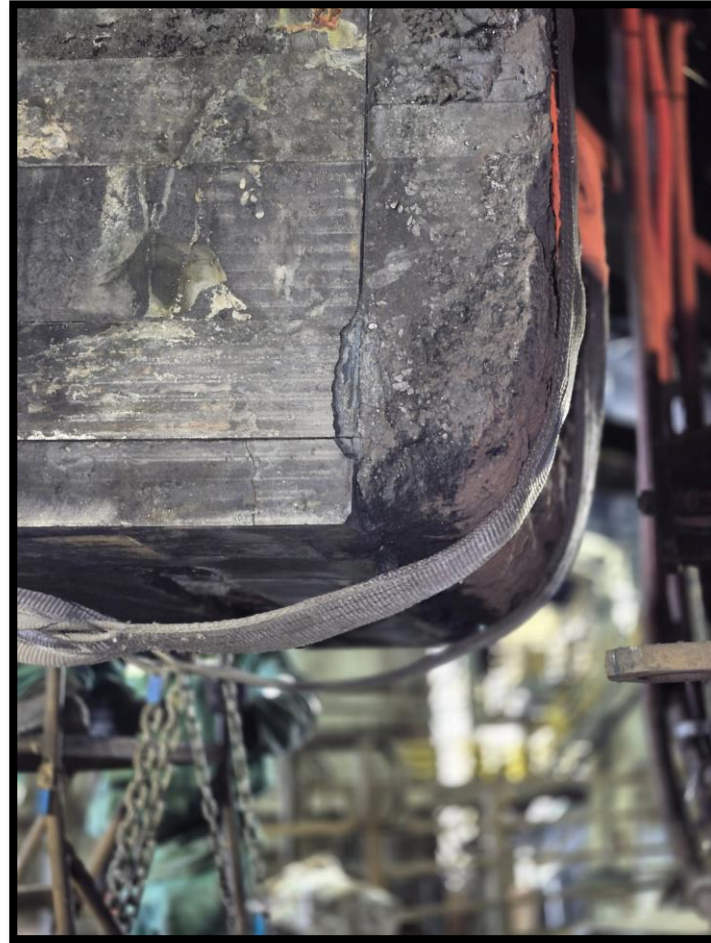
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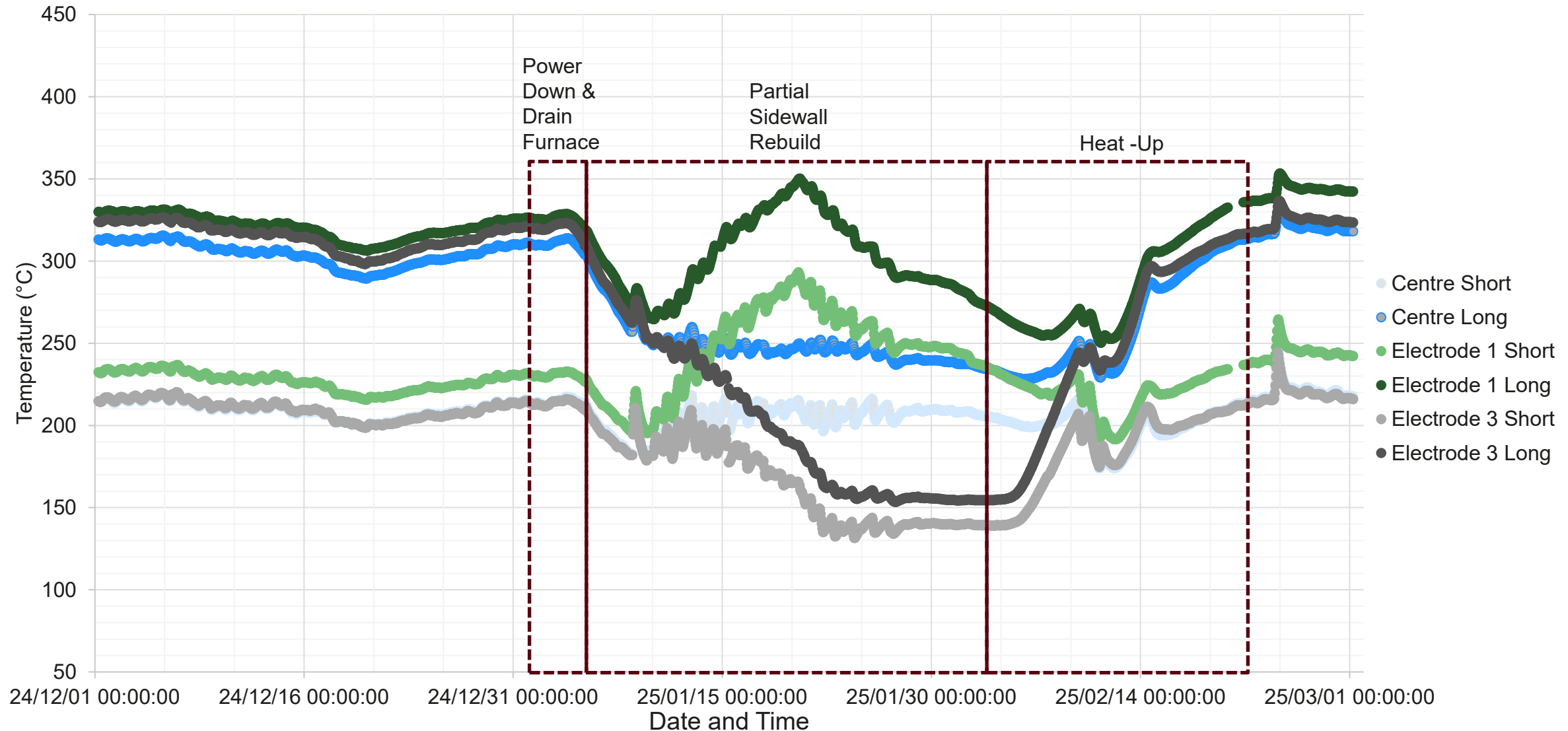
Lessons Learned

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Operational Performance: Hearth Stability

KEEPING IT COOL: TEMPERATURE TRENDS & WEAR PROFILES



Operational Performance: Cooler Condition

KEEPING IT COOL: TEMPERATURE TRENDS & WEAR PROFILES

BEFORE



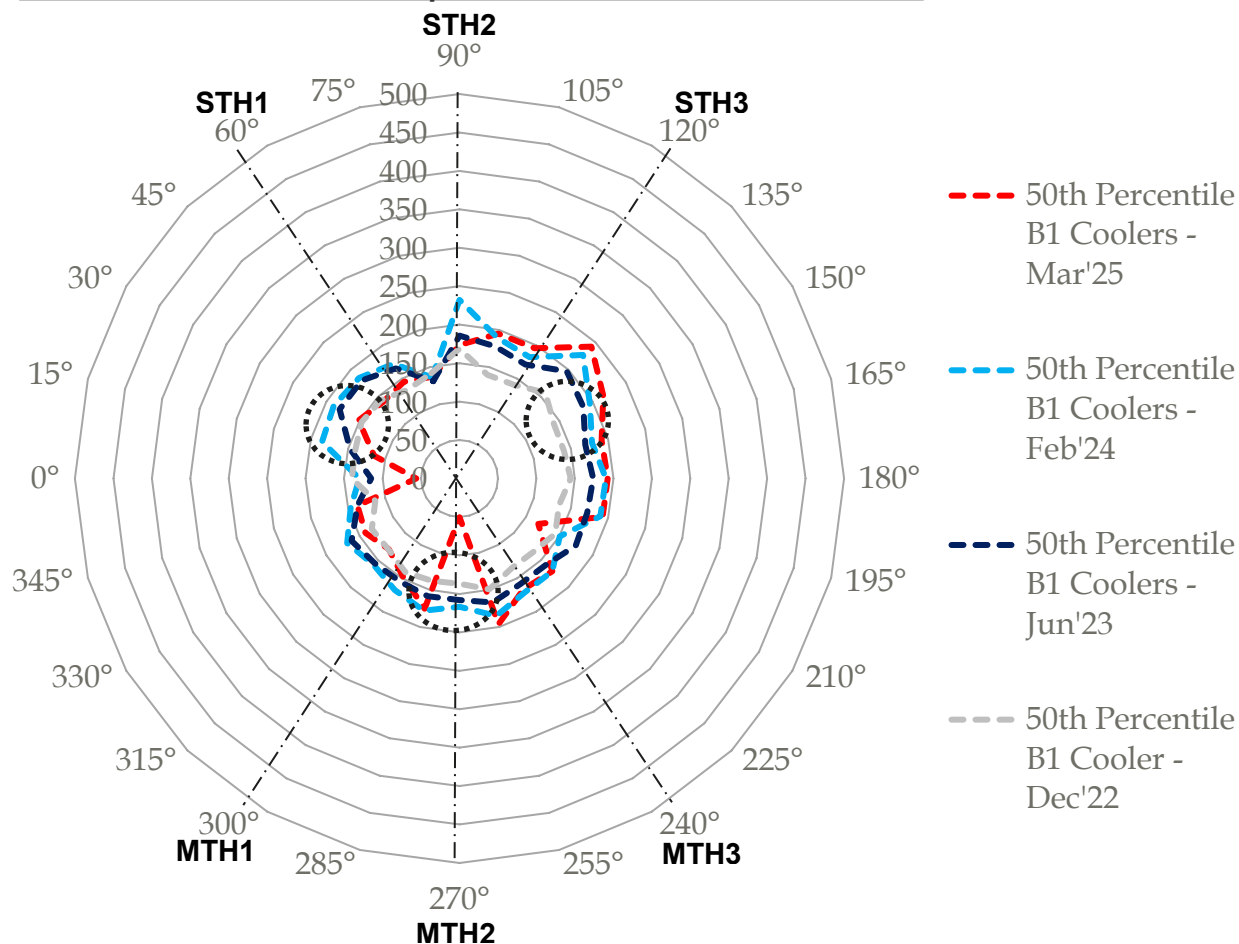
AFTER



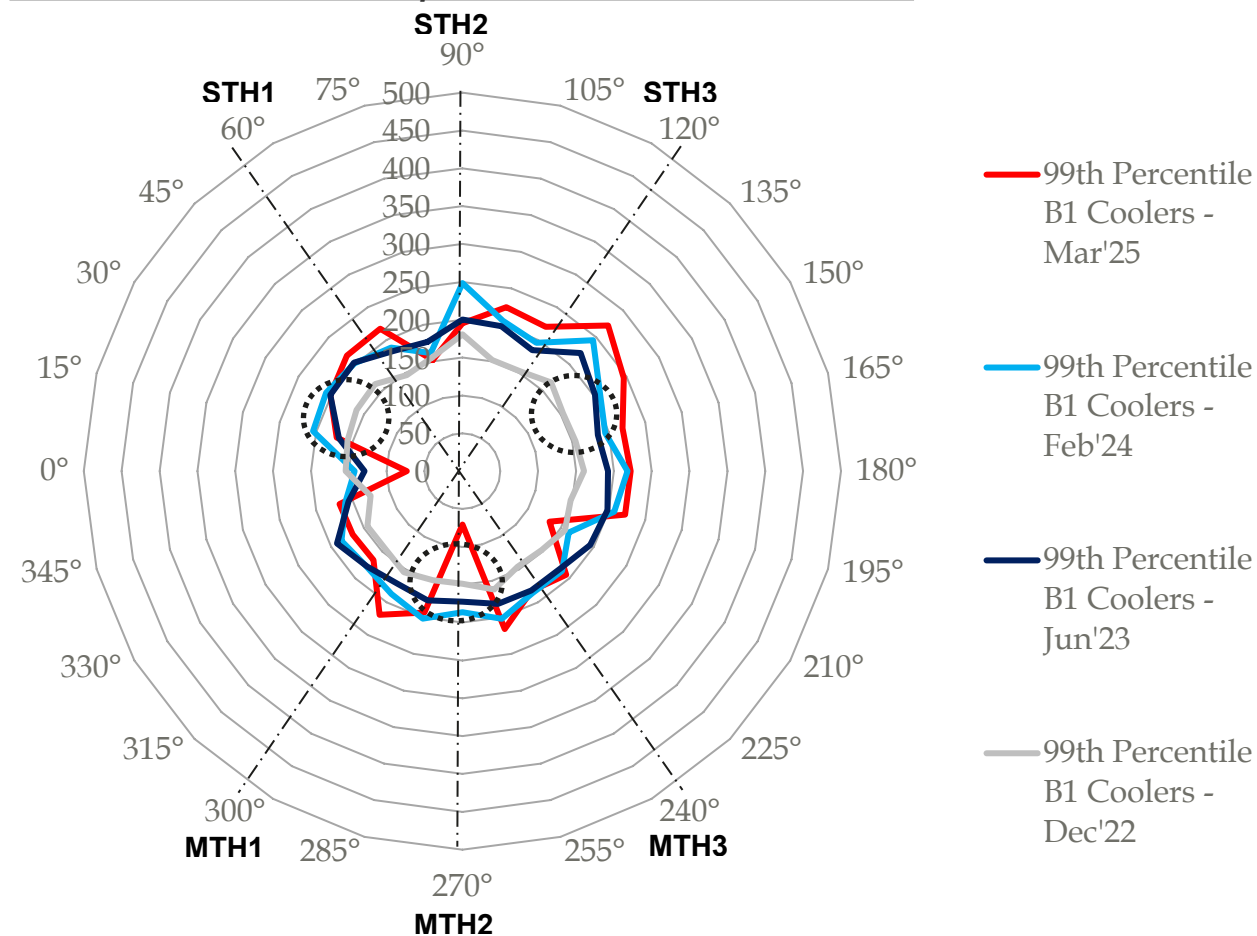
Operational Performance: Temperature Trends

KEEPING IT COOL: TEMPERATURE TRENDS & WEAR PROFILES

50th Percentile Temperatures – B1 Coolers



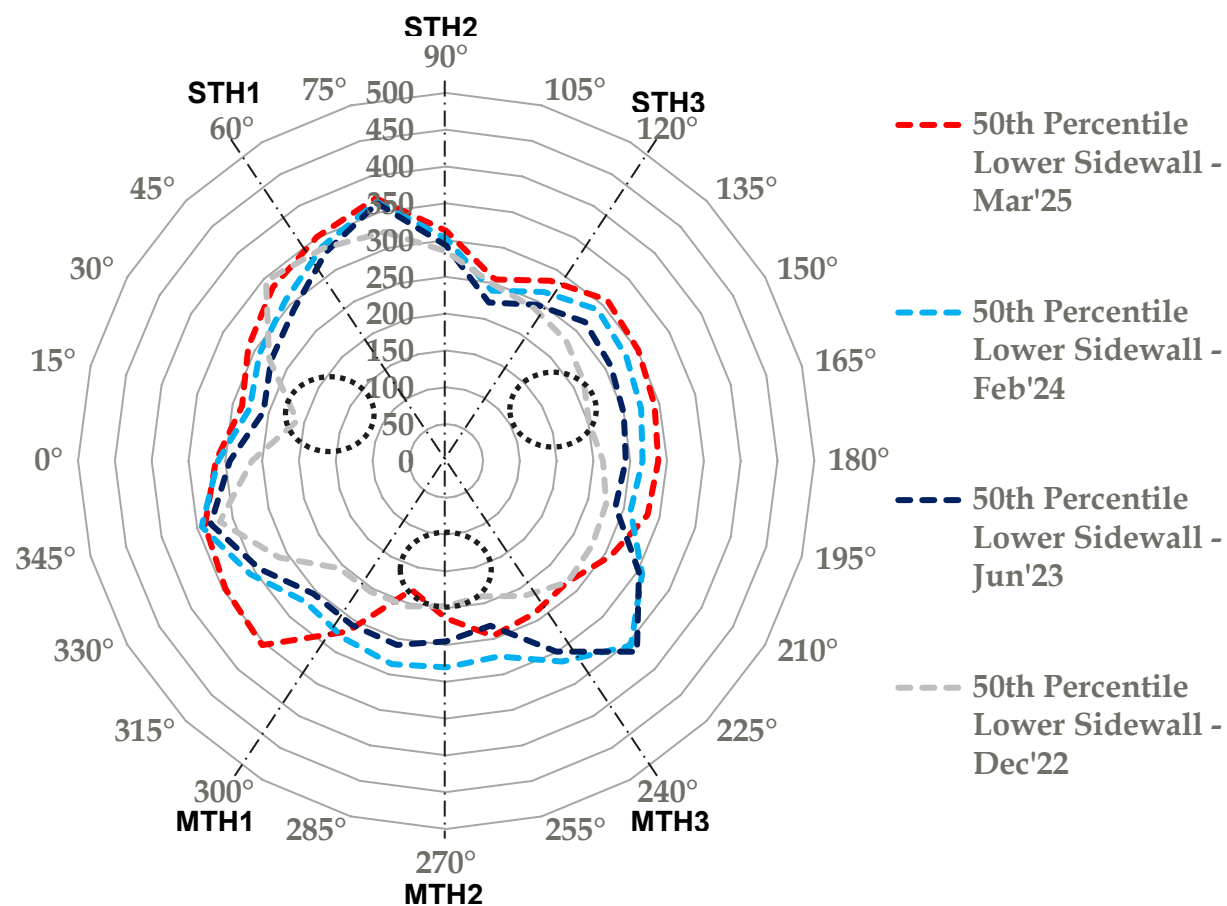
99th Percentile Temperatures – B1 Coolers



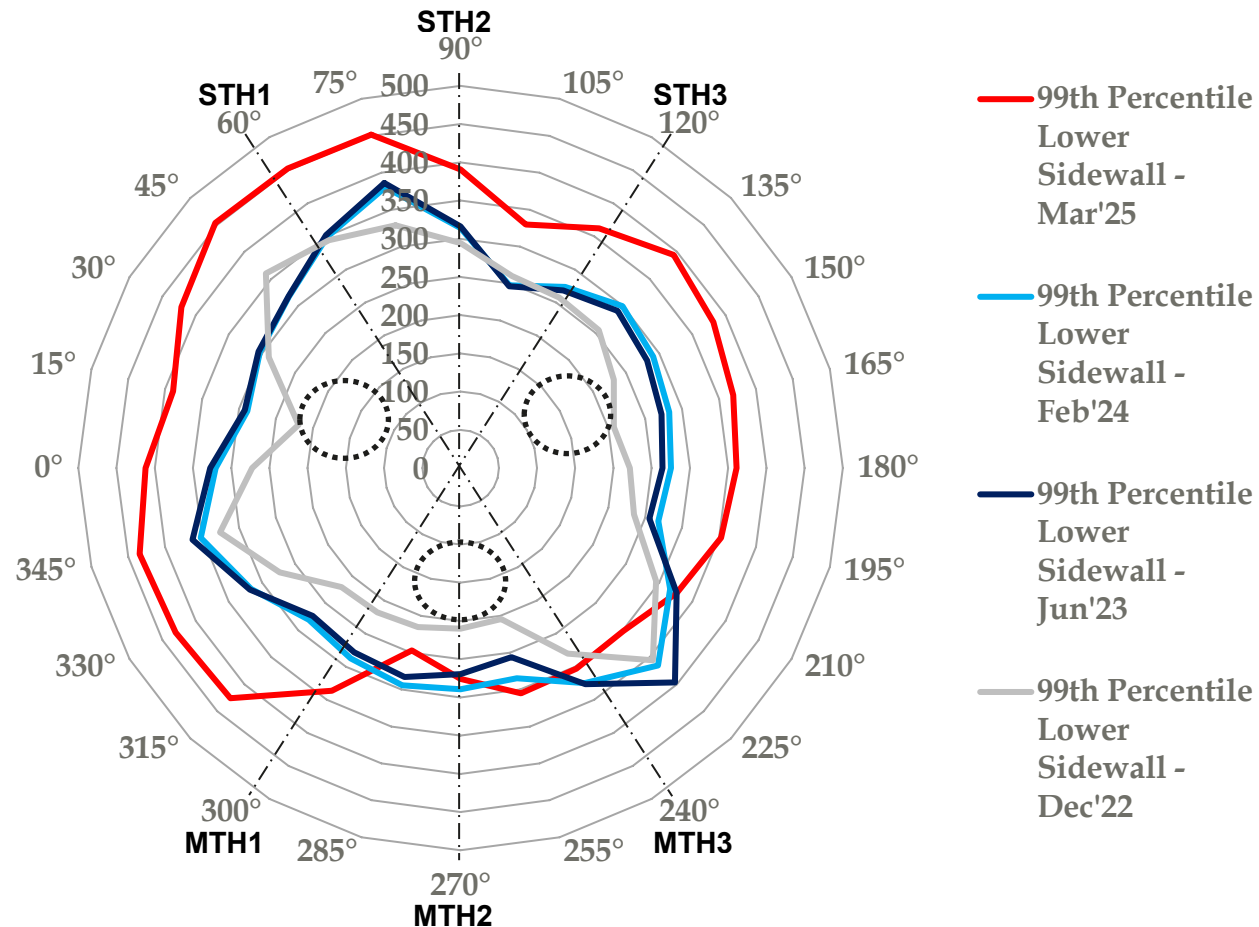
Operational Performance: Temperature Trends

KEEPING IT COOL: TEMPERATURE TRENDS & WEAR PROFILES

50th Percentile Temperatures – Refractory

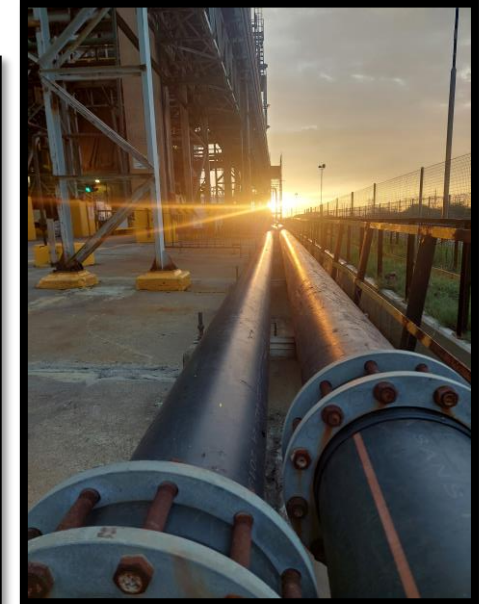


99th Percentile Temperatures – Refractory



Conclusions

WRAPPING IT UP: COOL TECH FOR THE FUTURE



- Copper-graphite coolers show good corrosion resistance with minimal wear after 27 months in operation.
- Successful hot partial sidewall rebuild highlight robust furnace design.
- Preliminary wear and temperature data indicate that 48-month sidewall campaign is achievable.
- Partial rebuild project allowed for some lessons learned.



Reference Articles:

- Joubert, H., de Villiers, G., Mbedzi, P., Davis, J., 2024a. Composite Copper-Graphite Cooler for PGM Furnace Sidewall, in: *Advances in Pyrometallurgy*. Springer Nature Switzerland.
- Joubert, H., de Villiers, G., Nel, J., Senekal, D., Mbedzi, P., Davis, J., 2024b. PGM furnace crucible upgrade and performance, in: *Southern Africa Pyrometallurgy 2024 Proceedings*. The Southern African Institute of Mining and Metallurgy, Johannesburg, South Africa, pp. 221–233.
- Mc Dougall, I., 2013. Sidewall design for improved lining life in a PGM smelting furnace. *The Journal of The South African Institute of Mining and Metallurgy* 113, 631–636.



THANK YOU

Tenova Pyromet

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