Pot Turnaround Time Reduction at Hirakud Aluminium to Enhance Productivity

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Abstract

Hirakud Smelter a unit of Hindalco Industries Limited is a part of Aditya Birla Group. Hirakud Aluminium is an integrated aluminium smelting complex which uses GAMI technology and is one of the oldest smelters in India, established in 1959. The original potlines were converted from Søderberg to prebake pots in 2006–2009, which had inherent challenges in terms of technology and retrofitting. Subsequently, during 2012–2014, there was also a brownfield expansion of 50 kt/a with 80 235 kA side-by side GAMI pots.

Aluminium production is a continuous process and productivity depends on the number of operating pots. Hirakud Smelter maintains a pot life cycle of 6 years by relining proactively approximately 10 to 12 pots/month to prevent any sudden pot failure. To do this we had to achieve pot turnaround time (TAT) lower than 8 days. As pot replacement is carried out in-situ, many challenges are faced during the relining of cells to maintain the pot turnaround time within the target.

After lots of brainstorming sessions and analysis, various initiatives were implemented to improve day-to-day operations and maintenance. As a result, TAT decreased and production increased. When the TAT reduction project started, in the financial year (FY) 2021, TAT was 12.7 days, and it was gradually reduced to 7.5 days in FY 2025, compared to the target of 9.0 days. This is the best TAT ever achieved by Hirakud Smelter through continuous improvements in procedures and co-ordination among the teams.

Keywords: Pot idle time, Pot relining, Pot life, Pot changeover, Productivity.

1. Introduction

Aluminium smelting is an energy-intensive and continuous industrial process where maximum productivity relies on uninterrupted operation of pots. Any downtime in a pot due to failure or delay in relining has a direct and measurable impact on overall productivity, energy consumption, and financial output.

The importance of optimizing pot turnaround time (TAT) lies in minimizing unproductive periods and improving pot availability. In global aluminium industries, average benchmarking TAT ranges from 6 to 10 days depending on the smelter's automation, infrastructure age, and technology used. While newer plants using cutting-edge AP or DX+ technologies have a leaner TAT footprint, older smelters must adopt innovation and agile planning to stay competitive.

Hirakud Smelter is a unique case, a legacy unit upgraded from Søderberg to prebake pots, still reliant on traditional infrastructure. In such a context, improving operational metrics like TAT is not merely a technical challenge but a strategic priority to safeguard profitability, and future sustainability. The initiative detailed in this paper shows how cross-functional collaboration, thoughtful planning, and locally adapted innovations can yield results comparable to those from newer smelting operations.

The following sections will delve into the historical challenges faced by Hirakud, the structured methodology adopted for turnaround reduction, innovations deployed on-site, and the measurable impacts achieved in terms of productivity and safety.

2. Background and Historical Context

In 2009, as part of a modernization strategy, the potlines were converted from Søderberg to prebake technology using GAMI technology from 2006-2009., marking a substantial technological and production leap by amperage increase from 55 to 85 kA [1, 2]. Subsequently, during 2012–2014, there was also a brownfield expansion of 50 kt/a with 80 side-by-side 235 kA GAMI pots in a separate potroom [1]. This upgrade improved energy efficiency and reduced environmental impacts. Unlike greenfield smelters with uniform infrastructure and automation, Hirakud operates in a retrofitted environment where physical constraints, legacy workflows, and equipment limitations affect performance metrics such as pot TAT. Historically, TAT of 12.7 days was due to in-situ relining, limited crane availability, and slow pot cooling times. These constraints prevented Hirakud smelter from following industry best practices, making Hirakud less competitive.

Benchmarking studies conducted within the Aditya Birla Group, particularly comparing Hirakud with newer plants like Aditya Smelter and Mahan Smelter, highlighted stark contrasts. While those facilities had an average TAT of 4–5 days due to modular operations and enhanced automation, Hirakud embarked on a challenge to reach similar TAT performance.

This historical backdrop underscores why TAT improvement at Hirakud is both an operational challenge and a strategic opportunity. The shift from reactive to proactive relining planning, supported by engineering innovations and cross-functional collaboration, have been essential for the success of the project.

3. Problem Definition and Objectives

3.1 Problem Definition

In 2020, Hirakud Smelter faced persistent challenges with high TAT, averaging between 11–13 days. The core issues stemmed from in-situ repairs of both the pot shell and pot superstructure (PSS) while the pots were located in live operational areas. This high TAT not only affected aluminium production volume due to idle time but also led to inefficient manpower utilization and frequent scheduling conflicts with operational jobs.

The complexity was further magnified by the smelter's infrastructure. Only two overhead cranes are available in each potroom, which are already engaged with routine operations. Additional delays arose from slow pot cooling rates, extended castable curing time, and lack of pre-prepared pot shell. Collectively, these constraints placed tremendous pressure on both production planning and resource allocation.

Key bottlenecks contributing to high TAT included:

7.1 Lessons Learned

- **Cross-functional Ownership is Essential:** Early involvement and ownership by all stakeholders, operations, lining, maintenance, and safety, ensured seamless coordination and minimized resistance during execution.
- **Planning is a Continuous Process:** The use of detailed Gantt charts, coupled with daily reviews, created a dynamic planning culture where adjustments were made in real time based on ground-level feedback.
- **Innovation Does not Always Require High Investment:** Modifications such as adjustable EOT crane hoists, water sprinklers, and pre-repair logistics were low-cost innovations that delivered high impact.
- **Manpower Development Multiplies Results:** Investing in crew training and skill enhancement-built execution resilience and boosted morale under pressure.
- **Data-Driven Monitoring Strengthens Accountability:** Progress dashboards, Gantt chart tracking and structured feedback collection created a performance-focused ecosystem.

7.2 Recommendations for Replication

- **Standardize and Document the Workflow:** Create process manuals for lifting, shell shifting, and fast-track relining to ensure repeatability in other pot rooms or units.
- **Create a Modular Execution Team:** Form a core group of skilled individuals who can act as a rapid response relining unit across the plant.
- **Encourage a Recognition Culture:** Recognize high-performing teams and individuals to build a culture of excellence.

In conclusion, the TAT reduction initiative shows how legacy facilities can achieve world-class performance through structured thinking, inclusive planning, and consistent execution.

8. Conclusions and Future Outlook

The TAT reduction project at Hirakud Aluminium is a case study on how legacy industrial operations can achieve step-change improvements in productivity, safety, and workforce capability. By strategically replacing time-intensive in-situ repairs with modular relining techniques, and supporting this with innovative planning and tool development. the smelter has effectively transformed a chronic bottleneck into a model of operational excellence.

Looking ahead, Hirakud aims to further reduce TAT below 6.5 days by refining cooling processes, using of machine in de-lining and ramming operation and replacement of partially lined potshells. Plans are also underway to roll out the lessons from this initiative across other maintenance-intensive functions and sister units within the Hindalco and Aditya Birla network.

9. References

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