Pot Turnaround Time Reduction at Mahan Aluminium to Enhance Productivity

Senthil Nath[1], Kamal Kant Pandey[2], Pratap Sahu[3], Chandan Choudhury[4] and Jay Das[5]
1. Joint President,
2. Vice President,
3. General Manager,
4. Manager
5. Assistant General Manager
Hindalco Industries Ltd, Mahan Aluminium, Bargawan Singrauli, Madhya Pradesh, India
Corresponding author: pratap.s@adityabirla.com

Abstract

Mahan Aluminium pot line being a green field smelter, relining started three years after full commissioning. In order to maintain the normal life cycle of six years, pot line team has to reline approximate 9 - 10 pots/month as a proactive approach towards avoiding any sudden pot failure. To execute this plan, we have to achieve Pot Turnaround Time (TAT) below seven days. As pot replacement activity was carried out for the very first time in AP36 pots in Hindalco Mahan Aluminium pot line, many different challenges faced during the pot lining activity to maintain the pot turnaround time within target time. After a lot of brainstorming and analysis, various initiatives were applied during day-to-day operation and maintenance practices which helped to sustain as well as maximize the production volume by reducing pot idle time. Pot yearly TAT trend is as follows: 2018: 9.17 days, 2019: 8.82 days, 2020: 6.08 days, 2021: 5.16 days. Through continuous improvements in procedures and co-ordination among the teams, Mahan achieved the best ever average TAT of 5.16 days in full year 2021, against the target of 6.0 days.

Keywords: Pot idle time, Pot relining, Dead Pot, Pot change over, Potline productivity.

1. Introduction

An aluminium potroom can contain hundreds of electrolytic cells or pots that are connected electrically in series. We have 360 pots connected in series in two rooms of 180 pots each. Within each pot, molten aluminium is produced by the reduction of alumina (Hall-Héroult process). Optimizing energy use, preventing downtime and reducing costs of replacement are the key for improving potline performance. A well composed pot can be increased the pot running efficiency and sustained the critical process parameters. Henceforth, the critical or high aged pots need to be relined in regular intervals to avoid failure and meet the target production. The aged potshells need to be removed within the stipulated time frame and replaced to meet the yearly production target as well as maintain the symmetry for other parameters.

To compete in the global market in terms of production with quality, each smelter had to work strongly on the probable factors which might have appeared as major setbacks for the future. On the other hand, Mahan had to find a way to achieve the lowest ever turn around target below what Aluminium Pechiney (AP) Technology set worldwide i.e., six days. Reduction in TAT has significant impact on potline performance and consequentially on metal production cost.

2. Challenges in Reducing TAT

Mahan Aluminium has latest AP36 technology which is the first of its kind in India with 360 pots in operation. Aluminium smelting involves extraction of aluminium from its oxide (alumina) using an electrolysis process. Mahan ramped up and achieved full capacity of 360 kt/year in

August 2015. In an AP pot line of 360 kA, pot life is expected to be approximately 6 years. As all the 360 pots cannot be shut down at the same time, good planning and execution must be followed to avoid any sudden risk of failure and unsafe incidences. Since Mahan has had more than 40 black-outs and more than 100 times current reductions mainly due to Power Plant stabilization, grid disturbance and rectifier issues since the start-up, the pot life became critical, and we were forced to reline approximately 9-10 pots/month.

In the second-generation pots there are lots of challenges to conquer, such as, variation in pot performance due to commissioning normalizations in first generation, significant history of power outages, earthing trolley availability, difficulties in welding in high magnetic field, and development of solutions to these challenges.

Limitation of pot lining capacity is another major factor that needed to be considered. Since different pots have different pot life and to achieve a better pot life, the start-up had to be accelerated to approximately 9-10 pots per month. To achieve this with lining capacity of only 5-6 pots per month, the turn-around time for each pot will increase and this will not be a sustainable solution. Hence, we needed to enhance our lining capacity to almost equal or higher than our requirement, i.e., to ten pots per month, either by increasing the number of empty shell available, or by increasing the number of skilled crew to maintain the required re-lining rate.

Pot replacement needs specialised high-capacity cranes, such as tapping and miscellaneous assembly (TMA) (70 t capacity) and cathode transfer assembly (CTA) (185 t capacity) to handle the weight of pot superstructures and stopped potshells. These cranes are few (One TMA and One CTA) and hence their availability during requirement is very critical. Preventive maintenances quality and scheduling of this equipment are the keys to ensure more than 95 % availability to achieve performance of replacement within targeted time frame.

3. Execution Methodology:

Pot turnaround time is defined as the time between the pot cut-out and bath-up, the time when the aluminium production is resumed. Minimum turnaround time gives maximum production. Hence globally each smelter identifies best practices, keeping safety-first in mind to shorten turnaround from 9 to 8-7-6-5 days and so on to achieve better production.

A 360-kA pot line has a normal potline voltage of more than 1500 volts. The removal and replacement of a potshell need to be done very safely, hence an earthing trolley is connected to the pot replacement site to keep the potential difference between the pot and earth at zero volts to to achieve zero electrical hazards for the crew working in the near-by area. Since the pots in the entire pot line are connected in series, the earthing trolley must be connected only at one place; this restricts the work on multiple pots at a time, except if they are very near the earthed pot.

So, identifying the critical pot is most important to avoid multiple stoppages at a time which may lead to delays in pot replacement due to the constraint of earthing trolley. Hence a scientific model was developed on the basis of pot history like the number of power outages, pot age, cathode voltage drop (CVD) trend, Fe and Si in the metal, side shell temperature (SST) /Collector Bar Temperature (CBT) results, etc.

Pot performance literature of AP30 Technology around the world was analysed. A machine learning model was built, including pot life, machine availability, reliability of engineering equipment through good maintenance strategy, shut down planning based on critical pot index, validation through autopsy. All these parameters are required to stop pots in a potline, so that two pots are not stopped or fail at the same time, which would cause a replacement delay. After

Mahan has taken up several new initiatives to develop the workflow ability as well as its team development to set a benchmarking target about the reduction of TAT in pot replacement work (Table 3), which must be of interest for other Indian primary aluminium producers.

Table 3. Activity wise tracking against Planning and Budgeting (P & B)

Activity	Full year 2020		Full year 2019 (h)	Full year 2018 (h)
	Target (hrs)	Actual (hrs)		
Pot stoppage to equipment removal	24	16	28	28
Riser, clad cutting to PSS, pot shell removal	28	26	32	32
Basement cleaning and other grinding works	16	16	26	28
Pot shell, PSS placement to handover	36	34	38	44
Total earthing trolley time	80	76	96	104
Pot preparation & energisation	20	15	24	24
Pot Energization to start up bath pouring	60	58	64	64
TAT in days	7.67	6.82	8.82	9.16
No. of Pots Started	90	92	77	47

This project was recognized in several platforms, such as **prestigious** PRIDE award, Appreciation by Business Unit and Cluster level Leaders, other Hindalco Industries Limited (HIL) smelters (Renukoot, Aditya and Hirakud). HIL corporate members visited Mahan Smelter to learn the best practices followed by Mahan, in order to replicate the best practices in other HIL smelters.

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