

The Roadmap of AP-ALBA to 400 kA

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Abstract

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Aluminium Bahrain (ALBA), the world's largest single-site aluminum smelter outside China with aluminium production of more than 1.548 Mtpa (2020 production) is known for its technological strength and innovative strategies. Reduction Line 5 in ALBA was built in 2005 using AP30 technology at 330 kA with a capacity of 308 ktpa being the longest reduction line at that time with 336 AP30 pots. Line 5 was started in a world record time of 77 days. The operating performance of Line 5 has been one of the best among all AP30 potlines. With a commitment to improve further, many actions and strategies were put in place, taking advantage of the technology robustness and in-house innovations. Presently, Line 5 is operating at 400 kA which is 20 % higher than the original capacity. As per technology supplier and peer potlines, installation of Forced Convection Network (FCN) is crucial for Line 5 design to operate at 400 kA safely. ALBA has taken the challenge and the risk to increase to 400 kA and defer the large CAPEX of FCN installation to a later stage. Special focus was given to optimizing process parameters, improving practices, upgrading of lining design, increasing anode size and training/developing the technical competency of the teams. This paper details the experience of amperage increase journey without large investment on FCN and the performance of ALBA Line 5.

Keywords: ALBA AP30 Potline 5, Amperage increase, Anode-cathode distance (ACD), Forced cooling network.

1. Introduction:

Aluminium Bahrain (ALBA) started its metal production with commissioning of two reduction lines 1&2 in 1971-1972 with capacity of 120 kt/y. ALBA has been progressively expanding until it reached production of 500 kt/y in 1993. Reduction Line 5 was started using AP30 technology in 2005, being the longest reduction line at that time with a total of 336 pots. In 2018 Reduction Line 6 was built using DX+ Ultra technology with a total of 424 pots at line amperage of 460 kA and is now operating at 476 kA. Upon completion of Potline 6, ALBA has become the world's largest single-site aluminum smelter outside China with aluminium production of more than 1.5 Mtpa.

Reduction Line 5 pots started up in a strategic way in the shortest duration of reduction line start-ups ever. It took only 77 days to bath up all the 336 AP30 pots. On 5 April 2017, Reduction Line 5 suffered from long power outage which led to shutdown of 274 pots out of the 336 pots operating. Speed, Agility and Simplicity (SAS) concept made the recovery of reduction Line-5 at ALBA a benchmark in the aluminium industry. Line 5 was recovered in less than four months with start-up speed of 3.20 pots/day in a safest and fastest manner in the world. After recovery

from the long power outage the amperage increase journey resumed and now Line 5 is operating at 400 kA with outstanding operating performance as compared to other AP30 smelters.

2. Historical Performance

2.1 Current Increase Milestones

Since the start-up in 2005 current increase projects have always been part of the operation of Line 5. Line current in start-up design was at 330 kA and in the first year a current increase of 7 kA was achieved in 2006. Followed by ongoing current increase projects at a rate of 4 kA per year, Line 5 is currently operating at 400 kA with a total current increase of 70 kA above the design current. The fastest increase rate per year was achieved in 2018 (15 kA) from 378 kA to 393 kA (Figure 2) with the implementation of copper insert lining design. The current creep journey has achieved total growth in production of 60 ktpa, approximately 20 % above the start-up design capacity as it is shown in Figure 1.

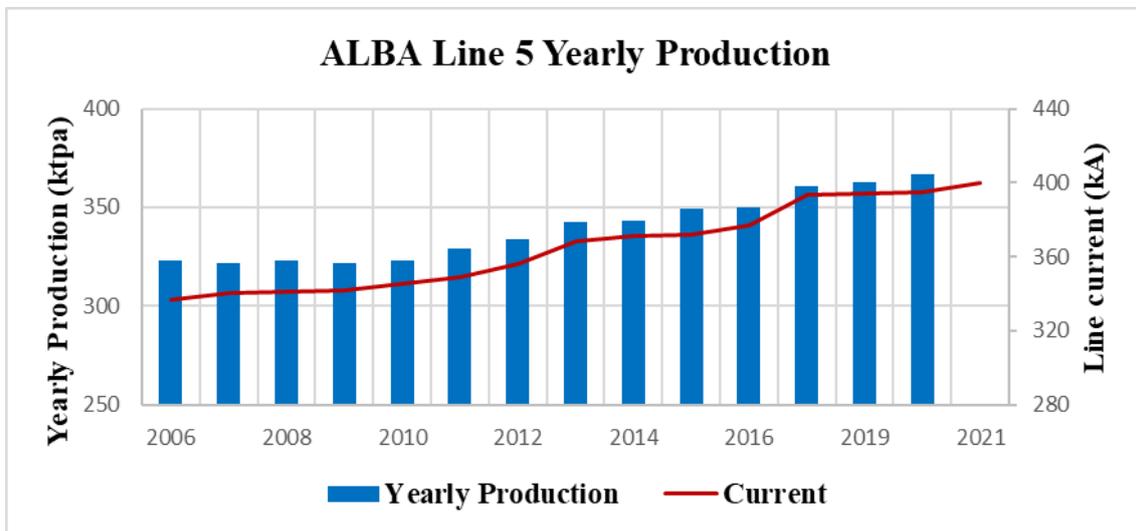


Figure 1. Line 5 current increase with annual production until the end of 2020.

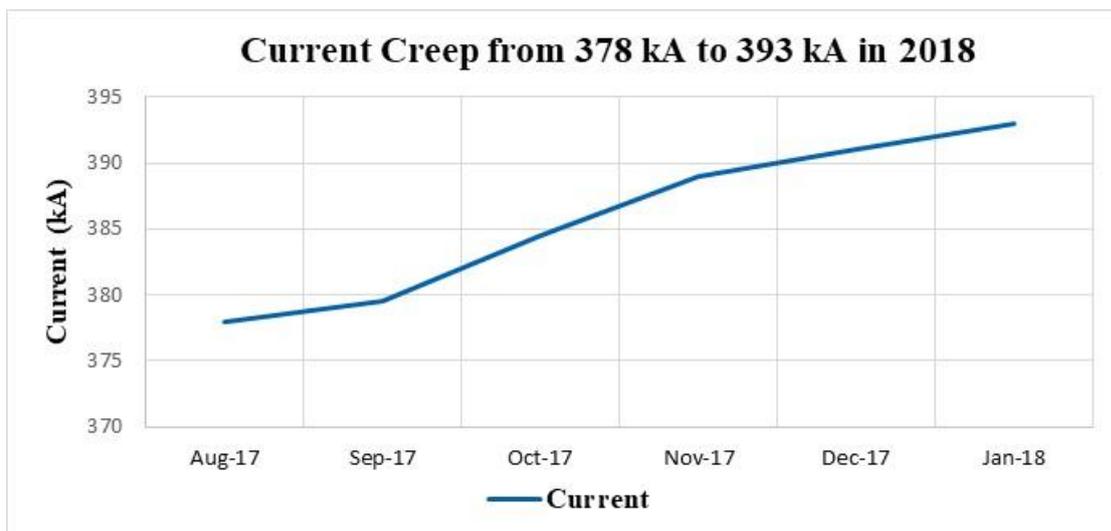


Figure 2. Line 5 highest current increase rate in 2018.

6. Improvement in Work Practices

- To improve the quality of operation and workmanship, it was decided to initiate process excellence team to monitor and control key performance indicators. At the beginning the assigned team had the responsibility to do physical inspection of different operations and compare the performance score of different teams in different shifts. Moreover, the team had the responsibility to improve the procedures of the different activities, such as anode change and covering, metal & bath level compliance, tapping compliance, etc.
- Later on, more development was done by the team which included monitoring the technical aspects of potline operation such as the number of pots kept in manual control, number of raised anodes, pots with abnormalities such as high instability and high temperature, etc.

The results achieved by each team are being discussed by the employees themselves and corrective actions are put in place. All the mentioned activities have contributed to engage all the employees and increase awareness about the importance of quality, procedures, and safety.

7. Measurements during Amperage Increase

Necessary measurements have been taken during amperage increase in reference pots and at defined frequency before and after amperage increase. The necessity of measurements was mainly to determine the heat balance and cross voltage around different cell components and based on the results of measurements necessary actions and optimizations were done. Examples of monitoring activities is shown below:

- Side shell temperature
- Side ledge profile
- Red shell inspection
- Basement cleaning: Busbars temperature and overall conditions.

8. Conclusion:

ALBA has safely increased amperage from designed 330 kA to 400 kA keeping the potline operating performance as benchmark as compared to other AP technology smelters. The challenge to reach 400 kA without installing FCN has been achieved by implementing major modifications, introducing cutting edge technology and engaging all stakeholders. Further current increase journey has been launched to reach 415-420 kA by 2023.

9. References

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