Baked Anode Density Improvement with Rotary Coke - A Success Story of ALBA

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Abstract

The gradual deterioration in anode grade coke quality over the past two decades and its impact on anode quality has been well documented. One of the most affected properties is the coke porosity, commonly measured by the vibrated bulk density (VBD). It is well known that a drop in VBD has a direct impact on the baked anode properties, especially baked apparent density (BAD). A drop in BAD due to a deterioration in coke quality can be compensated by blending high-density shaft coke with rotary coke. Carbon plants with this blending capability can achieve good BAD's. ALBA has its own rotary calciner and produces calcined petroleum coke for captive use, meeting 80 % of ALBA's coke requirement. The worldwide deterioration in green petroleum coke has impacted ALBA's calcined coke porosity leading to low anode BAD's. This paper describes some measures taken by ALBA that enabled an increase in BAD by 0.03 g/cm^3 when using only rotary coke. This was important since one of ALBA's four carbon plants does not have the capability to blend shaft coke with rotary coke. A complete analysis of the process and equipment settings and parameters was carried out and several aspects were considered for improving density. The most significant being the changes made in crushing, mixing and forming parameters. This paper shares the ALBA success story to achieve baked anode densities ≥1.580 g/cm^3 with rotary coke only.

Keywords: Rotary coke, baked anode density, Rhodax, mixing and cooling energy, counterweight

1. Introduction

Aluminium Bahrain (ALBA) is the world's largest single-site aluminium smelter with an aluminium production of more than 1.6 million tonnes (2024) and is known for its technological strength and innovative strategies.

Potline 6 was commissioned in 2019 with DX+ Ultra technology, originally designed to operate at 460 kA. Within six years, it had reached 478 kA an impressive increase of more than 4 % over its original design, Figure 1.

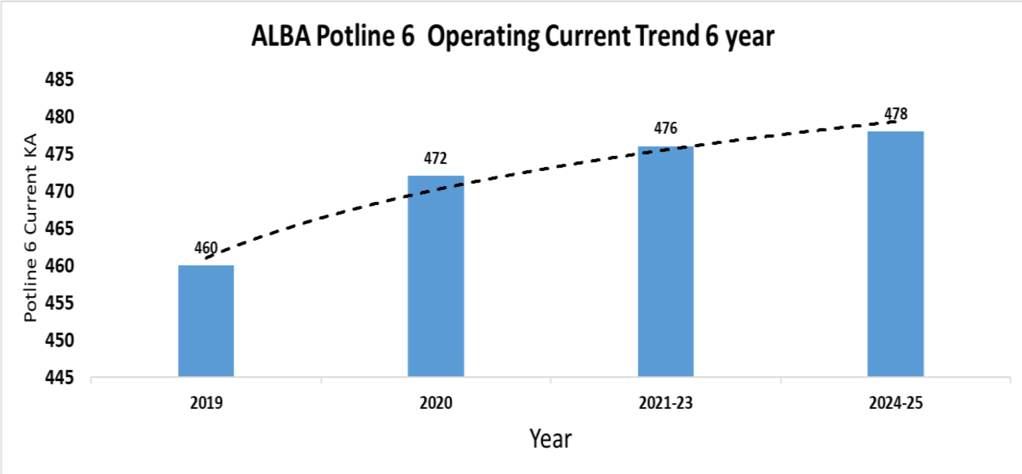

Figure 1. ALBA potline 6 operating current trend.

One of the critical factors in sustaining high amperage operation is anode quality. Potline 6 performance has shown notable sensitivity to baked anode density (BAD), likely due to the higher anode current density compared to other potlines. A reduction in BAD to < 1.56 g/cm^3 during Q3 2024, had a negative impact on potline performance, prompting the formation of a specialized team to optimize process parameters and increase BAD to ≥1.58 g/cm^3.

BAD is influenced by raw material quality, dry aggregate granulometry, mixing energy and anode forming parameters.

This paper presents ALBA's comprehensive approach to enhancing BAD from 1.55–1.56 to 1.58 g/cm^3 and above using relatively low VBD rotary kiln calcined coke. The optimization strategy focused on optimization of key process parameters affecting BAD and equipment capability enhancements. These included improvements to crushing efficiency, mixing energy, and anode forming parameters in the paste plant.

ALBA's Paste Plant 4, commissioned in 2019 to supply anodes to Potline 6, incorporates state-of-the-art technology, including:

- **Rhodax® crusher** for dry aggregate preparation, Figure 2a.
- **IMC® process (Intensive Mixing Cascade)** for paste mixing and cooling using an Eirich mixer RV33 and Cooler RV33, Figure 2b.
- **Xelios™ vibrocompactor** for anode forming equipped with vacuum and counter pressure.

All the dry mix materials are fed into the Rhodax® crusher, and the output of the crusher is processed through a Mogensen screening system, where materials are classified based on particle size. In this plant, two fractions comprising grains (0.3–30 mm) and fines (< 0.03 mm) are being used for green anode production.

To further improve anode quality and facilitate current creep in Line-6, more projects are underway. Some of these projects are listed below and mainly focus on more efficient coke and butts crushing in the Rhodax plant to ensure good packing density:

- Coke crushing facility to crush coke below 10 mm before feeding to Rhodax crusher
- Optimize Rhodax crushing circuit by installing roll crusher to crush oversize material and get maximum benefit from the Rhodax crusher.

8. References

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