Anode Performance Improvement with Limited Expenditure and Baking Furnace Options

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Abstract

The present study describes the successful attempt to enhance the anode performance in the pots by modifying its design in the anode plant of Sohar Aluminum with minor modifications of the baking furnace and conveying systems. To support the amperage creeping and improve the current efficiency in a context of low LME-driven expenditures, several options were considered to overcome the bottlenecks in anode paste plant (APP) and in the anode baking furnace (ABF). After proving the concept works with deeper and longer dummy anodes, the production anodes were successfully slotted at 350 mm while being formed within the existing vibro-compactor mold box. Anode length extension was also performed, leading to 1.5 % additional surface area for the subsequent electrolytic reaction. The challenges on baking the resulting longer anodes beyond the original equipment manufacturer (OEM) specifications (degassing joints and coke bed top insulation) in the ABF were also overcome. The extensive work led to conclusive findings regarding the monitoring of the new SO_2, CO, and H_2S emission levels on the furnace deck, heat loss, packing coke oxidation, final baking level, anodes electrical and chemical properties. Positive results were achieved in pots after several cycles.

Keywords: Anode design performance, Anode baking furnace, Longer anodes, Anode slots.

1. Requirement in Potlines

To reach the business plan of 397 300 t/y at 400 kA while sustaining the current efficiency performance, Sohar Aluminium had to decrease the current density below 0.95 A/cm^2 and the pot instability. This was a conclusion from a previous internal study showing in the pot booster section that the current efficiency (CE) decreased at greater amperage creeping. Unfortunately, the existing anode dimensions were 1600 mm (length) x 650 mm (width) corresponding to 0.96 A/cm^2 at 400 kA. The anode slots depth was 300 mm.

Confirmed by the pot designer, the pot shell could accept an additional 90 mm to the anode length, but the width had reached its limit. The additional length contributes to increase the bottom anode surface area, thus lowering the current density. Additionally, the anode slot depth could be raised to extend its positive effect during the life of the anode in the pot. Low investment was considered on this project to make it more attractive.

2. Opportunities and Bottlenecks in the Anode Plant

2.1 Paste Plant

The Anode Paste Plant (APP) extra capacity allowed weight to be added to each anode block without compromising the daily production figure of anode blocks. Besides, the plant was equipped with two vibro-compactors and each mold box permitted an increase of up to 50 mm in the anode length. The mold boxes installed in 2016 came initially with two provisory spacers on each side for this purpose. This meant the anode length could be extended from 1600 to 1650 mm (baked anode dimension) without major investment in the APP (see Figure 1).

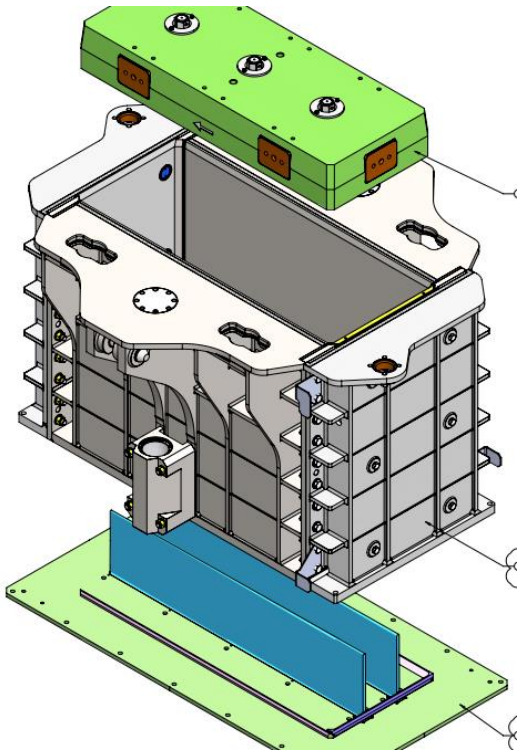

Figure 1. Vibro-former mold box with spacers.

The anode is formed with its slots in Sohar aluminium. An increase in the slot height, while technically feasible, would imply more risks of anode broken parts, missing carbon for the reduction process (referred to as Reduction in the later part of the work), and potential damages on the slot plate.

2.2 Baking Furnace and Rodding Shop

The anode baking furnace (ABF) manufacturing specifications clearly stated the anode had already reached its maximum size fitting into the pit. Any significant change in anode length might trigger a multimillion-dollar modification of the ABF refractory and furnace tender assembly (FTA) handling the anodes.

In the pit, three layers of anodes stand on each other during the baking process. These anodes, once stacked, reached the last degassing joint layer top with a margin of 10 mm as represented on Figure 2. Consequently, there was no anode length increase possible following manufacturer recommendations without a modification of the ABF refractory and civil structure.

decision. The gain in combining the two changes exceeded the initial estimation on internal rate of return for this project.

8. References

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