Amperage Increase in EGA Al Taweelah DX Technology Potlines

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Abstract

EGA operates two DX technology potlines (Lines 1 and 2) in Al Taweelah, with 808 pots (202 pots in each potroom) today. The amperage has increased from 350 kA at start-up in 2010 to 437 kA in 2023.

The new generation of pots has collector bar copper inserts, which enabled amperage increase. Amperage was increased to 422 kA by April 2018, and after a few months, it was decreased after some challenges with carbon. Another amperage increase started in October 2021. At first, amperage was increased by 2 kA per month to reach 435 kA in March 2022. This was followed by five months of process optimisation, completed in August 2022. Pot operation parameter changes were made according to the following rules:

- Pot voltage should be reduced according to theoretical calculations, in order to maintain the heat balance in the pots.
- Unscheduled anode changes should not cause any increase in gross anode consumption.
- Anode effect frequency should remain the same.
- Cathode resistance should not increase.
- Standard deviation of thermal parameters should not increase from its starting value.
- Current efficiency should be at the same level as at starting.
- Superheat should also remain the same, with no increase in its standard deviation.
- Metal height is to be raised by 2 cm from 22 to 24 cm gradually to make sure that the magneto-hydrodynamic stability was maintained.

Once the above process requirements had been achieved and maintained, the two potlines were set for a new target of 436 kA, which was reached in September 2022 with good KPIs since. In this paper amperage increase from 416 kA will be described in continuation of the ICSOBA 2018 paper [1].

Keywords: DX technology, Amperage increase, Pot performance criteria.

1. Introduction

EGA's Al Taweelah Potlines 1 and 2 (then 378 pots per pot line) were started at 350 kA during 2009 and 2010 using DX Technology [1]. Line amperage was successfully increased up to 380 kA in the potlines by October 2012 [2]. During the first-generation pot changeout, a few strategic pot design changes were carried out which enabled the amperage Al Taweelah DX potlines to 422 kA by April 2018 [3-5]. As part of the P100 expansion project, an additional 26 pots were added to each DX potline in 2021 [6].

This paper is focused on Al Taweelah DX potlines journey to 437 kA by May 2023, close to the existing rectifier and busbar system capacity. This was achieved by executing a plan developed by identifying the enablers, applying, monitoring, and correcting them. Anode size, Cu inserts in

collector bars, pot side insulation design, and pot bath chemistry modifications based on the source of alumina, are among the identified enablers which are discussed in this paper.

2. Major Milestones of the Amperage Increase Plan

Figure 1 shows the different stages of amperage increase from 2018 to 2023. The graph from the start-up to 2018 is given in [3].

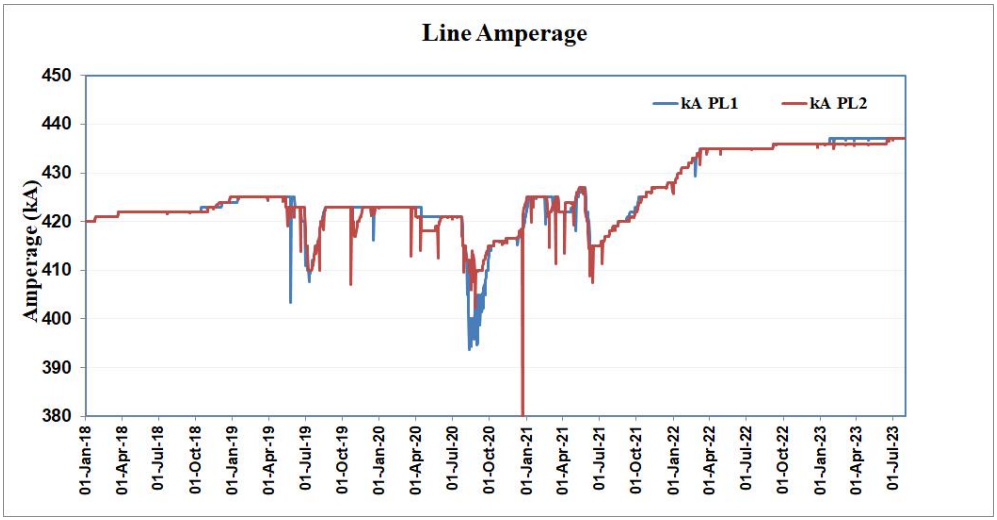

Figure 1. Amperage increase stages from 2018 to July 2023.

Pre-Ramp-up stage: Potline amperage was raised from 422 kA to 427 kA in May 2021, but it could not be sustained at 427 kA due to ongoing anode quality issues, so the amperage was reduced to 415 kA as part of the mitigation plan.

Amperage Increase Stage 1: The Amperage programme was re-initiated after stabilizing the operation; 435 kA was achieved in March 2022.

Amperage Increase Stage 2: From 435 kA to 437 kA, achieved in June 2023, after confirmation of rectifier and busbar capacity to sustain this amperage. Currently, both Al Taweelah DX potlines are operating at 437 kA.

3. Major Modifications

A few modifications in pot lining and pot shell structure were made in view of the strategic amperage increase in EGA potlines with DX technology. These modifications broadly intend to improve heat loss to maintain the pot thermal balance stable while increasing the amperage.

3.1 Potshell Design Modifications

In addition to the modification discussed in the previous paper [3], it was experienced through the second pot generation that red hot spots on the potshell are more visible on the duct end and tap end of the pots. The EGA modelling group provided the solution by making a minor modification of the potshell, increasing the length of the end wall colling fins, and using graphitized end wall carbon inserts (Figure 2). Estimated impact was an additional heat loss of approximately 5 kW to help the higher amperage operation.

Table 2. KPIs of Potline 2.

Parameter	Unit	2018	2019	2020	2021	2022	2023 Jan.-July
Amperage	kA	422.0	422.3	418.3	422.6	434.6	436.2
Current efficiency	%	93.3	92.3	92.3	92.3	93.8	93.6
Metal production	kg/pot-d	3169	3140	3111	3146	3284	3288
Net pot voltage	V	4.224	4.237	4.253	4.291	4.234	4.235
DC net sp. energy cons.	kg/t Al	13.50	13.74	13.74	13.86	13.45	13.48
Net C consumption	kg/t Al	416	419	423	418	409	411
Gross C consumption	kg/t Al	523	552	582	601	553	552
Fe	%	0.050	0.085	0.129	0.119	0.068	0.065
Si	%	0.031	0.036	0.041	0.035	0.031	0.030
Bath temperature	°C	965	964	961	959	958	958
Excess AlF_3	%	9.4	10.1	10.3	9.4	9.0	9.4
AE frequency	AE/pd	0.04	0.08	0.16	0.20	0.04	0.02
AE duration	sec	14	33	62	65	12	9
PFCs emissions, CO_2 equivalent*	CO_2-eq kg/t Al	16	63	306	306	13	9

8. Conclusions and Way Forward

Through the developmental initiatives undertaken at EGA, the inhouse developed DX technology has demonstrated remarkable efficiency, cost-effectiveness, and energy consumption. EGA's commitment to environmental responsibility is evident in its adoption of low-emission technology, which has set an industry benchmark in reducing environmental impact [9].

Currently, EGA's Al Taweelah DX potlines are planning to achieve another significant amperage milestone of 440 kA, having received the rectifier and busbar system capacity clearance from the original equipment manufacturer (OEM) to accommodate the increased potline amperage. A pivotal aspect for the success of this amperage increase plan is the seamless collaboration of all teams and the swift rectification of any deviations. The potline health index will guide us to the goal.

9. References

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