

Critical Pots Index Report in EGA Potlines

Sajid Hussain¹, Nadia Ahli², Abdalla Alzarooni³, Maitha Ismail Faraj⁴, Abdallah Abdelrahman Rahbar⁵, Vinod Nair⁶ and Rama Katta⁷

1. Engineer I - R&D
 2. Senior Manager – Smelter Development
 3. Vice President Technology Development & Transfer
 4. Manager - Process Efficiency Potroom
 5. Manager Potlines
 6. Lead Engineer Process Control
 7. Senior Project Leader - Intelligence and Mobility
- Emirates Global Aluminum (EGA), United Arab Emirates
Corresponding Author: sajhussain@ega.ae



Abstract

Emirates Global Aluminium (EGA) is extensively pursuing the implementation of Industry 4.0 and its tools in potlines to monitor and improve the potline operation by identifying abnormal behaviour of individual pots. There are some common symptoms which are observed in sick and unstable pots, such as deviation in alumina dumps, anode quality leading to spikes, red potshell, increase in silicon content in the metal, change in pot super heat and internal heat etc. Generally, these symptoms are indicator for the operation/process team to flag pots with such behaviour as a sick/instable pot depending upon the severity of abnormal parameters. The sick or unstable pots are logged in the log book for corrective actions.

In order to automate the process of identifying the sick and abnormal pots, EGA technology developed critical pots index report using the Power BI software. The most common symptoms of abnormal pots were identified, and for each parameter deviation values and weightages were defined. A weightage was given for each abnormal parameter depending on the criticality of parameters such as, combined voltage drop (measured between the metal pad and the centre of downstream pot anode beam), silicon content in the metal, red potshell, bath temperature, noise, etc. Each pot is filtered for specified parameters, the weightage of parameters with the deviation is summed up, and the pots with weightage score above a specified limit are reported as sick or unstable. Pots with index score of 0-0.35 are declared as normal operating pots, pots with index score of 0.36 to 0.6 are declared as unstable and pots with index score 0.65 to 1.0 are declared sick pots. The score is 1 if all parameters on the list are out-of-range. This critical index report is configured in Smelter Analytics and is accessible to Potline Operation. The Critical Pots Index Report is configured separately for each potline to define the range of parameter deviations. This report is regularly used to track pots with abnormal behaviour, to provide rapid corrective actions and reduce the number of pots with abnormal operation.

Keywords: Critical Pots Index Report, DX+ technology, DX+ Ultra technology, Amperage increase, Cell performance.

1. Introduction

EGA is the world's leading 'premium aluminium' producer with business from mining and refinery to smelting and casting. In 2022, EGA produced 2.653 million tonnes of hot metal from its two production sites, Jebel Ali and Al Taweelah, and surpassed the milestone of 40 million tonnes of hot metal production since start-up in 1979. Potlines in both production sites comprise seven technologies (D18+, CD20, D20, D20+, DX, DX+ and DX ultra) with 2843 pots [1]. EGA is fully committed and focused to innovate the aluminum production process using Industry 4.0

and artificial intelligence tools in the operation areas to produce the metal with minimum impact on environment while maintaining highest industrial safety standards.

Microsoft Power BI based Critical Pots Index Report is one of the tools which is being implemented in EGA potlines to identify critical pots based on their latest performance data. Currently, this report has been configured for EGA Al Taweelah potlines (Potline 1, 2 and 3 operating 1266 pots) and is used by operation and process teams to track the critical pots and prioritise their actions depending upon the nature of pot abnormality.

Critical Pots Index Report has been also developed by EGA for ALBA Potline 6, which uses EGA's DX+ Ultra technology [2].

2. Traditional Method of Identifying and Handling Critical and Abnormal Pots

Aluminium production process faces multiple challenges which includes pot abnormality triggered by deviation in pot operating parameters with respect to set targets. Operation and process control teams work hand in hand to identify pots with abnormal operation and take corrective actions to restore normal pot operation by following the guidelines set to eliminate each pot abnormality. Pot abnormal/critical conditions include pot operation with high/low bath temperature, high instability, anode problems, heavy carbon dust, red potshell, high combined voltage drop, muck (sludge) on cathode blocks, high silicon, iron, copper content in the metal, alumina dissolution issue, high anode effect frequency, and pending routine activities. Each abnormal/critical pot is evaluated by operation and process teams to find root cause of the problem. A thorough investigation is carried out for abnormal/critical pots by reviewing the history of pot performance, recent events, and corrective actions taken.

After careful evaluation of pot performance, corrective actions are applied to restore normal pot operation from abnormal/critical condition. A list of abnormal/critical pots is continuously updated for the potline. The list of abnormal pots and the course of actions to be taken to remedy the abnormal operation condition of each pot is communicated to operation teams through traditional ways of communication which include white boards in the control room, log books and WhatsApp.

The existing method of pot evaluation required time to analyse the pot historical performance for the critical KPIs to find out the root cause of deviation and to determine which parameter triggered abnormal pot operation. Analysing and updating the list of abnormal pots manually on a regular basis is a tedious job with the possibility of miscommunication. Critical Pots Index Report is the solution to replace traditional methods; it identifies abnormal/critical pots, using Power BI by generating a system-based report of critical pots based on the latest pot performance data.

3. Development of Critical Pots Index Report – Out of Range Report Implementation in ALBA Potline 6

It is important to understand the evolution process of identifying the KPIs which were used to identify or declare a pot with abnormal/critical condition. At the beginning, an out-of-range pot performance report was developed by EGA's Technology Transfer Process Advisor at ALBA, using Power BI for ALBA Potline 6 during amperage increase. This report generated the list of pots continuously operating out of range with respect to critical KPI targets. The critical KPIs such as bath temperature, noise, anode effects, alumina dumps, silicon % in the metal, etc., were analysed for the previous 7 days. An out-of-range limit was defined for each KPI, and Power BI filters were used to filter the pots with repeated out of range behaviour. The pots which were operating continuously out-of-range for 4 days and more were filtered for each KPI. Then visually

Moreover, this report also provides information about the potline operation trend which help the management to make decision for resource allocation in case of increasing index score. The Critical Pots Index Report was configured for EGA Al Taweelah Potlines 1 and 2 with DX Technology in July 2023. In the next phase, this report will be configured for Jebel Ali potlines.

9. References

1. Sergey Akhmetov, Abdalla Alzarooni and Nadia Ahli, EGA story from humble beginnings to a mega smelter, *Proceedings of the 40th International ICSOBA Conference*, Athens, 10-14 October 2022, *Travaux* 51, 53-71.
2. Michel Reverdy et al., The successful implementation of EGA DX+ Ultra technology at ALBA, *Proceedings of the 38th International ICSOBA Conference*, 16-18 November 2020, *Travaux* 49, 539-549.
3. Sajid Hussain et al., ALBA Potline 6 operation during amperage increase, *Proceedings of the 40th International ICSOBA Conference*, Athens, Greece 10-14 October 2022, Paper AL02, *Travaux* 51, 1015-1028.
4. Nicole Teeling, Olivier Charette, Jean-Denis Carrier and Saif Alhashmi, Smelter potline extension at EGA Al Taweelah smelter, *Proceedings of 39th International ICSOBA Conference*, Virtual, 22-24 November 2021, Paper AL07, *Travaux* 50, 647-657.