Enhancing Potline Productivity Through Implementation of In-House Automation Control System at Maaden Aluminium

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Abstract

At Maaden Aluminum, we are dedicated to enhancing potline productivity through the implementation of an automated inhouse system. Our commitment to continuous improvement is reflected in our focus on the best operational practices, which positively impact safety, process efficiency, and production outcomes. The Pot Tending Assembly (PTA) is a critical piece of equipment in the reduction process, responsible for major operational activities such as anode changes and Metal tapping. Traditionally operated by human operators following standard procedures, the potential for human error can lead to safety incidents, property damage, and negative effects on production.

To mitigate these risks, we made several upgrades in our Automation and Process OT environment to follow several operational activity-based Standard Work Instructions (SWIs) within the crane operations. These updates ensure that operators adhere to all required steps, reducing the likelihood of errors. Additionally, all crane movements are tracked through Level 2 Human-Machine Interface (HMI), with summary reports shared with employees on a shift basis. This transformation not only enhances safety and process reliability but also drives significant improvements in overall production efficiency.

Keywords: Potline digitalization, PLC system, Alpsys, Pot tending assembly, Anode change.

1. Introduction:

In the earlier phases of potline operations at Maaden Aluminium, the absence of a data interface between the PTA and Alpsys Pot Micro-System posed significant challenges. The lack of a tracking mechanism allowed unrestricted access to safety and configuration pages, limiting visibility into operator actions and hindering key performance indicators (KPIs) monitoring in the critical tasks such as anode changes and covering operations relied on manual confirmation through Pot Micro inputs, increasing dependency on ground operators and exposing the process to human error. Furthermore, inconsistent anode changes, particularly in breaking, shoveling, and gauging – compromised process stability and overall smelting efficiency.

2. Anode Change and Covering Operations

2.1 Identified Challenges During and After Anode Change

2.1.1 High Workload and Heat Stress Exposure

Anode change (AC) and covering is one of the most frequent and essential activities in the pot room at Maaden Aluminium, with approximately 600 anodes replacing daily to maintain optimal cell performance. These operations are structured around a 25.5-day anode change cycle, with each pot room/shift typically assigning a single operator (Figure 1) to perform the following tasks:

- Anode changes: 35–40 per shift
- Anode coverings: 35–40 per shift
- Anode re-coverings: 35–40 per shift

To execute these tasks effectively, a two-operator system is used: one operator stationed in the PTA cabin and the other operating on the pot room floor. This dual-role configuration is essential for ensuring both operational compliance and personnel safety. The floor operator is exposed to significant physical workload and environmental stressors, necessitating precise coordination with the PTA operator to achieve full procedural compliance and mitigate safety risks

The extreme summer temperatures in Ras Al Khair, often surpassing 45 °C, create substantial challenges for floor operators during anode changes. Those working in the pot room are exposed to both ambient heat and intense radiant heat from reduction pots and spent butts. This combination has been a major contributing factor to heat stress incidents in the reduction area.

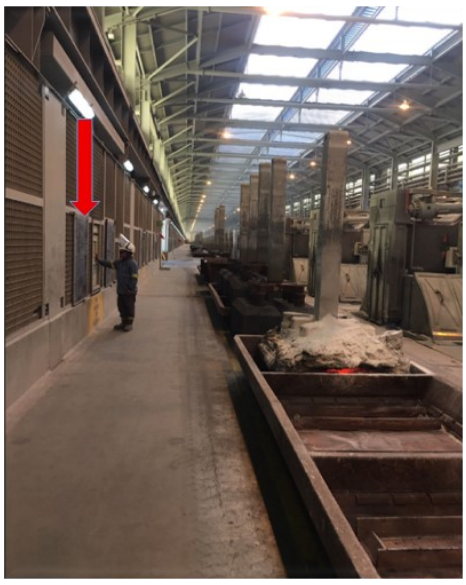

Figure 1. Operator giving AC command.

2.1.2 Anode Effect Occurrences

According to the procedure, anode change commands should be issued 2–3 minutes before the removal of anode butts. However, due to timing mismatches when the ground operator sends the command too early or too late relative to the PTA operator's action the pot may register an anode effect, as the required actions are not achieved in time. Figure 2 shows the number of anode effects during anode change.