New Cell Preheat Shunt Design in EGA Al Taweelah Potline 3

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Abstract

Cell relining, preheat and start-up are required for replacing reduction cells at the end of their life. EGA Al Taweelah Potline 3 has 458 cells operating at 468 kA. Each cell is produces approximately 4.5 tonnes of aluminium per day. A power reduction of 90 minutes is required for each cell start-up. Stopping the production of 457 cell for 90 minutes at each start-up, costs 1 million USD per year. It also impacts the environment by increasing HF emission and operational disturbances. We have developed a system to avoid the production loss and associated problems in the entire plant. We have designed a power bypass system (shunt) for cells at restart to eliminate power reduction of 150 kA and the usage of split-wedge shunts. The new design of the shunt is useful for both EGA plants, at Jabel Ali and Al Taweelah. In Al Taweelah Potline 3, also all early cell failures were re-started using the shunts, to prolong the cell life and to save the cost of building a new cell. This is saving 1 million USD per year.

Keywords: Power reduction at cell start-up, Cell start-up shunts, Reduction of HF emission, Cell life improvement, Cell instability reduction.

1. Introduction

EGA Al Taweelah Potline 3, the world's longest potline with 458 cells was started at 440 kA from September 2013 to June 2014, and is operating at 468 kA now. This potline contributes approximately 20 % of EGA's annual hot metal output. Potline 3 originally utilised Generation 1 cells of DX+ design, which were upgraded to Generation 2 cells in 2018-2019. This upgrade included the implementation of copper-inserted collector bars to optimise energy consumption.

However, in 2021, an unforeseen disturbance necessitated the premature shutdown of certain cells before they reached their full-service life, requiring a mandated restart. Restarting these cells poses significant challenges due to the non-uniform wear of the cathode surface, resulting in graphite islands of varying thickness. Applying the full line load during the restart process risks overloading specific collector bars, potentially leading to their failure.

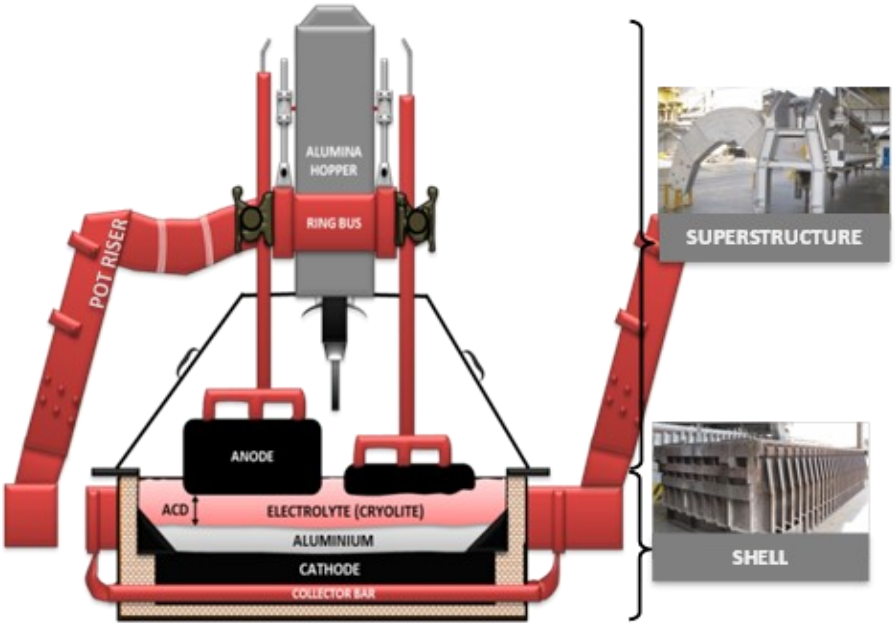

Figure 1. Schematic of a cell and superstructure. The true shape of DX+ pot risers is shown in top right picture.

2. Preheat Process

2.1 Energising a Pot

The primary objective of preheating a cell before bath-up is to increase the cathode surface temperature as close as possible to the operating cell bath temperature. This facilitates a smooth transition from a cold to an operational cell, preventing thermal shock to both the cathodes and anodes, and ensuring the controlled baking of the ramming paste used in cell construction. Additionally, effective cell preheating is crucial for managing the electrical resistance of the cell components and minimising large thermal gradients within the cathode, thereby reducing energy wastage during startup.

A newly lined cell features a flat cathode surface, allowing for a uniform bed of resistor graphite pads during preparation for energisation. In contrast, a restart cell has an uneven cathode surface, resulting in a significant increase in the amount of resistor graphite required. Our observations indicate that the graphite consumption for preparing a restart cell is nearly five times higher than that for a new cell, despite no changes in the graphite island dimensions. Typically, our new cells have a voltage of less than 4 V at cut-in with an average preheat rate of 20 °C.

Figure 2 illustrates the process of laying the resistor graphite pad bed onto the cathode surface of a newly lined cell. The uniform cathode surface ensures that the bed thickness is solely determined by the shape of the wooden panels. The preheat team is trained to verify the quality of the template before laying the pad, ensuring consistent thickness under all anodes. This arrangement guarantees uniform resistance to the current flow from individual anodes through the cathode to the collector bars.