Pot Blasting Abnormality Control at Balco

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Abstract

Aluminum industry uses high temperature electrolysis to extract pure liquid aluminum from alumina. An Aluminium production line consists of several electrolytic cells connected in series. Any sudden pot tap-out, may lead to amperage hinderance, and thereby disturbance to the physical condition and process parameter control for all the pots in the circuit. By managing the operational practice discipline and focused process parameter control, BALCO was achieving benchmarking low power consumption consistently. In the last few months, Balco was facing an issue of sudden pot tap-out or strong red shells due to pot blasting (explosion). In this paper, we briefly discuss, how we proceeded to understand the probable root causes for such sudden blasting, implement control actions and reduce occurrence of such abnormality.

Keywords: Pot blasting, Power consumption, Pot tap-out, Control actions, Low power consumption.

1. Introduction

Aluminium manufacturing is a high intense power consuming sector (almost 14 kWh/kg Al). The process involves reduction reaction of alumina to aluminium in an electrolytic cell. Cathode of the cell lies on the shell bottom over which electrolyte and anode assembly are placed. Hence, it is obvious that the life of the cell is highly depended on the cathode stability. When starting a pot, cathode is expected to remain intact until the age of 1800-2000 days. If the cell life is lower, the whole cell is cut out and restarted, which is quite expensive. Additionally, in a modern aluminium smelter, there are more than 300 pots that are connected in series to one another in a single bus-bar circuit. Abnormalities in a pot include open circuit or pot tap-out, which have potential to damage the bus bar circuit, thereby involuntarily stop several pots together.

In any aluminium smelter pot tap-out is a known phenomenon in which the hot electrolyte or metal inside the pot pours out through the protective potshell. At BALCO, in last few years, we were observing a crucial phenomenon of sudden blasting, quite violent local explosion, in a particular position in many pots at different instances, mostly followed by a severe red hot side walls of the potshell, and often even proceeding to a pot tap-out. This report summarizes the direction and findings of investigation into the root causes of the pot blasting and green patching. The pot blasting predominantly occurs on top of pot shell outer surface with visible or sometime less visible cracks having dispersed bluish green patches. Also, few short-term mitigating actions to help prevent blasting will be described, and the potential causes of the underlying conditions that may cause the blasting will be proposed.

2. Impact of Pot Blast

Table 1 shows the frequency of pot blasts. The pot blasting and associated pot shell hot spots were first observed in August 2017 and was happening at irregular intervals in many pots.

Table 1. Pot blasts since 2017.

From January 2017	Number of pots	Number of locations	Remarks
Total blast location	50	18	Side shell
Total blast occurred in pots	50	50	Side shell
Controlled blast but still stopped	38	26	Medium impact
Blasted and leaked	12	12	High impact tap-out

With reference to Table 1, the frequency of pot tap-out is 24 % (12/50 pots), which is very high. When pot blasting happens unexpectedly, there is a generation of intense energy in the cell, which initially damages to pot hood, rim and deck plate (Figure 1). The potshell starts getting hot spots which may result in pot tap-out (Figure 7). There is also risk of a complete potline failure through an open circuit, earthing faults or busbar damage.

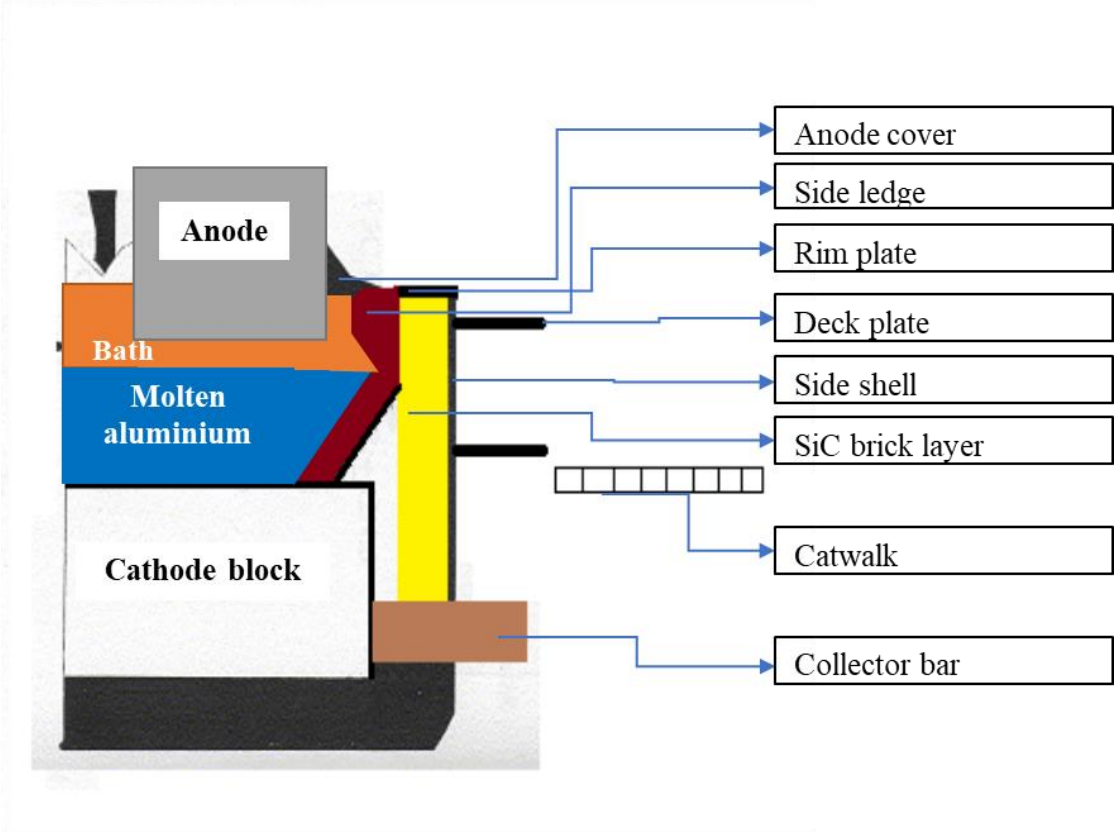

Figure 1. Partial cross-sectional view of pot and nomenclature (area related to blasting).

3. Analysis Approach

The analysis approach is shown in Figure 2. This analysis followed a review of a few pertinent papers [1-2], but no such abnormality was found in the literature.

8. References

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